KPMG

Sinocharged: The bright future of China's electric vehicle market

A special report on electrification

Part of the KPMG China Autotech Series

毕马威中国未来50榜单系列
KPMG China Future 50 Ranking Series

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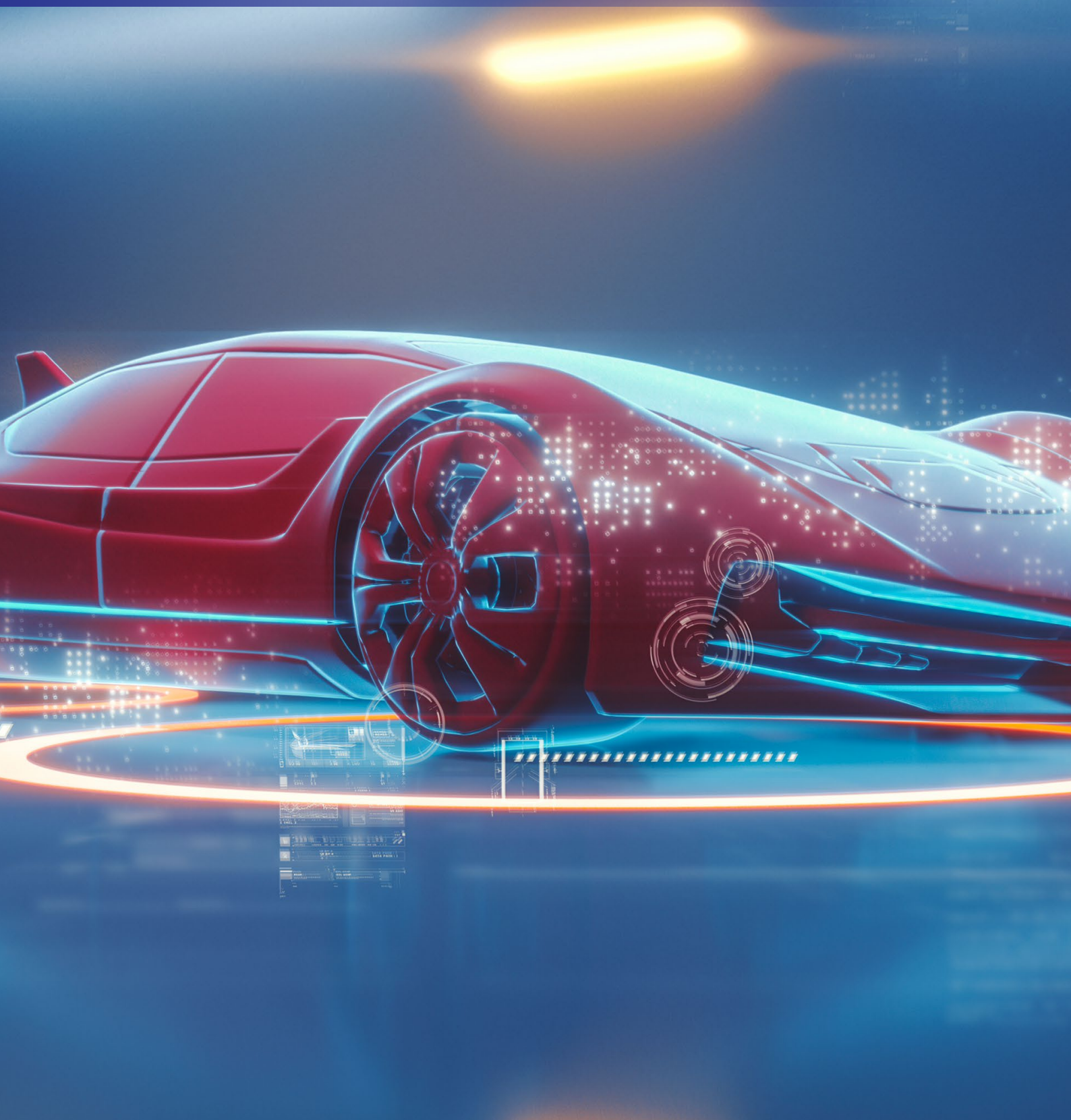

01 Executive Summary

Norbert Meyring
KPMG China
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Head

Evolution of electrification

We are in the midst of an auto industry evolution fusing electrification, mobility, service innovation and connectivity. Despite experiencing rapid new energy vehicle (NEV) sales growth in China for several years, sales growth faltered in 2019. China's NEV market has been historically supply and policy driven. While pioneers like Tesla jump-started awareness among Chinese car buyers, their segmentation has prevented them from addressing mainstream demand.

Then came 2020. The dramatic shift over the past year within the NEV market reveals more and more characteristics of a demand-driven marketplace. Nowadays, consumers put more emphasis on a sustainable and environmentally friendly lifestyle. This phenomenon has become even more noticeable with the pandemic as more consumers, particularly in China, are demanding sustainable vehicle options in distinct price brackets.

Apart from the change in consumer perception, there have also been changes in the stance by regulators. For instance, China has now vowed to become carbon-neutral by 2060, partly via the electrification of transportation. This policy shift is taking place not just in China but also in other parts of the world. In Europe, various countries have established deadlines to end internal combustion engine (ICE) vehicle sales. In the US, the new administration is expected to adopt policies prioritizing environmental protection. The president-elect's ambitions include procurement of EVs by the federal government, and installation of 500,000 new public piles across the country.

All of the aforementioned demand and policy evolutions have propelled auto industry participants to intensify their efforts on electrification. Not only are the new generation of start-up original equipment manufacturers (OEMs) selling NEVs, but traditional OEMs are acting on their commitments to launch their own NEV products which are more than tangential offerings. General Motors is staking the future of the organization on NEVs with their "Everybody In" campaign.

The result? China and major automotive nations are witnessing the beginning of a vibrant NEV market.

Emerging trends

First, NEV affordability remains a key value proposition. Since the battery is the major cost item for NEVs, battery technology innovations will be crucial to enhance the quality, cost, durability and range of batteries. As such, OEMs that can develop or source affordable and better-quality batteries would have an edge versus their peers.

Second, the modernization of the NEV platform will drive vehicle connectivity. As the applications and implications of this go far beyond the automotive sphere, this will involve R&D alliances with various non-automotive technology companies to tease out and incorporate the best and latest innovations.

Third, with what is still a nascent NEV charging network, there will be rapid growth in charging pile numbers. Pile supply may initially follow the examples of shared bicycles in China and become excessive in the future. After market consolidation, a few capable national leaders will remain. In this area, we will see more participation from traditional energy companies as they transform their businesses to prepare for the coming electric decades.

In this report...

We summarize the latest trends in three major areas of electrification – OEMs, the battery value chain and EV charging. Integrated throughout are observations from KPMG partners involved in the auto industry as well as senior management from some of China's most innovative automotive startup companies.

More information on these companies can be found in our annual publication, KPMG China's Autotech 50. The next edition will be published in mid-2021.

02 China's Leading Autotech 50 - Innovators in Electrification

China's Leading Autotech Innovators

Companies are arranged in alphabetical order based on their Chinese pinyin names.

Company name	Logo
Aulton	奥动 Aulton
Ebusbar	Ebusbar 巴斯巴
SVOLT	SVOLT 蜂巢能源
Human Horizons	华人运通 HUMAN HORIZONS
Nassen Automotive Electronics	NASN
NETA	哪吒汽车
Qingtao Energy	清陶发展
Shanghai Horizon	Horizon Fuel Cell Technologies
ENOVATE	ENOVATE 天际汽车
WM Motor	威马汽车 WELTMEISTER

Attention: The featured company profiles of these start-up are based on information submitted by the Autotech candidates and on interviews conducted by KPMG with their senior executives. This list is neither a complete market screening nor an exhaustive listing of companies in the automotive market. The authors of the China Leading Autotech 50 aim to enhance the attention given to technological innovation in China's automotive sector and to promote industry communication. This publication is not an evaluation of the compliance or creditworthiness of these companies, an endorsement of the company or their business model, and the contents should not be construed as providing investment advice.

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汽车科技
Autotech

China's Emerging Autotech Innovators

Companies are arranged in alphabetical order based on their Chinese pinyin names.

