MIOTECH

Path to Carbon Net-Zero:

China's Electric Vehicle Industry

AMI · ESG

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Content

Summary

1. The principal aim of this paper is to take a look at the Chinese electric vehicle (EV) industry in the context of Environmental, Social, and Governance (ESG) issues, especially the flourishing start-ups NIO, Xpeng and LI Auto. By analyzing their outlook with evidence from government policies, financial markets and the energy sector, this paper discusses how ESG programs can be integrated by these enterprises to unlock more opportunities in the future.

2. There have been multiple policies taking effect to boost the development of this industry, both in China and other countries. Policymakers in China – as well as the European Union and United Kingdom – are targeting EVs to be the mainstream by 2030. That implies an unprecedented transition to e-mobility in the coming decade.

3. Environmental and social issues of the industry are centered around batteries. The carbon emissions from producing and charging vehicle-use batteries have raised doubts about the actual carbon savings of EVs. Meanwhile, battery-related problems are a major cause of fires and other accidents involving EVs.

4. NIO, Xpeng, and LI Auto have less diverse boards of directors than mature carmakers like Toyota or General Motors, with members coming mainly from the automobile, technology, or investment sectors. Governance issues could arise where a lack of disclosure on sustainability poses threats to these start-ups.

5. The bulk of institutional investors behind these start-ups claim to have evaluated sustainability in their investment considerations, but those who do not prioritize sustainability have been convinced to invest by market prospects.

6. The world has been moving towards renewables in energy production and greater demand for EVs has reduced the unit cost of electric power. EVs can be particularly lucrative for manufacturers that have been first movers in autonomous driving and the Internet of Vehicles.

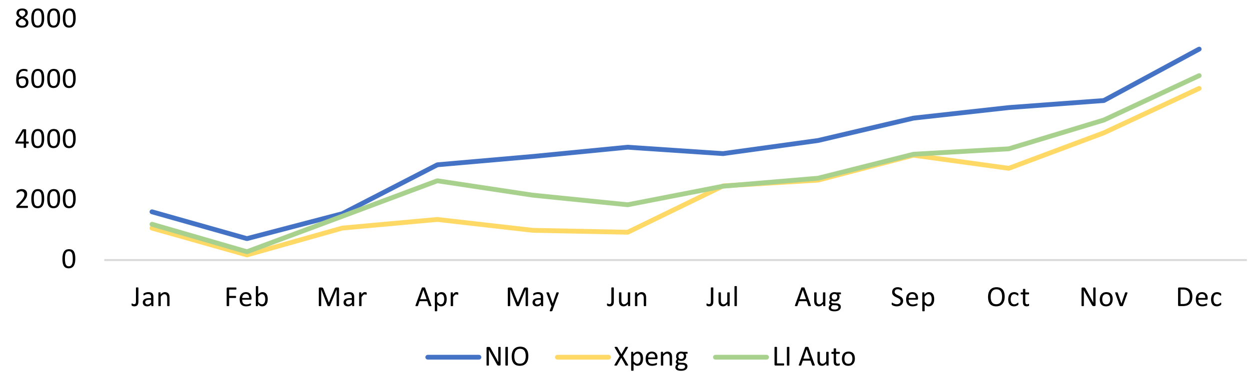
Policy Shift: The Next Decade Could be the One for Electric Cars

Quick Takeaways:

- Subsidies for EVs will remain in place for the next several years, given their incentive value, but the industry expects they will be phased out at some point.
- The "dual-scoring" policy - combining the Corporate Average Fuel Consumption (CAFC) credit and the New Energy Vehicle (NEV) credit - can be an effective push to market participants.
- The world is seeing a clearer vision of decarbonization with various nations targeting 2030 as the turning point, implying a landmark decade to come for the EV industry.

NIO, Xpeng, and LI Auto, the three top-tier Chinese new-generation EV manufacturers, have released their annual delivery results for 2020 (Figure 1.1). NIO delivered 43,728 vehicles in 2020, up by 112.6% year on year. Xpeng delivered 27,041 vehicles in 2020, realizing an annual growth of 112.0%. LI Auto, whose products became available from December 2019, delivered 32,624 vehicles in 2020. In November 2020, new registrations of Statutory Automobile Liability Insurance (SALI) for NEVs surged by 180.22% year on year to about 176,700, of which 21,015 were new registrations for cars by start-up carmakers, an increase of 224.21% (Gasgoo, 2020). Notably, of the 121,339 new registrations for start-up carmakers in the first 11 months of 2020, personal insurers accounted for 74.13%. Improvement in range performance and increased production capacity of carmakers have motivated more individual consumers to choose EVs, but the Chinese government also has a role to play in this process. With the government's transition from offering incentives for electric car buyers and manufacturers to turning the screws on internal-combustion engine (ICE) cars, the general public finds it harder to ignore NEVs. In this section, we will look at the policies announced this year, discuss their potential effects on manufacturers or consumers, and make international comparisons where appropriate.

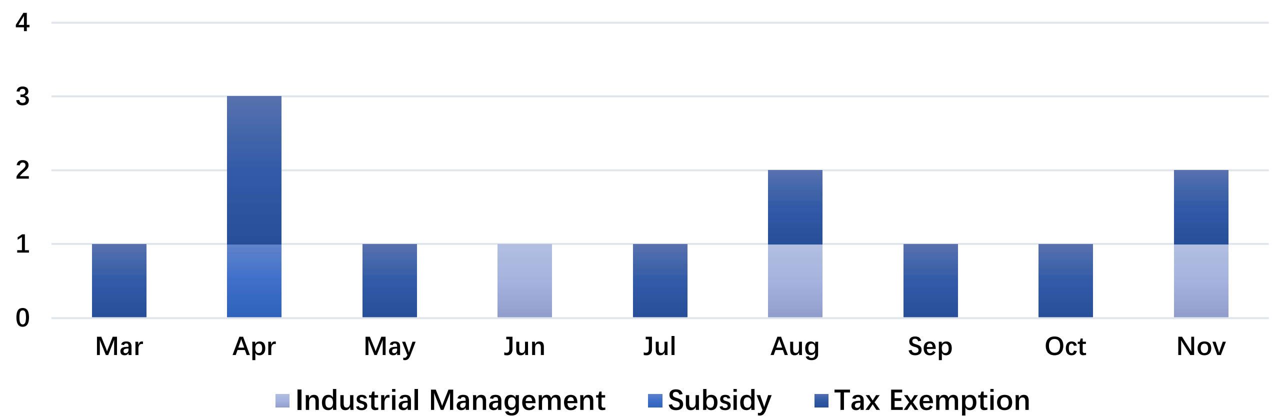
Figure 1.1 Monthly Sales of NIO, Xpeng, and LI Auto in 2020



Source: Publicly available information

Since 2009, China has had a long history of supporting NEVs through policy means, and 2020 was no exception, with up to 13 new policies issued (Figure1.2). The most significant is the New Energy Vehicle (NEV) Industrial Development Plan (2021-2035), published by the State Council in November, which outlines the country's expectations for the NEV industry chain and measures to realize them. In this plan, China aims for domestic NEV sales to account for about 20% of new vehicle sales by 2025 and battery electric vehicles to become the majority of new vehicles sold by 2035. Hecker, Mou, and Maennel (2019) from Deloitte estimated that in 2030, 15 million battery electric vehicles (BEVs) would be sold in China, making up 90% of the new energy vehicle sales.