Company name	Logo
First Technology	
PowerShare	
Modern Auto	
Shineline Power	
EVS	

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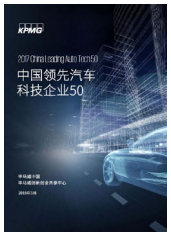

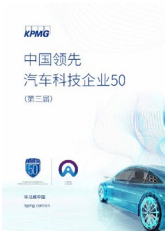

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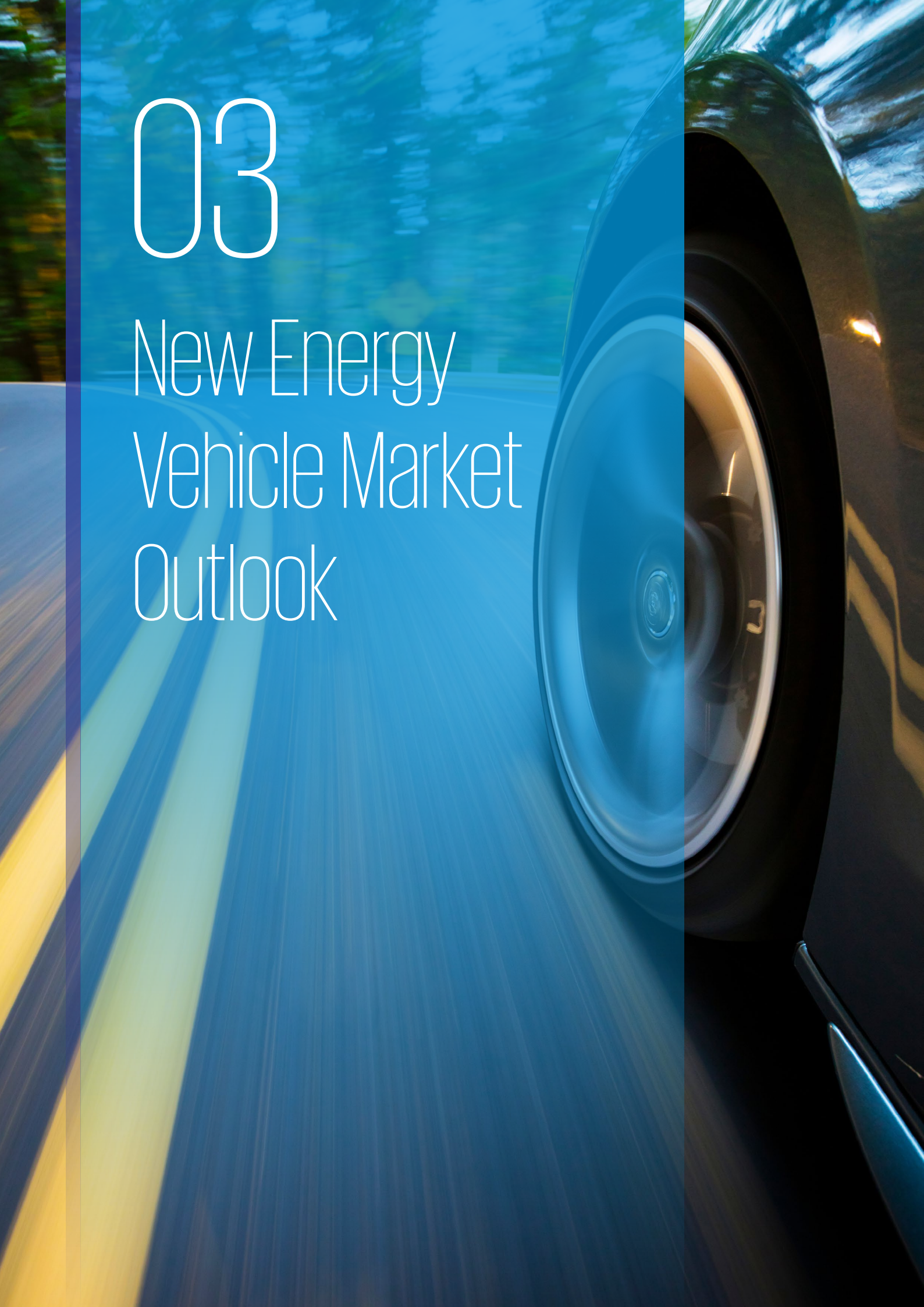


03

New Energy Vehicle Market Outlook

1 The supercharged past of the NEV market

China has been the world's largest NEV market by sales volume since 2015 and is poised to maintain that pole position for years to come. The road has had bumps and sales have been volatile. According to China Association of Automobile Manufacturers, in 2019, locally manufactured NEV wholesales – including passenger and commercial vehicles – amounted to 1.21 million units, an annual decline of 4 percent. The primary factors of this decline were a broader macroeconomic slowdown and retraction in cash subsidies on NEV purchases. Into the first half of 2020, amid the COVID-19 pandemic, sales were down further by 37.4 percent year-on-year (YoY). However, with the resumption of domestic business activities earlier than in most areas of the world and the release of a government consumption stimulus, double-digit monthly sales growth resumed. The result: NEV sales for 2020 grew 10.9 percent year-on-year.

China new energy vehicle monthly sales

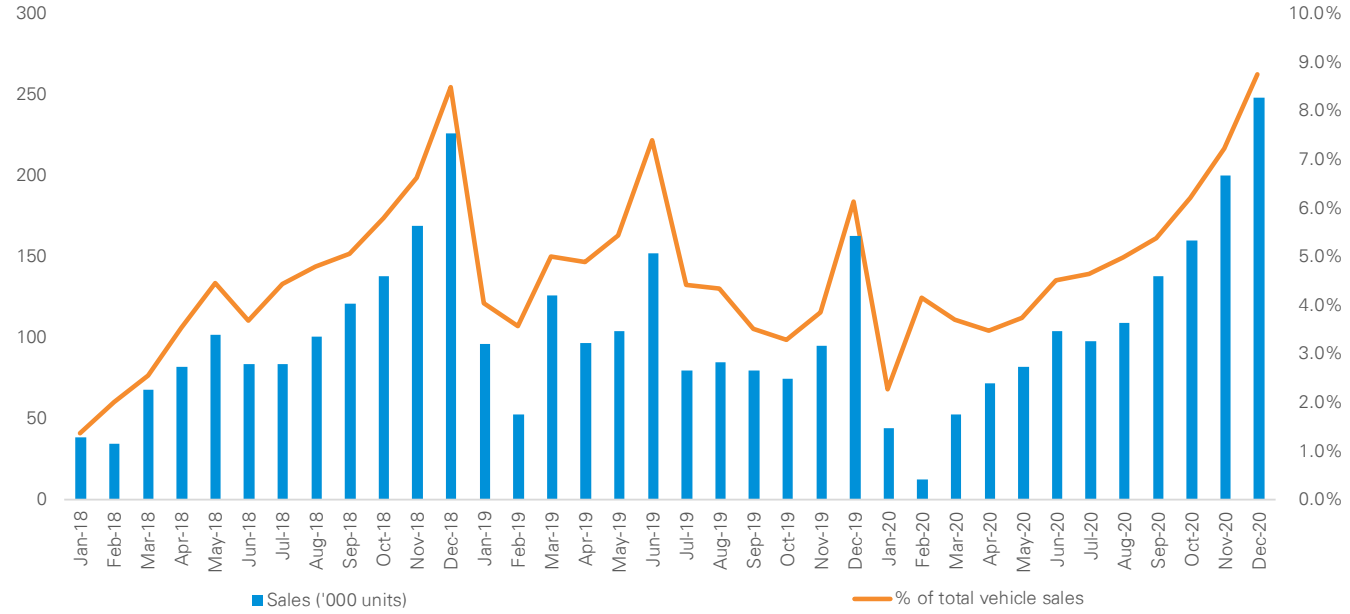


Figure 1 – China's new energy vehicle monthly sales
Source: China Association of Automobile Manufacturers (CAAM)

As of yearend 2020, there were 4.92 million NEVs on the road according to the Ministry of Public Security. Despite the recent adversity, China's NEV car parc borders on 5 million units, a symbolically important target set in the government's "Energy-saving and New Energy Vehicle Industry Development Plan (2012-2020)." Under the continued policy and regulatory support, rapid growth in NEV sales is set to stay. To elaborate, China Association of Automobile Manufacturers (CAAM) forecasted in December 2020 that 2021 China NEV sales will amount to 1.8 million units, implying 40% YoY growth. Also according to the "New Energy Vehicle Industry Development Plan (2021-2035)," China aims to achieve NEV sales volume that make up 20 percent of total vehicle sales in 2025. This implies a ballpark figure of 6 million units that year. Although the task seems daunting when compared to the 4-5 percent NEV sales contribution since 2018, the government is ready to support the growth with policy incentives on ownership (e.g., cash subsidies, tax waiver and restrictive policies on fossil fuel vehicles' ownership) and on usage (e.g., acceleration of charging infrastructure layout). All in all, China's automotive electrification drive is by no means slowing down and the NEV value chain will become much larger in years to come.

Major supportive NEV ownership policies in China for private passenger cars

Category	Relevant departments	Description
Central government monetary subsidy extension beyond 2020	Ministry of Finance (MOF), Ministry of Industry and Information Technology (MIIT), Ministry of Technology (MOT), National Development and Reform Commission (NDRC)	2020 maximum private passenger NEV subsidies at RMB24,750/car, with annual cut of 20% in 2021 and 30% in 2022
Waiver of vehicle purchase tax	MOF, Tax Bureau, MIIT	Waiver of vehicle purchase tax (tax rate at 10% of pre-VAT price) until 2022
No annual vehicle or vessel tax	MOF, Tax Bureau, MIIT	As stated
Dedicated NEV license plate	Various local governments	No need to enter ICE car license plate lottery in Beijing, Tianjin, Hainan, Guangzhou, Guiyang, Hangzhou, Shenzhen; no need to enter normal car license plate auction in Shanghai, Tianjin, Hainan, Guangzhou, Hangzhou, Shenzhen No roadway usage restriction in Beijing, Shanghai, Chongqing, Tianjin, Guangxi, Henan, Hebei, Chengdu, Dalian, Guiyang, Hangzhou, Nanchang, Ningbo, Wuhan and Xi'an Parking discount in Shanghai Chongming, Chongqing, Chengdu, Kunming, Fujian, Guangxi, Henan, Hubei, Inner Mongolia, Shandong, Shanxi, Chuzhou, Hefei, Huangshan, Nanchang, Ganzhou, Haikou, Sanya, Nanjing, Suzhou, Wuxi, Xuzhou, Nantong, Yangzhou, Huaian, Yancheng, Zhenjiang, Shenyang, Shenzhen, Xi'an and Yinchuan.

Source: Various Chinese government departments and local governments
(Data valid as of December 2020)

2 The electrified future for vehicle sales

1. Recent trends

In recent years, China's NEV market has been dominated by domestic manufacturers who enjoyed more than a combined 80 percent market share. This is mainly attributable to a dearth of NEV models from traditional foreign OEMs, particularly in the entry-level passenger vehicle segment. Notwithstanding the local brands' overall dominance, there has been endless customer churn amongst local brands driven by product and consumer perception changes. To elaborate, low-end subcompact (A00) battery electric vehicles (BEV) with post-subsidy price of below CNY50,000 were popular before 2018, with smaller local OEMs like Zhidou and Zotye being beneficiaries given their focus on those products. However, with the reduction of and more stringent technical requirements for subsidies, those smaller OEMs were squeezed out while bigger local OEMs with better R&D, such as Guangzhou Auto (GAC) and Great Wall gained prominence.

There are two additional recent observations for local OEMs. Firstly, there is a resurgence in popularity for subcompact BEVs, which now come with better quality and specifications, with successful models such as Shanghai Automotive (SAIC)-GM-Wuling's Hongguang Mini and Great Wall Motor's Ora R1. These vehicles are treated more as a low-cost daily short haul commuter rather than fitting into the traditional car ownership concept. Secondly, a few start-up OEMs, namely NIO, Li Auto, Xpeng, have established a pole position with their relatively pricier NEV models. This implies wider consumer acceptance of NEV models in different subsegments, a sign of an overall healthier vehicle market.

China NEV retail sales by brands

	2017		2019		11M20	
Rank	Brand	Market share	Brand	Market share	Brand	Market share
1	BJEV	18.5%	BYD	19.8%	SAIC-GM-Wuling	13.3%
2	BYD	15.8%	BJEV	9.2%	BYD	12.7%
3	SAIC	7.3%	Geely	7.0%	Tesla (China production)	12.6%
4	Zhidou	6.6%	SAIC	6.4%	GAC	5.8%
5	Zotye	6.5%	Tesla (import)	5.2%	SAIC	4.6%
6	Jiangling	6.0%	SAIC-GM-Wuling	5.2%	Great Wall	4.6%
7	Chery	5.2%	Great Wall	3.8%	BJEV	4.3%
8	JAC	5.0%	GAC	3.4%	NIO	4.0%
9	Chang'an	4.5%	Chang'an	3.4%	Chery	3.4%
10	Geely	3.9%	BMW Brilliance	3.3%	Li Auto	2.9%

Source: China Passenger Car Association (CPCA), WAYS, KPMG analysis

For foreign OEMs, there have been few runaway successes outside of Tesla. In recent years, Tesla manage to position itself within the top 10 BEV OEMs by new vehicle sales with their imports of Model X, Model Y and Model 3. The brand benefits from a true premium image and as a pioneer that sets the standards for BEVs. With such a high price tag on the import models due to import duties, Tesla never reached the pinnacle of NEV sales. With a new factory opening in Shanghai in 2019, the fully localized Model 3 has emerged as amongst the top selling BEV models in 2020.

Traditional foreign OEMs have historically taken a more conservative pace towards electrification. One need look no further than the next most popular foreign brand NEV by sales: the BMW 530Le plug-in hybrid (PHEV) which is based on an ICE vehicle platform. In our view, the lack of foreign OEMs' interest to electrify in the past was due to their established position in the ICE market, the accompanying high margins, and the uncertainty around profitability and residual value of NEVs. As such, accelerating the cannibalization of their ICE business with low or negative margin NEVs, particularly when demand remained low, did not make economic sense. However, particularly in 2020, we have seen very strong commitments towards an electric future by global OEMs.

2. Future trends

A More compelling reasons to electrify, especially for traditional OEMs

Despite initial reluctance, foreign OEMs have become more eager to expand their NEV product offering for the following reasons:

Government support – To achieve the goal of NEV popularization, the Chinese government has extended cash subsidies (albeit reduced in value and tagged to more stringent technical requirements) to at least 2022. There are also non-cash incentives such as a purchase tax waiver (approximately 10 percent of sticker price) and license quotas in cities with ICE ownership restrictions. OEMs also need to abide by the dual-credit (NEV credit and fuel efficiency credit) system, which means acquiring positive credits by producing NEVs to meet requirements. We expect these non-subsidy incentives to continue as China remains committed to becoming a major global player in electric vehicles. As the credit system matures, companies that follow the guidelines for the powertrain mix objectives will be those that benefit the most.

Infrastructure improvements – Range anxiety and insufficient charging facilities are among car owners' key concerns around NEV ownership. These worries will be mitigated by i) the coordinated push by governments, OEMs and third parties (e.g., energy companies and the state grid network of companies) to rapidly populate the charging network; ii) the introduction of technologies such as higher power-density or longer-range batteries, high-voltage fast charge and battery swapping. The 'pile push' and these innovative technologies may be implemented in China before anywhere else in the world. More details will be discussed below in the section on charging.

Reduction and eventual reversal of the production cost gap – It remains more costly to produce an NEV than an ICE of similar specifications due to battery costs. However, with ongoing improvements in technologies (e.g., higher battery power density), battery production costs are trending downward. What's more, amid a continuous tightening of emission standards, the cost to develop and produce more efficient internal combustion engines will rise given physical barriers. As such, OEMs will find their profitability - and their presence in the world's largest vehicle market - tied to their NEV portfolio.

> **"Market leadership changes will be ongoing, but since traditional OEMs are now more serious about electrification, competition will become more intense both locally and globally. Unlisted start-up OEMs coming from a weaker funding position could face ramp up challenges."**
>
> **– Gary Xu**
> Partner,
> Mergers and Acquisitions
> KPMG China

B Joint ventures to gain market share as the market consolidates

Going into the new decade, foreign OEMs – via their Chinese joint ventures (JVs) – are destined to gain market share in the NEV segment. The majority of OEMs have demonstrated their determination to succeed in China with announcements of significant further investment into the country. This decade may differ from the last, with more dedicated NEV platforms (e.g., Volkswagen's MEB platform), secured battery supplies (e.g., BMW's tie-up with CATL), and more co-opetition. Considering the established brand image of foreign OEMs, we predict growing interest for new dedicated NEV models like Mercedes Benz's EQC and Porsche's Taycan.

The overall combined vehicle market size will likely not grow fast enough to match the sales targets of all the major (or minor) OEMs. Amid hefty NEV R&D costs, availability of more NEV products by foreign OEMs and leading local OEMs, as well as more stringent technical requirements by the government on subsidy eligibility, market consolidation is inevitable. This necessary process has already begun, with the potential phasing out of smaller traditional local OEMs like Zhidou and Zotye, along with some start-up NEV OEMs like Bordrin.

C Tesla and Chinese NEV start-ups will challenge traditional OEMs

When the cameras are rolling, China CEOs have been known to welcome the influence of Tesla as an educator of the market. The company brought a new and cool perspective to car ownership by means of bypassing dealerships and integrating the appeal of consumer electronics into environmentally friendly vehicles. This is particularly appealing to China's wealthy younger generation, who have more money to spend on vehicles than their contemporaries in Europe or North America. In the foreseeable future, Tesla's market leadership will be maintained as prices drop on the Model 3 and local production begins for the Model Y.