Figure 1.2 Number of Released Policies to Promote Electric Vehicles in 2020

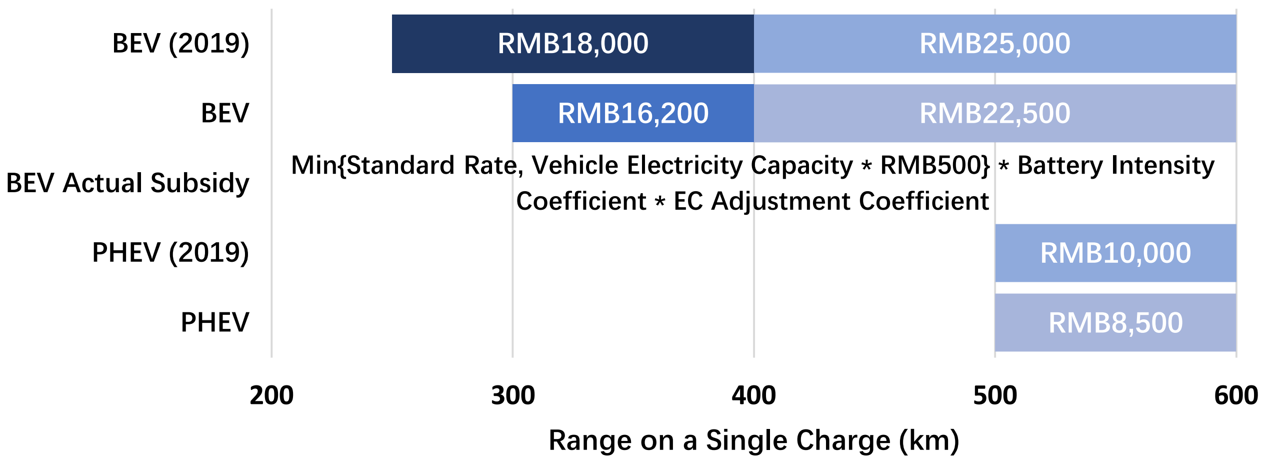


Lowering Subsidies: The Roles of Government and Enterprises in Pricing Incentives

It is not news that the Chinese government exempts new energy vehicles from vehicle purchase tax. From January to November 2020, there were no fewer than eight expansions of the exemptions, to more established makers such as Tesla and BYD as well as newcomers such as NIO, LI Auto, and even Ennovate, a Chinese start-up electric carmaker established only six years ago. In April 2020, an announcement was made that tax exemptions will be effective until the end of 2022.

Moreover, there are subsidies available to makers and purchasers of EVs. There seems no definitive answer as to how government policy on subsidies will continue. On the one hand, the Ministry of Finance lowered subsidies on electric car purchases to prevent over-reliance on subsidies or subsidy fraud. On the other hand, the ministry was on the verge of discontinuing subsidies at the end of 2020, but then approved the extension to 2022, although they were 20% less last year, and will be reduced further by 30% in 2021 and 2022. BEVs with ranges shorter than 300km were excluded from subsidies.

Figure 1.3 2020 Subsidy Rates of Electric Passenger Cars by Chinese Government



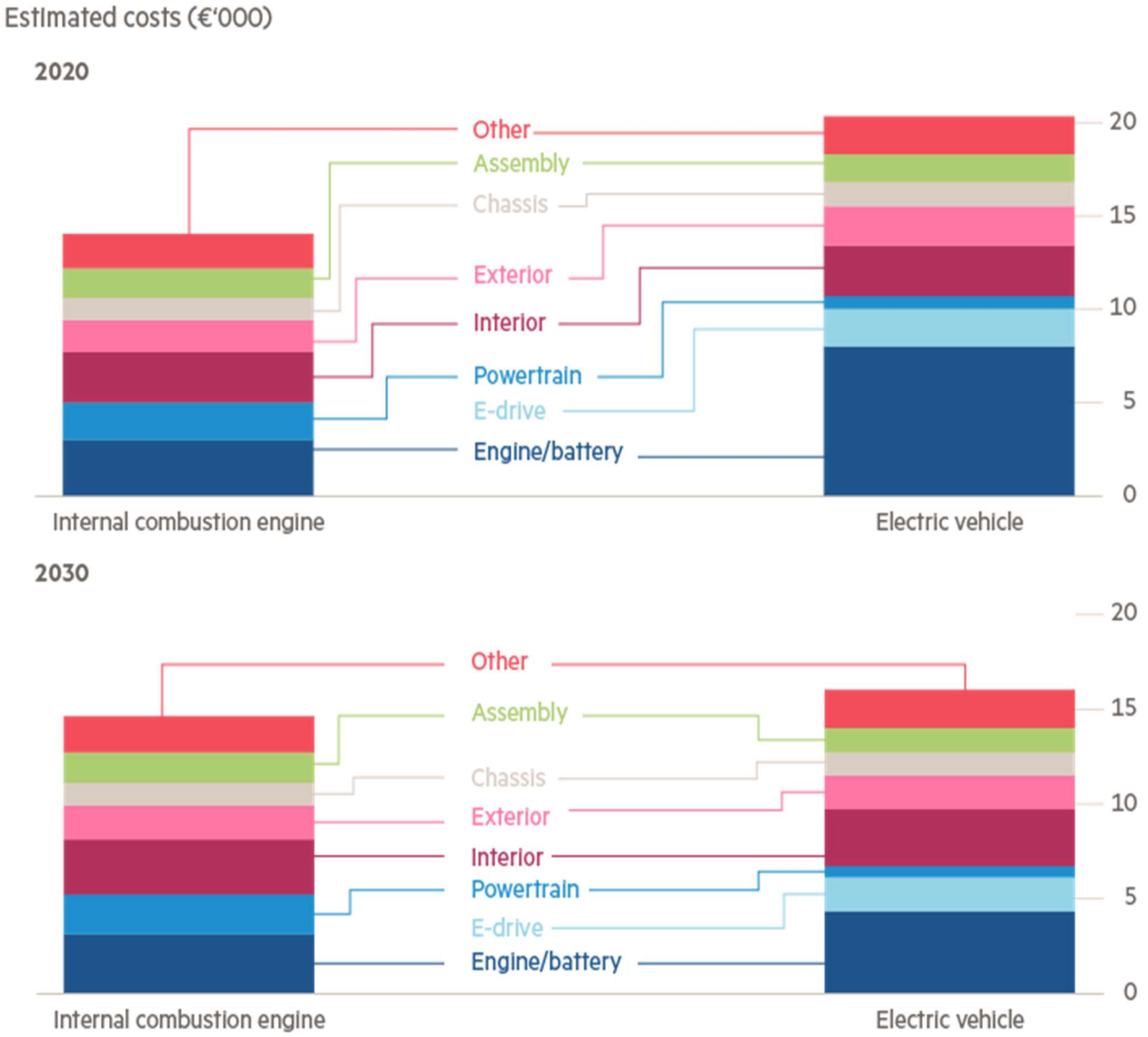
Source: Ministry of Industry and Information Technology of the People's Republic of China