Besides Tesla, some local NEV start-ups are also trying to outmaneuver traditional OEMs with new business models. For instance, NIO's sales continue to ramp up despite the previous perception that local brands cannot compete in the premium NEV segment. While traditional local OEMs have never been successful in the premium ICE segment, NIO managed to establish a leading BEV position through an emphasis on customer experience and user feedback-driven product design and upgrades. Meanwhile, Li Auto has proposed a premium alternative to BEV and PHEV by focusing on range-extending electric vehicles to bypass range anxiety and charging network deficiencies. All in all, we believe that some NEV start-ups will thrive and compete globally based on their differentiated value propositions and unique products.

To avoid funding shortfalls, NEV start-ups have become more rational on spending and some of them may need to seek support from well-resourced traditional domestic automotive state-owned enterprises (SOEs), sometimes in the form of equity investments. This path is well paved: FAW was involved in BYTON's previous rounds of pre-IPO funding and is now helping BYTON reorganize. SAIC has also appeared in the latest round of pre-IPO funding of Weltmeister. Instead of equity tie-ups, NIO has instead set up JVs with SOEs to explore the mass market segment, with the first model of the GAC & NIO JV, the Hycan 007, now available for purchase.

> **"Fundraising activities in the NEV industry are frequent and market consolidation has been ongoing with market leader changes over the years. While more NEV start-ups are still emerging, they are now more rational and controlled in terms of capital deployment."**
>
> **– Gary Xu**
> Partner,
> Mergers and Acquisitions
> KPMG China

To address the challenges from Tesla and other NEV start-ups, many traditional domestic OEMs have adopted a new practice of singling out their NEV and NEV component businesses under standalone entities with separate leadership. Such a business model can help foster new thinking, accelerate decision-making, and support collaboration with external parties.

Examples of OEMs' standalone NEV brands and component entities

Traditional domestic OEM	Standalone NEV brand
SAIC	R
Dongfeng	Voyah
BAIC	Arcfox
GAC	Aion
Geely	Geometry
Great Wall	Ora
Traditional domestic OEM	**Standalone component entities**
SAIC	Hasco
Great Wall	SVOLT
BYD	FinDreams

Source: Company public information

"Nowadays traditional domestic OEMs such as SAIC and Dongfeng are launching their latest NEV products under separate brands, in some cases under a stand-alone business entity. OEMs are taking a similar approach with their NEV component subsidiaries such as BYD's FinDreams and NIO's XPT. Standalone identities simplify strategic investments by and cooperation with external parties."

– Luther Kang
Partner, Automotive Strategy
KPMG China

D Technology development and adoption diverge

Further adoption of NEVs will enlarge the market for NEV-specific modules (i.e., batteries, electric powertrain systems and electronic control systems) and components for making these modules. While the supply of NEV batteries (at least the battery cells) will still be dominated by third party suppliers like CATL and BYD, there are likely to be two distinct camps for the remaining core components. Higher end NEV OEMs such as Tesla and NIO prefer keeping core proprietary technologies and core EV component manufacturing in-house. On the other hand, mass market NEV OEMs will prefer focusing on product design and outsourcing the components to minimize upfront R&D costs. In between these two, there are also OEMs like SAIC, BYD and Great Wall, whose affiliate component suppliers develop core parts for themselves and to supply other OEMs.

Core component suppliers of sample NEV models

	Core component					
Car models	**Motor**	**Motor control unit (MCU)**	**Battery cell**	**Battery management system (BMS)**	**Battery pack**	**Vehicle control unit (VCU)**
SAIC Volkswagen ID.4X	UAES Hasco (subsidiary of SAIC)	Valeo Siemens UAES Hasco Magna	CATL	Preh Joyson	SAIC Volkswagen	Continental
SAIC GM Wuling Baojun E300	Founder	Zhuhai Enpower	Great Power	Great Power	n.a.	SAIC GM Wuling UAES
GAC Aion V	Nidec	Nidec	CATL Farasis CALB	GAC	GAC	n.a.
Geely Geometry C	Nidec	Meidensha	CATL	CATL	CATL Geely	n.a.
BYD Han EV	BYD	BYD	Chongqing Findreams (subsidiary of BYD)	BYD	n.a.	BYD
NIO ES6	XPT (subsidiary of NIO)	XPT (subsidiary of NIO)	CATL	UAES	ZENIO (NIO is an investor)	UAES
Xpeng P7	JJE	Infineon (for components)	CATL	CATL	CATL	Xpeng
Weltmeister EX5	BorgWarner	Inovance	CATL Lishen	Dongguan Powerwise	Weltmeister	Shenyang SimConTec
Li Auto ONE	UAES BorgWarner	Inovance	CATL	CATL	CATL	n.a.
Tesla Model 3	n.a.	Tesla	Panasonic	Tesla	Panasonic	Tesla

Source: Gasgoo

Domestic suppliers *Foreign suppliers* *Sino-foreign JV suppliers*

As such, we project that younger and smaller NEV components suppliers with focus on i) major modules targeting the mid-to-lower end NEV segment, ii) components for making the major modules such as inverters and micro-controller units (MCUs), and iii) software and algorithm suppliers for various control systems will thrive.

This segmentation stems from China's heavy reliance on foreign sources for chips such as Insulated Gate Bipolar Transistors (IGBTs) that are found throughout NEVs. Major chip makers like Infineon, Intel and Nvidia provide these critical components to manufacturers in China which develop the overall part modules on batteries, motor control, advanced driver assist systems (ADAS), and more. Uncertainties surrounding the US-China relationship could pose a disruption risk to the supply chain in the future. With such risks in mind, the Chinese government has singled out auto-spec chips as one of the strategic technology development items in the "New Energy Vehicle Industry Development Plan (2021-2035)." While home-grown chip makers are not certain to succeed, we can foresee tremendous support for companies in this area.

Another business opportunity is the gradual replacement of foreign component suppliers with local suppliers that are competitive on quality and price. NASN Automotive Electronics Co. Ltd. focuses on advanced line control chassis products. Its intelligent brake system is used in NEVs to help improve braking performance and energy regeneration, thus extending driving range. According to Ms. Huang, Assistant to General Manager, the company aims to offer lower price alternatives with competitive specifications to OEMs.

E Evolving vehicle retail channels

Tesla and NIO have revolutionized NEV sales by replacing dealers with direct sales outlets and online sales. What is more, the simpler architecture of BEVs vs. ICEs reduces maintenance requirements. Therefore, the traditional dealership's integrated 4S (sales, spare parts, service and survey) business model will be under threat in the NEV segment. Going forward, the 4S business model shall remain dominant into the foreseeable future, since it has been adopted by traditional OEMs in their NEV push. However, we will also see dealers considering alternative operating methods such as i) setting up showrooms for NEV brands on a standalone basis (now adopted by some local NEV start-ups like Weltmeister), ii) setting up maintenance workshops for single or multiple brands (already adopted by NEV OEMs including Tesla and NIO), and iii) participating in the battery value chain: battery testing, charging, swapping and recycling.

> **"The customer portraits of NEV owners are young well-educated urban white-collar workers. This group prefers online shopping and is familiar with social networking. OEMs are focusing on how to better interact with this new segment of customers and are building a customer journey around them which is different than for traditional ICVs."**
>
> **– Tong Zhe**
> Associate Director, Automotive Business Development
> KPMG China

3. Commercial NEVs: continued fleet growth and fuel cell technologies

A Rapid public and fleet development for buses and light/ medium trucks

Commercial NEVs - buses and trucks - account for about 20 percent of China's overall NEV car parc. In the first half of 2020, China's commercial NEV sales were down 25.2 percent YoY to 40,000 units, mainly due to pandemic effects and the cut in NEV subsidies in mid-2019, but full-year sales decline narrowed to 17.2 percent to 121,000 units amid business activities resumption in China[1]. Similar to passenger NEVs, BEV is the dominant technology vs. PHEV.

Currently, the bulk of commercial vehicles sold are public buses. Local governments are opting for electric bus fleets, and light and medium trucks for logistical and municipal purposes like sanitation. This is further supported by local government initiatives to create green zones in city centers. What is more, it is easier to integrate commercial NEVs for municipal use as routes and usage are more consistent and charging needs can be easily addressed by strategically located charging stations. As such, public buses and light medium trucks are likely to remain the driver for commercial NEV growth following the directive for all public transport fleets to be electrified by 2035.

Key commercial NEV OEMs are all domestic brands, with Yutong and BYD among the leaders in buses, as well as Chongqing Ruichi and Dongfeng among the leaders in trucks. Apart from being leaders in China, BYD is also an excellent example of overseas expansion into developed economies such as the US, EU and Japan. When compared to passenger NEVs, Chinese commercial NEVs are better positioned to enter the global market given relatively lower competition and their scale.