There is a global trend away from offering EV subsidies, and letting the market take over, in which case the players with core competences would be more likely to thrive. Transportation bodies need more funding for battery-charging infrastructure, so that they will not be overwhelmed by the number of new vehicles on the road. Carmakers have been leveraging subsidies to gain sales. A standard range made-in-China Tesla Model 3 has a list price of RMB 269,700 per vehicle, but can be purchased by individual consumers for RMB 249,900 after the RMB 19,800 subsidy is deducted. The Tesla Model 3, a consistent best-seller in China, has adjusted its pricing in China to ensure it is eligible for subsidies. The most recent policy requires pre-subsidy prices to be under RMB 300,000.

While the costs of manufacturing EVs have fallen, Miller (2020) has shown that it was still about 40% more expensive in 2020 to produce an EV than a traditional ICE-powered car (Figure 1.4). With carmakers and component producers pouring funds and resources into research and development (R&D), EV manufacturing costs should fall further and approach those of petrol and diesel cars by 2030.

The estimate by Miller (2020) may sound like an overstatement without the fact that the average costs of lithium-ion batteries, the most expensive component have plunged by 76% from USD 592 per kWh in 2015 to USD 137 in 2020, according to Baker and Traywick (2020), who forecast that the USD 100 tipping point would occur in 2023. And based on Figure 1.4, the cost of batteries will drop by about 40% in the coming decade, which, if true, means that the price of batteries would be about USD 82 per kWh by 2030. Batteries are the only component to see such a sharp decrease in costs, while others have experienced smaller drops.

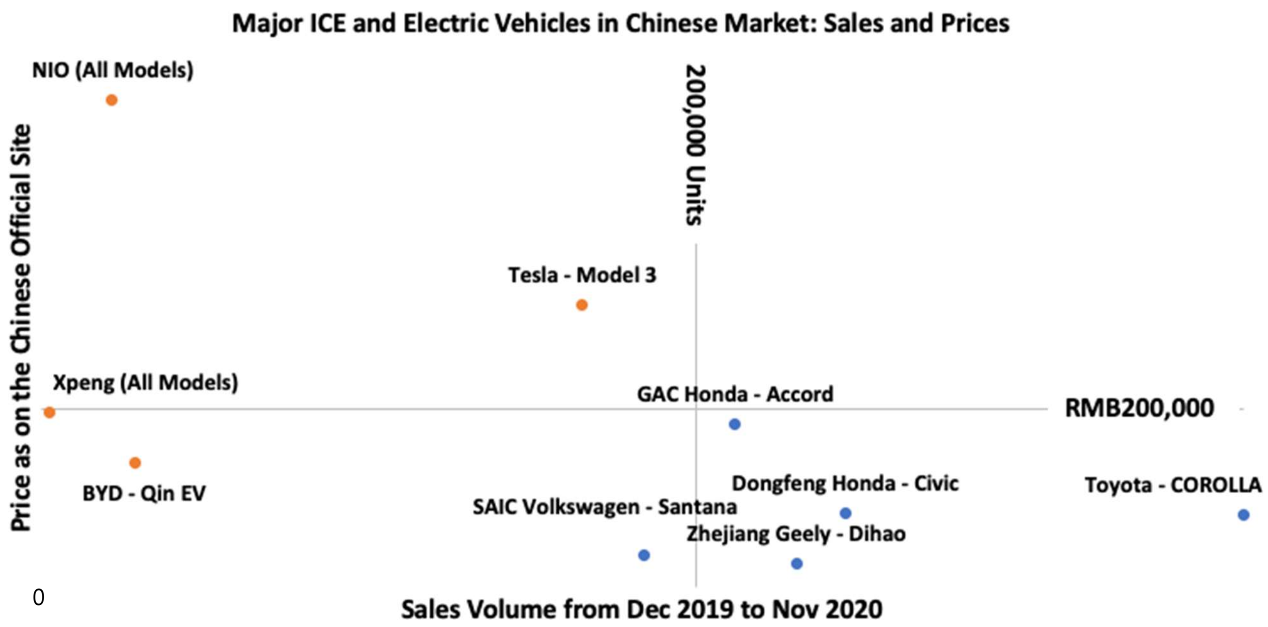
Figure 1.4 Estimated costs to produce ICE vehicles and EVs (€'000)



Source: Miller, J. (2020). Electric car costs to remain higher than traditional engines. The Financial Times, citing Oliver Wyman

EVs made by NIO, Xpeng, LI Auto – as well as those of Tesla and BYD – are still more expensive than the best-selling fossil fuel cars (Figure 1.5), and all of them except BYD made full-year losses in 2019 after R&D and other expenses. BYD's Qin EV is the least expensive and the only EV that can compete with the ICE cars in this sample in terms of price. That the bulk of electric cars are priced higher than their ICE equivalents, even when electric carmakers do not derive much profit from them, might explain why carmakers do not want subsidies to be cut. In summary, subsidies are still needed to draw more consumers to EVs, but the government is only going to offer them for a limited time before channeling them to other parts of the value chain. Manufacturers will continue to see cost declines and prepare themselves for market competition without the government intervening.