B Promotion of fuel cell electric vehicles (FCEV)

To date, electrification in the long-range bus and the heavy-duty truck segments is minimal due to some natural limitations of BEVs. Long-range requires bulky battery packs that hamper efficiency. Such headwinds could possibly be mitigated by future improvements in battery density and increasing charging options such as battery swapping. OEMs like Tesla are developing first generation electric heavy-duty-trucks but scaled commercialization in this segment remains limited.

Alternative technologies may be the answer in the form of the fuel cell. In October 2020, Premier Li Keqiang mentioned during an executive meeting of the State Council that China should strengthen renewable energy infrastructure. He emphasized the importance of constructing additional charging, battery swapping, and hydrogen refueling stations. In addition, the Chinese government has also highlighted its goal to develop fuel cell technology in the "New Energy Vehicle Industry Development Plan (2021-2035)." To elaborate, FCEV is listed as one of three key NEV technologies besides BEV and PHEV targeted for successful commercialization by 2035. The government will also promote the development of hydrogen storage systems and

Source: [1] China Association of Automobile Manufacturers

a network. From the corporate side, major commercial vehicle OEMs and suppliers such as Weichai Power have increased their efforts to develop fuel cell products such as drivetrains and fuel tanks. Smaller domestic companies such as Refire are dedicated entirely to the development of fuel cell technology. Without a doubt, the supply chain for FCEV will be an area of high growth in future.

Horizon Fuel Cell develops high-power density fuel cell stacks and systems with operations in China, Singapore, Europe and the US. By working with fuel cell system integrators, OEMs and hydrogen infrastructures developers, Horizon has been promoting adoption of FCEVs, with a specific focus on commercial vehicles. According to Zhang Chi, General Manager, amongst various new energy technologies, FCEVs have advantage over BEVs in long-range driving scenarios. China is still at an early phase of fuel cell habitat development with obstacles such as deficient hydrogen refueling networks, high logistics and storage costs, and uncertainty surrounding future policy support. Meanwhile, Zhang Chi believes that hydrogen production will not be a challenge. Going forward, with the government's setting up of 10 pilot-testing cities for FCEV adoption, the fuel cell market will further blossom.

NEV ecosystem provides opportunities for innovative business models

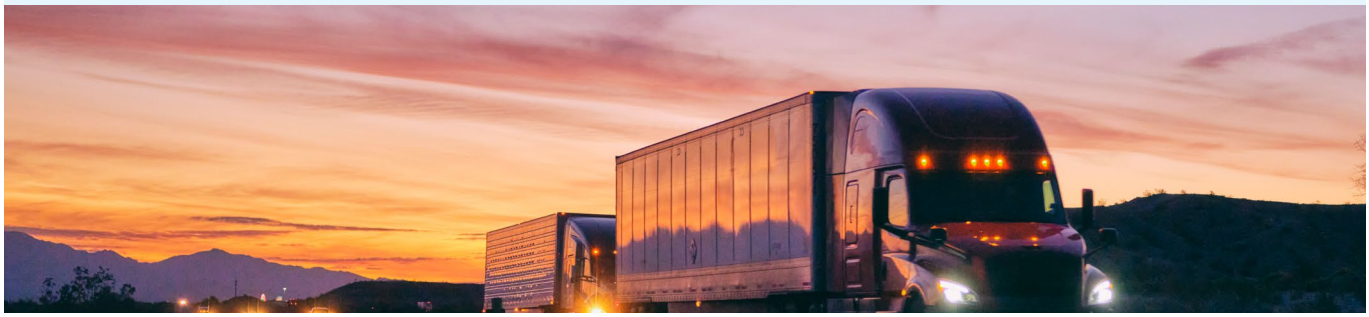
Compared to ICEs, NEVs have certain unique properties such as high initial price but low residual value mainly due to the depreciation of the battery and the high repair costs when the battery or aluminum frame are damaged. These are deal-breakers for some consumers when considering purchasing an NEV. Indeed, some OEMs like NIO and Xpeng tackle the battery cost issue by offering a lower upfront cost to purchase the vehicle while leasing the battery. This has been a popular option for NIO buyers. Battery leasing paired with swappable batteries creates a strong value proposition. If battery leasing becomes more prominent, there will be tremendous opportunities (and risks) for OEMs to offload battery assets to financial institutions or fintech companies who can monetize the assets most effectively using the growing volume of data generated by vehicles and drivers.

First Technology develops proprietary battery swapping technologies. The company cooperates with multiple OEMs. So far, First Technology has provided battery swapping services more than eight million times. First Technology invites investors to own the battery assets used in the swapping stations. In return, these battery investors will receive a cut of the battery swapping revenues.

Alongside the fintech opportunities for batteries, insurers will also develop new services to insure NEVs and drivers by analyzing big data sets on driving habits to provide better pricing options for NEV owners.

Apart from purely manufacturing and selling commercial NEVs, there could be new business models in the commercial vehicle market amid electrification, for example, truck-sharing.

> **"The division of labor will be finer in the NEV industry and hence new companies should focus on certain niche products or services. For instance, in the commercial NEV universe there will be more new business models beside simple commercial vehicle sales, such as matching service between goods for haul and idle logistic NEVs."**
>
> **– Luther Kang**
> Partner,
> Automotive Strategy
> KPMG China



3 Batteries-as-a-battleground

1. Context and current installed capacity

According to the China Automotive Battery Innovation Alliance (ABIA), China registered 62.2GWh of installed NEV battery capacity in 2019, implying a mild YoY growth of 9.2 percent due to the NEV subsidy cut in the middle of the year. Amid the COVID-19 pandemic, in the first half of 2020, installed capacity was down by 41.8 percent YoY but growth resumed in the second half with full-year installed capacity growth of 2.3 percent. Since the NEV battery supply chain is highly localized, the growth of China's NEV battery industry should go hand-in-hand with NEV sales growth going forward.

In term of battery types, lithium nickel manganese cobalt oxide (NMC) has been the mainstream type with capacity contribution of 61 percent in 2020, while lithium ferrous phosphate (LFP) batteries, mainly used for commercial vehicles, came second and accounted for 38 percent of installed capacity.

In term of suppliers, CATL has been the undisputed leader in the Chinese market since 2017 with 50 percent market share in 2020 thanks to its business tie-ups with major global and local OEMs, such as Tesla and SAIC. It is also amongst the global leaders given their leadership in China and its global expansion, like setting up facilities in Germany and supplying to BMW. Over the years, demand for CATL's batteries has been strong and in order to secure their products, larger OEMs like SAIC and Geely set up battery manufacturing JVs with CATL. After CATL, BYD is the second largest contributor with 15 percent market share in 2020, mainly supported by in-house demand.

Because of the removal of the battery supplier "white list" (including only local brand suppliers) in 2019 and the ramp up in local Tesla production, global suppliers LG Chem and Panasonic also entered the Top 10 supplier list in 2020 with 10 percent combined market share. Despite the entry of these global suppliers, it is unlikely that foreign suppliers can gain more share in future since even more global OEMs are tying up with local suppliers with one of the latest examples being Volkswagen's investment in Gotion.

> **"Leading Chinese NEV battery suppliers, along with other major Asia suppliers in Japan and Korea, will continue to be the leaders in the global supply chain considering their strong market position."**
>
> **– Miguel Montoya**
> Partner, Deal Advisory
> KPMG China

China NEV battery installed capacity

	2018			2019			2020		
Rank	Brand	GWh	Share	Brand	GWh	Share	Brand	GWh	Share
1	CATL	23.5	41.3%	CATL	31.46	50.6%	CATL	31.79	50.0%
2	BYD	11.4	20.0%	BYD	10.75	17.3%	BYD	9.48	14.9%
3	Gotion	3.1	5.4%	Gotion	3.43	5.5%	LG Chem	4.13	6.5%
4	Lishen	2.1	3.7%	Lishen	1.95	3.1%	CALB	3.55	5.6%
5	Farasis	1.9	3.3%	Eve	1.64	2.6%	Gotion	3.32	5.2%
6	BAK	1.7	3.0%	CALB	1.49	2.4%	Panasonic	2.24	3.5%
7	Eve	1.3	2.3%	CATL-SAIC	1.43	2.3%	Eve	1.18	1.9%
8	Beijing National Battery	0.8	1.4%	Farasis	1.21	1.9%	REPT	0.95	1.5%
9	CALB	0.7	1.2%	BAK	0.69	1.1%	Lishen	0.92	1.4%
10	CENAT	0.6	1.1%	Sunwoda	0.65	1.0%	Farasis	0.85	1.3%

Source: China Automotive Battery Innovation Alliance (ABIA)

Despite the market dominance of CATL and BYD, China's battery industry is still considered fragmented with a long tail of competing firms. With the abundance of high value NEV cash subsidies, manufacturers were neither price nor quality sensitive on batteries. Instead, they would race to market to achieve maximum battery supply to obtain full subsidy benefits. With the tightening of subsidy requirements and the lower overall value of subsidies, the battery market is maturing and smaller companies and companies with lower end products are being phased out. A classic case is the bankruptcy of OptimumNano, which used to be among the top five but focused mainly on lower power density LFP batteries that have fallen out of favor. On the contrary, survivors with lower market share stay afloat by focusing on the A00 segment or commercial vehicle segment, which receives less attention from large scale manufacturers. Going forward, industry consolidation among battery suppliers will continue with suppliers owned by OEMs counterbalancing (perhaps by continuing to partner with) the major domestic battery providers.