Figure 1.5 Major ICE and Electric Vehicles in Chinese Market: Sales and Prices



Source: CEIC Data. (2020). China Automobile: Sales, and price information derived from official sites of carmakers

EV Mandate for Traditional Carmakers: Revised "Dual-Scoring" System Poised to Make a Difference

In recent years, the Chinese government has also introduced minimum permitted fuel consumption to spur the adoption of EVs, the most significant of which is the "dual-scoring" system. This refers to the "dual" calculations of both the CAFC and NEV credits for all car manufacturers and importers registered in China. Enterprises with negative credits transfer positive CAFC credits from affiliated firms, or compensate with positive NEV credits that are owned by them or purchased from any peer firm at a fixed price , according of RMB 3,000 per credit. The updated dual-scoring policy issued in June 2020, raises the NEV credit while lowering the CAFC credit (Table 1.1). Set at 12% in 2020, the NEV credit will be increased by two percentage points annually until it reaches 18% in 2023. The threshold for assessment of NEV credits is higher, leaving carmakers with lower NEV credit balances. Positive CAFC credits are applied when the assessment result is smaller than the threshold. These adjustments make it more difficult for carmakers to earn both positive CAFC credits and positive NEV credits, forcing them to arrange larger quotas for the production of NEVs Carmakers who sell only EVs have very few, if any, CFAC credits, but abundant tradable NEV credits. The dual-scoring system is another form of state support for electric carmakers. In 2019 Tesla accumulated 271,282 tradable credits and Jianghuai Automobile – NIO's foundry -- had 263,648, while FAW-Volkswagen posted negative 145,691 NEV credits. (Li, 2020)

Table 1.1 Dual-scoring System

	Corporate Average Fuel Consumption (CAFC) Credit
Assessment Result	$\frac{\sum(FC\ of\ a\ Vehicle\ Model * Sales\ of\ that\ Model\ )}{(\ Sales\ of\ All\ Models\ )}$
Hurdle	$\frac{\sum(FC\ Goal\ of\ a\ Vehicle\ Model * Sales\ of\ that\ Model\ )}{(\ Sales\ of\ All\ Models\ )} * Annual\ FC\ Requirement$
Credits Awarded	$Hurdle - Assessment\ Result$
Alternative Options with Negative Credits	▪ Compensate with residual positive credits from the previous three years ▪ Transfer credits with associated enterprises ▪ Compensate with self-owned NEV credits ▪ Purchase NEV credits from counterparts
	New Energy Vehicle (NEV) Credit
Assessment Result	$\sum Base\ Credit\ of\ the\ NEV\ Model * Sum\ of\ its\ Production\ and\ Import$
Hurdle	$Annual\ Production\ of\ ICE\ Vehicles * NEV\ Ratio$
Credits Awarded	$Assessment\ Result - Hurdle$
Alternative Options with Negative Credits	▪ Purchase NEV credits from counterparts

Source: Ministry of Industry and Information Technology of the People's Republic of China

The Role of Municipal Governments in Applying Restrictions on Car Owners and EV Enterprises

The report on 24 October 2020 that the Shanghai Public Security Bureau announced it would tighten restrictions on out-of-town cars ignited strong reactions in the city and reverberated across China. The new policies, effective from 2 November 2020, extended the period and expanded the scope of areas where driving non-local vehicles were banned. Specifically, driving non-local vehicles would be banned on all 15 elevated expressways in the city center from 7 a.m. to 8 p.m. every day. From May 2021 such restrictions would be imposed on ground-level roads. Every day from 7 a.m. to 10 a.m. and from 4 p.m. to 7 p.m. cars licensed elsewhere would not be permitted on all roads within the inner ring, effectively banning non-Shanghai vehicles during peak times. This new policy is expected to stimulate demand for NEVs, as owners of ICE cars in Shanghai can be licensed only via auction or massively oversubscribed lotteries, while new owners of EVs could obtain license plates free of charge and with a shorter waiting time. Thus prospective car owners who would drive within the inner ring would have to consider buying EVs and even frequent drivers of out-of-town cars in Shanghai would need to switch in order to travel without limits. The limitations in Beijing are even more strict: both ICE cars and EVs need to be licensed via lotteries. The only difference is that ICE cars are subject to randomly generated results while EVs queue on a first-come-first-served basis to be registered. Drivers can operate an out-of-town vehicle in Beijing for a maximum of three months, after which the car cannot be parked in zones 1-6 in the city.

As a key component in state-level plans, municipal governments have also realized the benefits of introducing EV projects to their cities. On April 29, NIO and state-backed strategic investors from Hefei inked an investment agreement worth RMB 7 billion in exchange for NIO's China headquarters being established in the Hefei Economic and Technological Development Zone. On December 3, Tesla announced that it planned to invest RMB 42 million in Shanghai to construct an R&D and manufacturing center for its supercharger, expected to start operation in the first quarter of 2021. The collaboration between Tesla and Shanghai is a textbook of international EV cooperation. Tesla established its Shanghai office in May 2018 and soon after that bid for an 86.5-square-kilometer parcel of land in the Shanghai Lin-Gang Special Area as the site of its Shanghai Gigafactory car-making plant. Tesla began construction in January 2019 and started operations in November 2019. According to Tesla's third quarter report in 2020, output of the Shanghai Gigafactory had reached 250,000 cars per year.

Global Picture: Hard Line on Decarbonization Heralds Landmark Decade for EVs

On 17 November 2020, the UK government advanced the date from which wholly fossil-fuel-powered cars could not be sold from 2040 to 2030 to combat the threats posed by climate change. EVs made up 2.85% of the vehicle market in the UK in 2019 (International Energy Agency, 2019). According to British officials, accelerating this process can boost the local EV market, attract more investment, and create jobs as well as meet environmental objectives. Globally, other countries have proposed electrification goals for 2030, including several in Europe, while the most ambitious goal announced to date is from Norway, with EVs already accounting for 55.93% of the market in 2019 and a ban on sales of new ICE vehicles from as early as 2025 (Table1.2). In the US, states such as Connecticut, New York, and Massachusetts have joined the Zero-Emission Vehicle (ZEV) Alliance, a group of national and subnational entities that has pledged to make all newly sold passenger vehicles electric by 2050. Germany is also a member of the ZEV Alliance.

Table 1.2 Global Automobile Electrification Goals

	EV Market Share	Governments' EV Penetration Goals (% of New Vehicle Sales)					
	2019	2025	2030	2035	2040	2045	2050
Canada	2.96%	10%	30%		100%		
China	4.94%	20%	30%				
Denmark	4.20%		100%				
France	2.77%				100%		
Germany	3.01%		30%				100%
Iceland	22.60%		100%				
India	0.07%		30%				
Ireland	3.10%		100%				
Israel	-		100%				
Japan	0.90%		100%				
Netherlands	15.14%		100%				
Norway	55.93%	100%					

Portugal	5.67%				100%		
Slovenia	-		100%				
South Korea	-		33%				
Spain	-				100%		
United Kingdom	2.85%		100%				
California, US	7.7%			100%			

Source: International Energy Agency. (2020). Global EV Outlook 2020; International Energy Agency. (2019). Electric car market share in selected countries, 2019

Fiscal incentives for EVs have been widely adopted around the world. Germany decided to extend the subsidies on EVs from 2021 to 2025, while reducing them in two steps, in a similar pattern to China. Germany has formed a more positive policy environment for e-mobility compared to other European countries. The country doubled fiscal incentives for EVs in June 2020 where consumers of EVs priced below EUR 40,000 could receive a EUR 6,000 bonus paid jointly by the government and the carmaker. The German government subsequently announced in November 2020 that the original subsidies would be added with another EUR 3,000 from the carmaker, raising the total bonus to EUR 9,000 per car. The French government originally announced it would raise subsidies for vehicles that cost less than EUR 45,000 from EUR 6,000 to EUR 7,000 per car, but in the fiscal budget unveiled in September 2020, the government held the subsidy at EUR 6,000 for 2021 with a reduction to EUR 5,000 from 2022. In Asia, Japanese media reported in late November 2020 that the government had planned to double the maximum EV subsidy from JPY 400,000 to JPY 800,000, with the final amount based on the range, but only if the EVs are charged with renewable electricity. In South Korea, according to the 2020 EV subsidy plan from the government, an electric vehicle could be awarded a KRW 8 million bonus.