2. Battery technology diversification

As mentioned before, NMC currently accounts for about 60 percent of the Chinese NEV installed capacity. When compared to other major available formats (mainly LFP), the advantages of NMC battery cells are clear: higher power density providing better mileage-to-battery-size ratio. However, there are shortcomings to NMC: higher costs due to the use of cobalt as cathode material, lower stability (i.e., higher risker of combustion), and fewer charging cycles. As such, there continues to be widespread adoption of LFP batteries in the commercial vehicle segment given less stringent requirements for battery size.

There are several trends in battery format design. To begin with, NMC batteries and cathode material makers have been trying to further reduce the composition of cobalt from the original nickel/manganese/cobalt ratio of 1:1:1 to the latest 8:1:1 in order to cut costs. The LFP format was poised to be phased out at one point, but BYD has developed a blade battery that can raise LFP battery pack power density as much as 50 percent via innovations in battery cell packing while reducing material costs. This battery is used in its latest passenger NEV Han with a driving range of about 600km. According to the company, third parties have expressed interest in procuring the BYD's blade batteries.

What's more, in the "New Energy Vehicle Industry Development Plan (2021-2035)," the Chinese government has highlighted the longer-term development of solid-state batteries and hydrogen fuel cell batteries. All in all, while NMC's leading status is unlikely to be shaken soon and battery manufacturing is still going to be dominated by scalable manufacturers, there is tremendous room for battery technology development that allows smaller auto tech companies to get involved.

Modern Auto, an emerging electric vehicle manufacturer, has adopted NMC technology because of better power density. The CTO, Li Yuan, still sees opportunities for LFP usage in the industry given lowering costs, which will further propel the popularization of NEV.

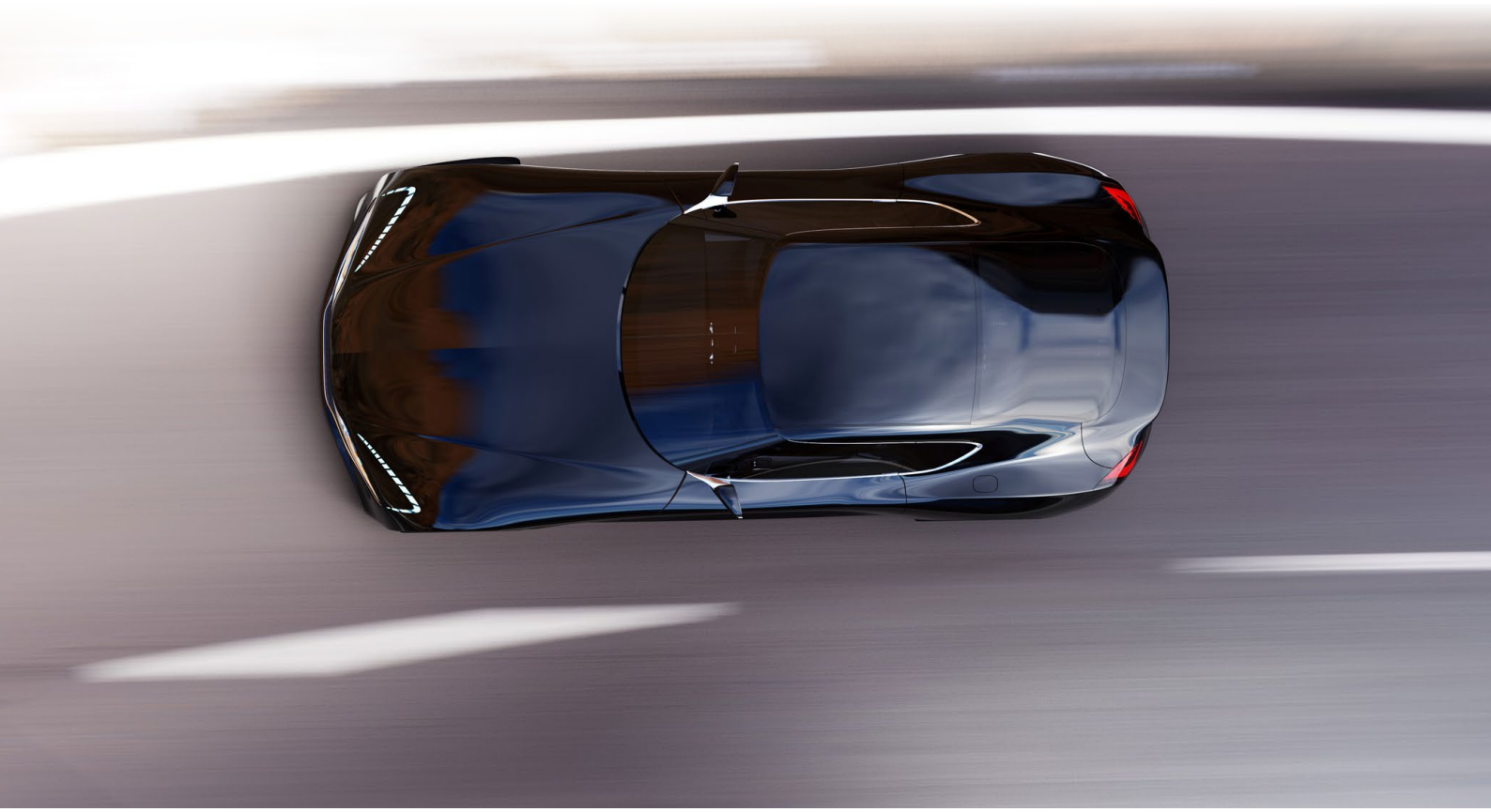
Another area of major research is the development of a solid-state battery. Higher energy density, longer lifecycles, and improved safety are all potential benefits of a solid-state battery. While large scale commercialization is unlikely in the near future, companies are taking transitional steps towards solid-state deployments: SVOLT recently announced a jelly concept battery which uses a semi-solid electrolyte which may begin commercialization by the middle of the decade. NIO's ET7 will be equipped with a solid-state battery, slated for release in 2022. Toyota is expected to announce a solid-state battery as early as 2021. These innovations show the development of alternative battery designs.

3. China's leading position in battery materials and components

China has placed continued emphasis on the strategic importance of developing the NEV industry to make China an auto industry powerhouse and to meet the country's green commitments. To support this, China has been securing access to the major material resources required to manufacture NEV batteries and is a forerunner in the materials processing industry. Besides being among the top five countries in terms of lithium reserves, Chinese companies like Tianqi and Ganfeng also bought stakes in overseas lithium reserves. China also owns eight of the fourteen largest cobalt mines in the Congo where the vast majority of the global cobalt resources lie. China also refines most of the lithium and cobalt globally and is among the leading producers of cathodes with leading manufacturers like Easpring and Shanshan. As such, the country can ensure adequate resources to match the booming NEV demand domestically and overseas.

In China's "New Energy Vehicle Industry Development Plan (2021-2035)," battery management systems (BMS) are placed alongside batteries as key technologies for development apart from motors and smart connectivity. While some major OEMs like Tesla opt for in-house BMS development in order to differentiate themselves, there is room for independent suppliers to supply BMS for more commoditized types of battery packs, such as those for lower end passenger NEV models and for commercial vehicles, and to supply components for BMS like sensors and software. This is not to mention that the BMS value chain is still fragmented without a dominant leader.

Take the battery thermal management system as an example. These systems are becoming more important considering i) the ever-growing power density of battery packs, and ii) government subsidies and NEV credits being more tied to battery efficiency. At the moment, while there is already the entry of traditional global vehicle heat management system suppliers such as Bosch, Valeo, Mahle and Hanon, the development of multiple technologies such as air based, liquid based, phase change material based, etc., will create room for more new companies to disrupt.



4. End-of-life for NEV batteries

The first big wave of batteries from NEVs sold in the middle of this decade are up for retirement. NEV battery recycling should be an important step as the end of the NEV battery lifecycle, and the need for recycling will begin to surge in China. As of now, there are few participants in the post-EV battery marketplace, beyond traditional industrial or chemical recyclers.

To elaborate, NEV batteries become ineffective when their capacity drops below 80 percent of the original capacity. At this point, they should be retired and used for other purposes or recycled. Under typical usage, retirement occurs after four to seven years. Many EVs are approaching these thresholds now.