Corporate ESG Engagement Within the Electric Vehicle Industry

Quick Takeaways:

- Electric vehicles have higher levels of carbon emissions in the manufacturing phase, but the lifecycle emissions are lower than those of fossil-fuel vehicles. Cleaner electricity is vital to further decarbonization as electricity used by manufacturing plants comprises the largest share of emissions.

- Batteries remain the dominant source of EV quality issues such as fires, which means manufacturers have much to do in terms of quality control and sourcing.

- Start-ups could have more diversified boards, bringing people from sectors outside automotive, technology, or investment to bring more expert views on sustainability issues. Information on sustainable development is important to investors and customers, and start-ups need more resources and experience related to their ESG disclosures.

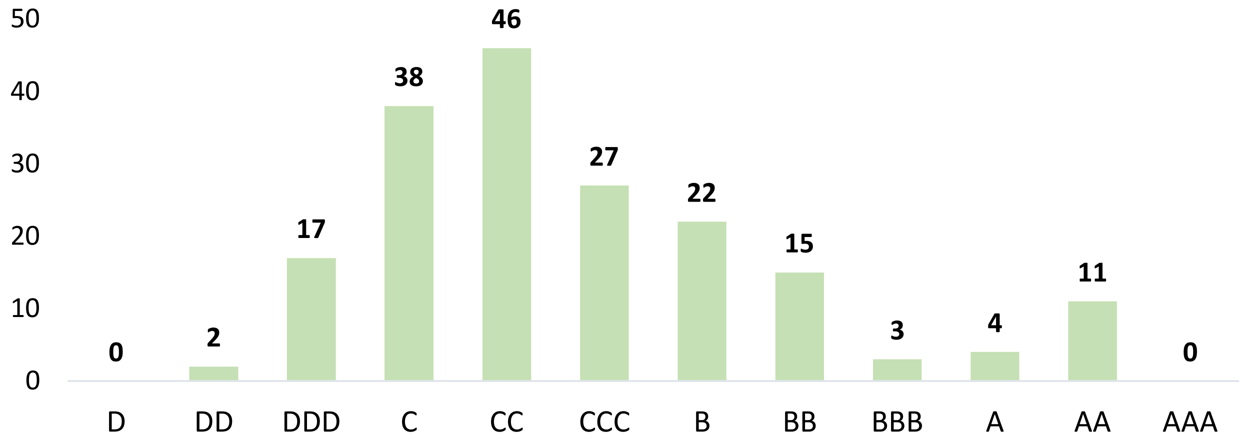
ESG , an acronym for Environmental, Social, and Governance, is a catch-all term for responsible investing and an evaluation standard for enterprises' non-financial sustainability performance (MioTech). The prioritization of ESG factors and their risk management can help an enterprise navigate a unique way for itself to achieve sustainable growth, which might not have immediate effects on corporate performance, but in the long term can make the enterprise more resilient to various types of sustainability risks.

As Wongtrakool, Borowske, and Vallespir (2020) have said in a report, the traditional automobile sector experienced something of a boom between 2009 and 2017, when the effects of the global financial crisis faded and soaring consumer demands boosted their profitability. However, in the wake of the environmental impact caused by economic activities as noted during the 2015 United Nations Climate Change Conference, known as COP 21, many governments signaled their ambitions to cut emissions. With road transportation accounting for about 15% of global carbon emissions, the automobile sector has to step up the marketing of EVs in alignment with the expectations of governments and societies. Apart from environmental pressures, vehicle manufacturers face extreme social pressure upon issues concerning product quality or customer service, even though some issues are caused not by carmakers by their suppliers or authorized service providers. And EV makers, whose rise is connected to a transition to a more sustainable society, are not subject to any fewer ESG risks. Indeed, they face added risks alongside those common to all carmakers.

For example, on 27 October 2020 , a Weltmeister EX5 car designed by WM Motors caught fire in Beijing following three similar cases that occurred elsewhere in the same month. The next day, WM Motors announced – both through the State Administration for Market Regulation and on its own social media channels – that it would recall 1,282 vehicles completed between 8 June and 23 September 23 over contaminated battery cells. The carmaker notified owners via its mobile app that the batteries would be replaced with other suppliers' and the company would offer reasonable compensation packages for the inconvenience caused. Although some considered the response to be insufficient, most thought it was an effective post-incident solution. WM Motors reported monthly sales of 3,003 vehicles in October 2020, up 42.5% month-over-month, and 3,018 vehicles in November. This incident illustrates how positive ESG management can help an electric carmaker.

However, to turn around negative public opinion and restore reputations are not the only roles of ESG management. In a rising industry with many opportunities, appropriate ESG management strategy can enable a firm to resolve potential issues ahead of others in the market. According to MioTech, the current distribution of ESG ratings in the Chinese automotive sector is suboptimal: it does not follow typical distribution patterns (Figure 2.1) and that there are no top performers, i.e., those with an AAA rating in terms of ESG. In this section, we will look at underlying ESG issues commonly seen in the EV industry and how they can be resolved by integrating ESG management into a company's overall operations.

Figure 2.1 ESG Rating Distribution of the Chinese Automobile Sector

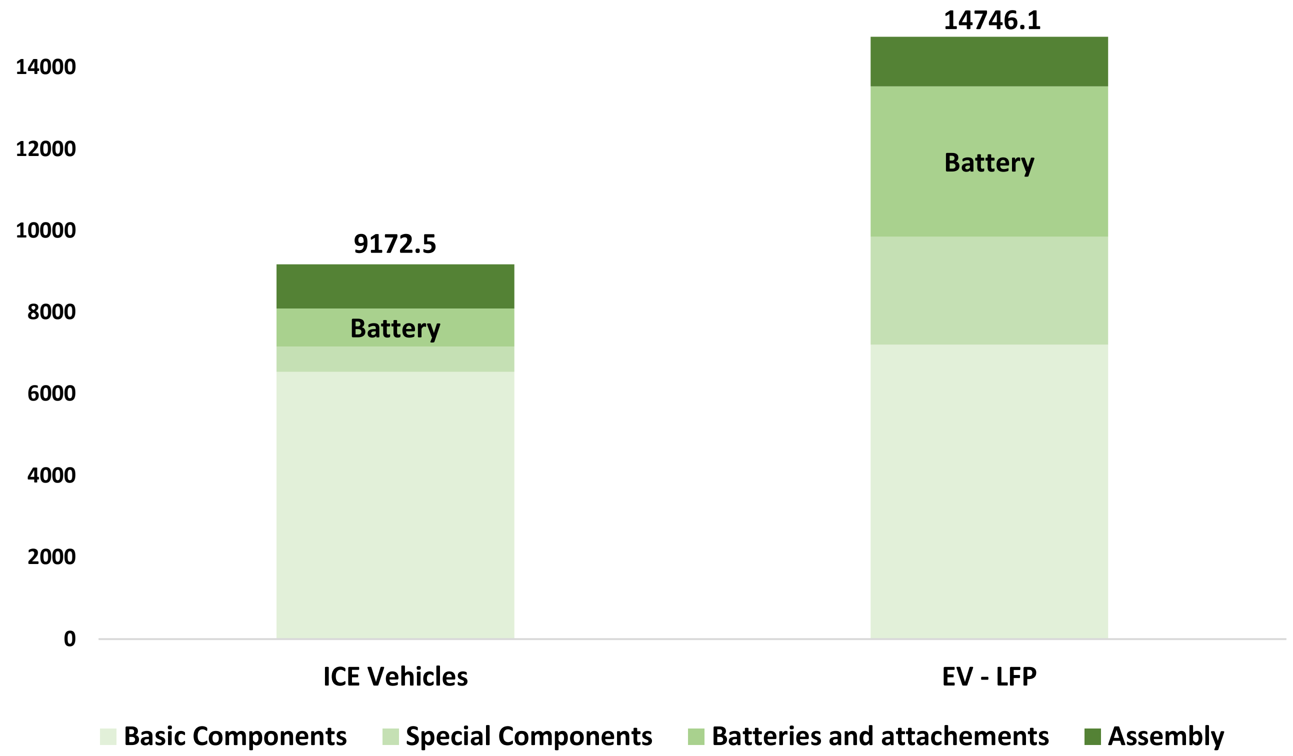


Source: MioTech Technology

Environmental: Emission and Recycling Remain the Topics

The green credentials of EVs have long been questioned, especially if emissions generated during manufacturing and charging are taken into consideration (Harrabin, 2020). Matousek (2019) contended that the carbon emissions from battery manufacturing outweighed those from producing the engine and transmission for an ICE vehicle, which might sway the fundamental basis of EV adoption. In May 2017, a research paper suggested, based on data collected in China, that to produce an EV could trigger an extra 5,000kg or 60% more carbon emissions, than an equivalent ICE vehicle (Qiao, Zhao, Liu, Jiang, & Hao, 2017), with the biggest disparity seen in battery manufacturing (Figure 2.2).

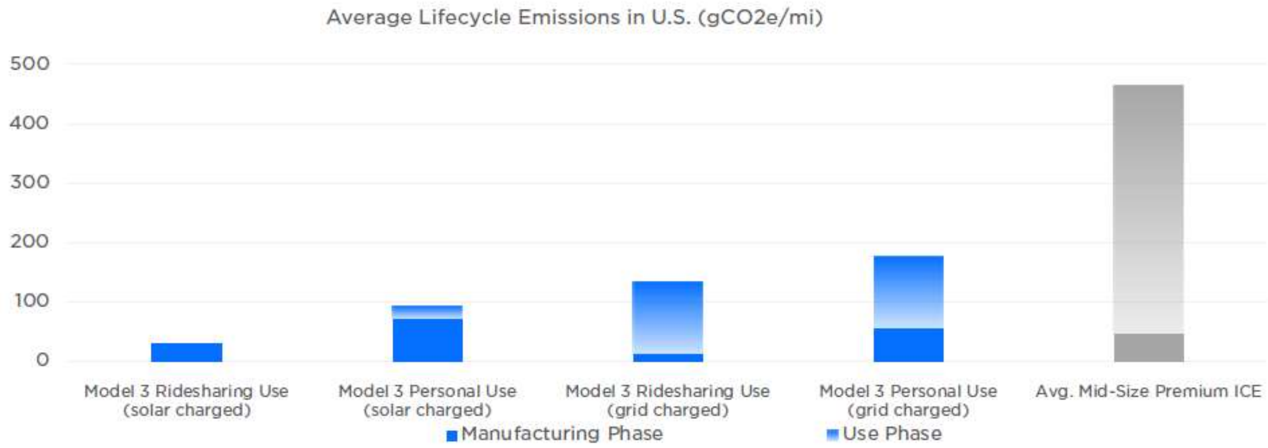
Figure 2.2 Carbon Emissions (kg) Per Vehicle Produced



Source: Qiao, Q., Zhao, F., Liu, Z., Jiang, S., & Hao, H. (2017). Comparative Study on Life Cycle CO2 Emissions from the Production of Electric and Conventional Vehicles in China

Tesla (2020) made a comparison of lifecycle emissions between its EVs and ICE vehicles in its 2019 sustainability report. The company revealed that for an average personal-use and grid-charged Model 3 vehicle in the US, the average emissions in the manufacturing phase were higher than average mid-size premium ICE vehicles (Figure 2.3), and for an average solar-charged Model 3 vehicle, the average emissions from the manufacturing phase were even higher – about 75g carbon dioxide emissions per mile.