At the moment, there are two main types of recycling. For LFP batteries that have more recharging cycles, the popular way is to recondition the batteries and reuse them in less power-intensive scenarios such as power storage for solar and wind energy or in low-speed EVs such as golf karts. OEMs like BYD and the telecommunications tower construction company China Tower have power storage businesses to reuse LFP batteries.

Recycling options for NMC are currently limited given their later popularization but availability will increase in upcoming years. For this type of battery, the mainstream recycling direction is to extract the core expensive materials such as nickel and cobalt for re-use. In this area, GEM and Brunp are amongst the key recyclers in China.

In 2018, the Ministry of Industries and Information Technology (MIIT) issued the "NEV Battery Recycling Management Temporary Method" that holds OEMs accountable for battery recycling. Then, in 2019, MIIT issued the "Guidance on Set-up and Operation of NEV Battery Recycling Service Networks" that requires OEMs to establish battery recycling service networks in their sales regions. Despite this, there are only around 30 qualified recycling companies and the industry is without established operating standards. Some restricting factors are a lack of quality verification standards for retired batteries and a nascent power storage industry, which limits profitability on battery recycling operations and, thus, the appeal for new entrants. There are business opportunities in areas such as retired battery grading standardization and assistance to OEMs in carrying out their recycling obligations.

First Technology also has plans for the batteries after they are used in their swapping stations. According to Chairman Nie Liang means of recycling include use in power storage facilities and in less demanding NEV environments such as low-speed electric vehicles.

From gasoline to battery - how traditional energy companies cope with changes

With ground transportation being a major area of energy consumption, especially for fossil fuels at the moment, a rapid pace of vehicle electrification would inevitably put pressure on the long-term outlook of oil energy companies. Indeed, in its 2020 edition of its Energy Outlook, BP foresees that despite continual growth in global energy demand, the structure is likely to change. The role of fossil fuels will decline, offset by an increasing share of renewable energy and a growing role for electricity. In other words, demand for oil will fall, with the scale and pace driven by the increasing efficiency of engines and the electrification of road transportation.

With this outlook in mind, BP set out a new strategy in August 2020 to transform the company from an international oil company focused on producing resources to an integrated energy company focused on delivering solutions for customers. In terms of electrification, the company acquired BP Chargemaster in the UK in 2018 to roll out ultra-fast chargers and invested in StoreDot for fast-charging battery technology. In China, BP invested in NIO Capital in 2018 to fund NEV ecosystem new ventures, invested in PowerShare, a company that offers an online platform to connect EV drivers, charging point operators and power suppliers in early 2019. BP also formed a JV in late 2019 with DiDi, China's leading ride hailing company, to build nationwide NEV charging infrastructure. The infrastructure will include standalone, reliable and high-quality charging hubs for DiDi drivers and the public.

Chinese energy companies are expected to follow suit. CNOOC stated in its 2019 Sustainability Report that the company will continue to promote the research and development of low-carbon footprint energy sources such as hydrogen and marine energy. Sinopec highlights in its 2019 Social Responsibility Report that the company has begun working on various hydrogen energy areas including hydrogen refilling stations, hydrogen production technologies, hydrogen fuel cell batteries and hydrogen storage materials.

All in all, we expect more traditional energy companies to diversify their businesses into more renewable energy areas by leveraging their balance sheets, R&D capabilities and existing global networks.

> **"Evolution in vehicle electrification requires the collaboration of various industries including auto, energy and the power grid."**
>
> **– Zhu Zhuomin**
> CEO, PowerShare

> **When setting up charging networks, energy companies have the advantage in location given their existing gas station network."**
>
> **– Wei Wenshen**
> Founder and President, Shineline Power

4 The journey from pump to pile

1. Charging pile installations must grow (and operate) to meet demand

A Current issues: insufficiency, imbalance and inefficiency

Insufficient charging infrastructure has always been a key setback in consumers' desire to switch to NEVs. According to the China Electric Vehicle Charging Infrastructure Promotion Alliance (EVCIPA), there were 1.68 million charging piles in China as at the end of 2020, far from the government's original 2020 target of 4.8 million. This implies that, on average, each pile needs to service three NEVs.

Apart from that, the distribution of charging piles is also imbalanced with little charging infrastructure investment to be found in less populated regions and some city public charging piles located in the outskirts of urban centers. Worse still, in many cases, parking spaces with public charging piles are either occupied by ICEs, or simply out of service. Such problems lead to an underutilization of public charging piles, hurt the profitability of charging network operators and lower driver trust in the effectiveness of EV infrastructure.

The high population density of China's major cities also adds to the complexity of installing private charging piles. EVCIPA estimates that there were only 874,000 private charging piles in the country by the end of 2020, compared to the government's original 2020 target of 4.3 million. More than 30 percent of NEV owners are unable to set up their own charging piles with issues including, but not limited to, a lack of permanent parking spaces and inadequate electrical infrastructure. This results in individuals finding more creative means to charge their NEVs, which may be neither safe nor sustainable.

Number of charging piles in China

	2017	2018	2019	2020
Number of public charging piles ('000)	214	300	516	807
AC	86	190	301	498
DC	61	110	215	309
AC/DC combo	66	0.5	0.5	0.5
Number of private charging piles ('000)	232	477	703	874
Total	**446**	**777**	**1,219**	**1,681**

Source: China Electric Vehicle Charging Infrastructure Promotion Alliance (EVCIPA)

Share of public charging piles nationwide by regions

Top regions	2017	2018	2019	2020
Beijing	14.2%	13.9%	11.4%	10.9%
Guangdong	13.7%	12.0%	12.2%	10.6%
Shanghai	12.3%	13.1%	10.7%	10.6%
Jiangsu	10.3%	10.1%	11.7%	9.5%
Zhejiang	4.6%	4.7%	5.6%	7.6%

Source: China Electric Vehicle Charging Infrastructure Promotion Alliance (EVCIPA)

Last but not least, since public charging facilities are operated by different companies, there is no handy one-stop information base showcasing all of these facilities' locations and availability, thus making charging a frustrating experience at times.

B Government support will drive exponential charging pile growth

While the Chinese government has been trimming the monetary subsidies on NEV purchases, the commitment on growing the NEV sector can be seen in the support on charging network expansion. In April 2020, the National Development and Reform Commission (NDRC) included the NEV charging network as one of the key new infrastructure areas. Installations of more charging piles was also under the agenda of the State Council's work report in May 2020 with the support of the world's largest power grid. There are also government subsidies to support the set-up and operation of charging piles.

The central government's idea of speeding up charging network expansion has also penetrated local governments' planning. For instance, Shanghai aims to add 100,000 charging and battery swapping facilities in three years[2] while Chengdu aims to add 23,000 piles[3]. All in all, to catch up with the growth of NEV ownership in the future, the growth pace of charging pile counts will only speed up given the current insufficiency. This creates a lot of the opportunities in the charging value chain.

Source: [2] *Action Plan for Promoting New Infrastructure Construction in Shanghai (2020-2022)*
[3] *Special Plan for New Infrastructure Construction in Chengdu*

2. Disruption and growth in the charging marketplace before consolidation

We define suppliers of charging piles, its supporting facilities such as power conversion stations, and components for assembling the piles (e.g., charging module, monitoring systems, charging guns, etc.) as upstream companies. At the moment, there are already numerous participants in the value chain, with more prominent names such as KSTAR (modules), Infy Power (monitors), and Jonhon (charging guns). While we see scale as major deciding factor for the business success of more commodity-type components such as charging pile casings and charging guns, there is still room for auto tech innovations in more sophisticated areas such as high-power rapid-charging equipment.

EVS is an NEV charging pile and charging pile component manufacturer that partners with OEMs and developers. EVS establishes connected charging networks and collects data on charging activities such as charging pile utilization and charging status.

In terms of the downstream charging network operators, while general perception may point to State Grid as the natural market leader given the control of the power network and financial resources, the State Grid's charging network is the third largest in China based on EVCIPA 2020 public charging pile count data with 22.5 percent market share. The top 2 operators are Teld and Star Charge, with 25.7 percent and 25.4 percent market share respectively. These two companies are also manufacturers of NEV charging equipment.

Share of public charging piles nationwide by operators

Top operators	2017	2018	2019	2020
Teld	45.6%	40.4%	28.7%	25.7%
Star Charge	13.3%	18.3%	23.3%	25.4%
State Grid	19.8%	18.9%	17.0%	22.5%

Source: China Electric Vehicle Charging Infrastructure Promotion Alliance (EVCIPA)

Apart from these names, we are seeing various types of companies also trying to set up networks. For instance, Tesla has about 5,000 superchargers in China exclusively for owners of their cars[4], in an attempt to make charging even more convenient for their owners. It is uncertain, though, whether this really gives much of an edge to the brand in China since the country is deploying standardized charging sockets (China GB/T), i.e., any NEVs will be increasingly able to charge up at any public charging piles available, a distinct advantage compared to nations without standardization.