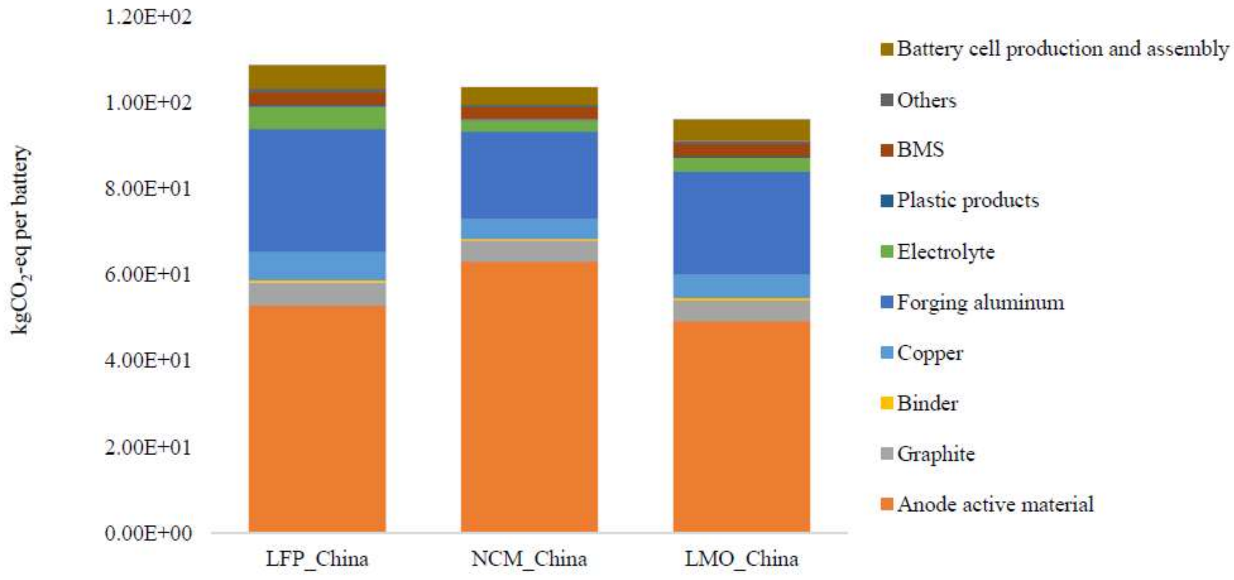
Figure 2.3 Average Lifecycle Emissions of Tesla Model 3 in the US



Source: Tesla Inc. (2020). Impact Report 2019

The manufacture of car batteries was linked to considerable amounts of carbon emissions. Hao, Mu, Jiang, Liu, and Zhao (2017) conducted mass research on batteries manufactured for the Chinese market – where lithium iron phosphate (LFP) and lithium nickel manganese cobalt oxide (NMC) batteries respectively accounted for 52% and 39% of the market in 2015 – and noted that they could produce 109kg and 104kg greenhouse gas (GHG) emissions per kWh of energy as of 2017 (Figure 2.4).

Figure 2.4 Comparisons of GHG Emissions of Manufacturing Vehicle-use Batteries in China

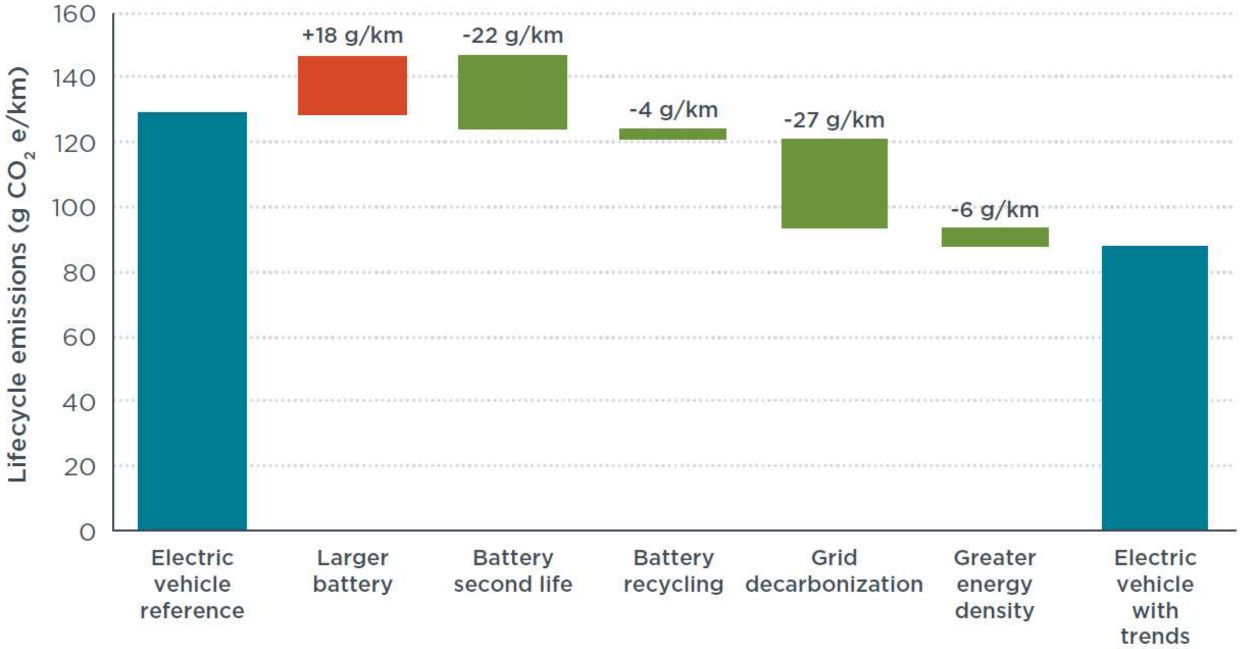


Source: Hao, H., Mu, Z., Jiang, S., Liu, Z., & Zhao, F. (2017). GHG Emissions from the production of lithium-ion batteries for electric vehicles in China

Research has also shone light on the other side of the end-of-life management of batteries. With individual consumers taking over from public transportation as the major EV market, there would be a sharp rise in the amounts of retired batteries. Currently, automakers are likely to offer a five- to -eight-year warranty on batteries (EDF, 2020), which corresponds to the estimate by China's Ministry of Industry and Information Technology (2019) that about 25GWh of batteries across the country would be retired in 2020. As battery cathodes contain heavy metals including nickel and cobalt, and the electrolyte contains toxic lithium hexafluorophosphate, inappropriate disposal of batteries will lead not only to a waste of metal resources but also potentially irreversible damage to the environment.

Two routes could be followed in the disposal of batteries, cascade utilization (or repurposing), and recycling. Cascade utilization refers to the adoption of out-of-use vehicle batteries in stationary storage to give them a "second life". A battery that is no longer suitable for vehicle use might still retain 80% of its initial capacity (Jiao, 2018), and EDF (2020) has said that an average electric car battery could last from 10 to 20 years before having to be replaced, leaving a possible 10-year life if used elsewhere. Given the current scale of the EV market, Engel, Hertzke, and Siccardo (2019) estimated that by 2030, used batteries should supply around 227GWh a year if some technological challenges could be overcome, surpassing the predicted demand of 183GWh. Hall and Lutsey (2018) added that through effective adoption of battery second life and recycling, accompanied by grid decarbonization and other feasible measures, the carbon emissions from manufacturing vehicle-use batteries could be reduced by 59g/km (Error! Reference source not found.).

Figure 2.5 Effect of Future Trends in Batteries on Carbon Emissions



Source: Hall, D., & Lutsey, N. (2018). Effects of battery manufacturing on electric vehicle life-cycle greenhouse gas emissions

As they are in direct contact with consumers, automakers should play a pivotal role in the effective disposal of vehicle batteries and they have the opportunity to generate extra revenues in this underdeveloped area. In October 2019, BYD, Japanese investment firm Itochu Corp and the Shenzhen-based battery recycling company, Shenzhen Pandpower, inked a deal to work together on repurposing of used EV batteries of (Ando, 2019), such as using them in solar power plants.