As mentioned in a previous section, traditional energy companies are also setting up charging networks in order to diversify their business away from predominantly oil and gas-reliant products. They are viable players in the market for charging networks considering their financial resources and the relative ease of rolling out a network by starting with their own gas stations. All in all, it is unlikely that smaller companies can succeed in owning and running a charging network, while there should be opportunities available for young auto tech companies in areas such as charging network management systems or related services.

It is also possible that with the ever-increasing size of the NEV fleet, shopping mall and mega store operators will become compelled to set up charging stations at their premises to attract NEV owners to park, charge and shop. The idea is actually adopted overseas by companies like IKEA.

Last but not least, there are also Chinese going overseas to capture the NEV charging market. For instance, in 2018 Star Charge has entered into a strategy collaboration with Hubject, Europe's leading provider of charging networks for electric vehicles, aiming to build the world's largest international charging network.

Source: [4] Tesla

3. AC at home, DC away, and other services to complement

At the moment, the two major NEV charging types available are alternate current (AC) slow charge and direct current (DC) fast/rapid charge. Power is transmitted in AC format within the power grid whereas DC is the current to charge an NEV. With AC charging, AC is transmitted to the NEV where an onboard charger will convert the current into DC and charge the vehicle. While AC charging piles can have power ratings of up to 43kW (a more common range is less than 11kW), the charging power limit is usually restricted by the onboard charger given the size constraints. This is the reason why AC charging is slower in speed and usually takes hours to complete charging.

For DC charging, the AC-DC conversion happens at the charging facility and hence there is less constraint on the size of the charger. The DC can then bypass the NEV's onboard charger and go directly to the battery. The power rating is higher compared to AC charging at more than 50kW, with rapid charging power as high as 350kW. In general, fast charging can charge batteries to 80 percent within an hour. Despite the speed, fast or rapid charging is not recommended for high frequency use because of the consequent speeding up of battery aging. In addition, high density placement of fast or rapid charging piles is also not ideal considering the resulting burden on electricity usage in certain areas.

As such, under China's "New Energy Vehicle Industry Development Plan (2021-2035)," the private charging network will be mainly be composed of slow charging piles, with fast charging piles (including high-power fast charging) being the emergency secondary in residential districts. For public charging networks in cities and suburbs and on highways, fast charging will be primary and slow charging will be secondary (vs. the current 60/40 split between AC and DC public charging piles).

Apart from the conventional charging method, the idea of battery swapping will also be further explored and commercialized, while more R&D will be done in the area of wireless charging, high power charging and smart sequential charging. To elaborate on battery swapping, it is already implemented by OEMs such as NIO and operators such as Aulton. The merit of this method is the speed of swapping versus charging. An additional benefit of battery swapping stems from the different lifespans of the vehicle's components: batteries currently lose some functionality within a few years because of chemical changes within the battery itself, while components in vehicles are typically engineered for a much longer lifespan. Allowing them to be easily separated may allow for short term improvements in battery technologies to be implemented throughout the lifespan of the vehicle. The model is not proven, however, as it does not solve some of the key challenges: storage of spare batteries and battery standardization needed for widespread adoption.

Shineline provides mobile charging pile services. The piles are powered by rechargeable batteries and can address the issues of limited power capacity and insufficient space, which can be seen in many fixed charging stations. The company has teamed up with several OEMs and pile operators. They target NEV owners who are willing to pay for convenience.

Also, with an aim to further develop FCEV technologies, the government has also encouraged R&D on hydrogen storage for future refueling options.

> **"The future charging network will be comprised of slow charging and fast/ rapid charging. Fixed charging stations and mobile charging piles will both be important parts of the future charging family."**
>
> **– Wei Wenshen**
> Founder and President,
> Shineline Power

4. Charging piles offer more than charging

One general complaint of NEV users in China has been the inconvenience in locating available public charging piles. While operators such as Teld have their own apps to show available piles, each app only shows the piles of that particular operator. NEV users end up juggling different apps in order to get a full picture, similar to car hailing before dominant players emerged. The situation is now changing as major operators like Teld begin collaborating to also include information about charging piles of their peers into the same app, thus leading to less hassle. In this area, much room exists for charging network apps to further improve.

Indeed, the benefits of a connected charging pile network go beyond improvements in pile availability information. Besides collecting vehicle charging data and electricity usage data, a smart connected charging pile network can also provide NEV usage data such as driving and charging habits. Together with the latest 5G technologies, these data can also be analyzed and used real time to improve the efficiency of the charging network. At the moment, it seems like charging network operators have an edge in this field given the ownership of the big data, but software companies can also have a role of supporting data analysis and the provision of related services.

PowerShare is utilizing battery AI combined with battery data from more than 360,000 EVs, partly obtained from vehicle charging, for multiple purposes. For instance, charging pattern data can be analyzed to determine if a charging station needs to be upgraded due to anticipation of higher power consumption in the future. Through partnerships with OEMs, they have access to an estimated 10 percent of NEV real-time usage data. PowerShare also analyzes NEV real-time battery usage data to help improve battery efficiency and longevity.

> **Charging operators are all heading towards the direction of energy digitization.**
>
> **– Zhu Zhuomin**
> CEO, PowerShare

Beyond NEV usage information, the big data obtained from the NEV fleet in occasions like charging can also reveal details of the lifestyles of NEV owners such as travel patterns and favorite venues or destinations. This valuable information can be analyzed and utilized to generate value-added service ideas for NEV owners, thus maximizing the value of charging network ownership.

> **Charging pile utilization is usually low and efficiency/profitability cannot be enhanced by only analyzing simple charging data. If combined with data on NEVs' conditions and usage patterns, more customized value-added services such as car care and shopping can be offered to NEV owners, thus making the charging network a more valuable habitat.**
>
> **At the moment, car usage data generated from the current NEV fleet is insufficient given the small fleet size and short usage life versus ICEs. But, since NEVs are powered by electricity and are mostly connected to the web in real time, the data size and value will be tremendous going forward with information on the NEV fleet's usage patterns and NEV owners' social lifestyle.**
>
> **– Phil Yu**
> Partner, Management Consulting, KPMG China

Under this direction, we can also see why many non-auto tech companies such as Baidu, Alibaba and Tencent are all enthusiastic about the NEV industry and are investing in start-up OEMs, developing vehicle operating systems and initiating alliances on NEV and smart vehicle ecosystem formation. The underlying idea is to eventually monetize the ever-growing NEV owner population, similar to how smart mobile device advancement has accelerated e-commerce in the past decade.

> **"Non-auto companies are going to be increasingly involved in the provision of infrastructure. At the moment, it is too early to predict winners as the NEV ecosystem continues to evolve. That being said, platform players like Baidu, Tencent and Alibaba will be inextricably involved in the ecosystem. One example is the establishment of alliances amongst various parties, typically including OEMs, IT hardware providers, internet companies, etcetera."**
>
> **– Thomas Bailey**
> Automotive Sector Executive, KPMG China

Vehicle to grid

China's "New Energy Vehicle Industry Development Plan (2021-2035)," brings the idea of vehicle to grid (V2G) to the forefront. In brief, NEV owners with their own charging piles tend to charge in the evening after work. While some of the charging times can overlap with the peak power consumption period (i.e., 8pm-midnight), the NEVs can also be charged during the trough power consumption period after midnight. Therefore, the V2G idea is that NEVs can be charged fully during trough hours and then give the electricity back to the power grid when idling in daytime via the charging network. This can improve the efficiency of power consumption, especially when we foresee a surge in future NEV adoption, while NEV owners will be given incentives to participate.

With this idea being laid out in the government's plan, there are opportunities for companies, including the grid companies, to generate business plans for electricity collection and to develop charging networks that can also be used for electricity collection.

Yet, according to Zhu Zhuomin, CEO of PowerShare, the V2G idea is only at the pilot testing stage at the moment as the relationships between NEV owners and grid companies is still nascent. Additionally, remodeling of the power grid is required to make it ready for V2G. From the OEM perspective, one key obstacle is the acceleration of battery degeneration due to the higher frequency of charging-discharging. All in all, PowerShare does not expect commercialization of V2G in the next three to five years.

5 Closing remarks

Without a doubt, Chinese and global NEV demand and fleet size will continue to grow rapidly thanks to government support, OEMs' increasing commitments and further NEV adoption by car owners. The wider use of NEVs will also create a new ecosystem from the traditional ICE value chain, in areas such as NEV-specific components, charging and peripheral services, and other big data applications, and creates new business opportunities for young auto tech companies. **"They are participating in the NEV industry at the right time and in the right place. As the industry is still evolving, there are still opportunities for technology disruptors for both products and services,"** said Norbert Meyring, KPMG Automotive Sector Head.

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04

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