Hall and Lutsey (2018) found that the largest source of GHG emissions in battery production was the electricity used by the manufacturing plants. In the 2019 CSR Report, BYD (2020) claimed a year-on-year rise in the electricity use of 1.72% in 2019, while other types of energy saw a decline in the past year, particularly petrol, the use of which was down by 56.06% compared with 2018 (Table 2.1). This confirmed that the use of electricity is inevitable in vehicle manufacturing. Therefore, adopting greener approaches to power will bring significant reductions for the manufacturing of batteries and thus EVs.

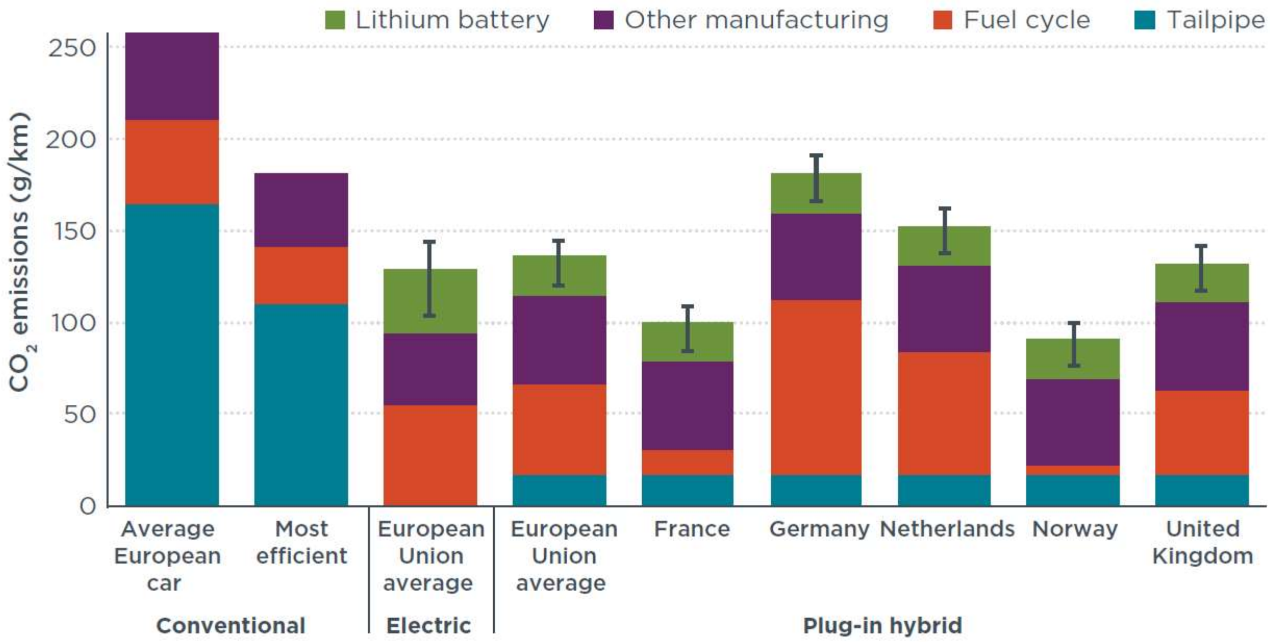
Table 2.1 Energy Use of BYD Company in 2018 and 2019

Energy	Metric	2018	2019	Increment
Electricity	0,000KWh	393,927.9	400,686.21	1.72%
Water	0,000Sq-Km	3,184.8	2,819.11	-11.48%
Gas	0,000Sq-Km	9,662	9,042.09	-6.42%
Petrol	0,000L	204.9	90.03	-56.06%
Diesel	0,000L	31.8	26.49	-16.56%

Source: BYD Company. (2020). 2019 BYD CSR Report.

Akio Toyoda, president of the Toyota Motor Corporation, has expressed concern that a switch to EVs would not necessarily reduce a country's carbon footprint – it was dependent on the country's power generation mix (Landers, 2020). He said that Japan could experience a rise in carbon emissions if the government attempted to eliminate gasoline-powered cars, because the country derived most of its electricity from natural gas and coal. However, in Europe where a larger share of electricity was generated from renewables and nuclear, even driving plug-in hybrid vehicles could reduce the average carbon emissions in the majority of circumstances (Figure 2.6). In China, researchers suggested that as in 2017, the average carbon emissions of an electric vehicle and a plug-in hybrid vehicle were 100g/km and 125g/km, while ICE vehicles averaged 157g/km, according to Wang and Shi (2018), who also estimated that the emissions in 2020 should be 81g/km, 104g/km and 115g/km respectively, as a result of wider adoption of renewable sources.

Figure 2.6 Comparison of Lifecycle Greenhouse Gas Emissions from Vehicles in Europe



Source: Hall, D., & Lutsey, N. (2018). Effects of battery manufacturing on electric vehicle life-cycle greenhouse gas emissions

Photovoltaic power generation, a way to convert solar light into electricity with semiconductor materials, is a potentially advantageous alternative. According to Tech to Deeptech (2019) published in the MIT Technology Review, there were more than 500 photovoltaic power plants in China in 2019, covering more than 2000 square kilometers (Figure 2.). In 2017, BAIC BJEV announced a 10-billion-yuan investment along with the launching of the “Optimus Prime Plan” which integrated photovoltaic power generation into the EV battery switching stations. In 2019, the company wrapped up its first photovoltaic power storage project in Tibet, with a capacity of 10MW, as reported by Liu (2020).

Figure 2.7 Photovoltaic Power Plants in China

Source: Tech to Deeptech (2019)

Social: Unstable Batteries Invite Quality Issues

Supply chains, product quality, and technological innovation are three major social risk factors, casting a shadow over development and impeding customer trust in EVs. The public believes EV makers should be responsible for these incidents, even though in some cases they should be taken care of by suppliers or authorized partners. Therefore, prevention and correction of such incidents has become a key task (PRI Association, 2018). Given the relatively novel status of EVs, customers are likely to adopt EVs only if the product quality and service are guaranteed.

In September 2020, an AionS vehicle produced by GAC's electric vehicle arm reportedly caught fire while driving, marking the third such incident in four months (China Securities Journal, 2020). The AionS model is characterized by its longer range of 510km on a single charge, owing to the NCM811 battery made by CATL. This battery is one of the few long-range options for EVs due to its very high density. So far, the NCM811 has been installed in numerous models designed by NIO, Xpeng and BMW, among other marques. CATL has long had a dominant position as a supplier of EV batteries in the Chinese market. According to the data on monthly installations of batteries by supplier provided by GG-II (2020), CATL ranked first in installations, with a volume three times that of second-placed LG Chem (Table 2.2).

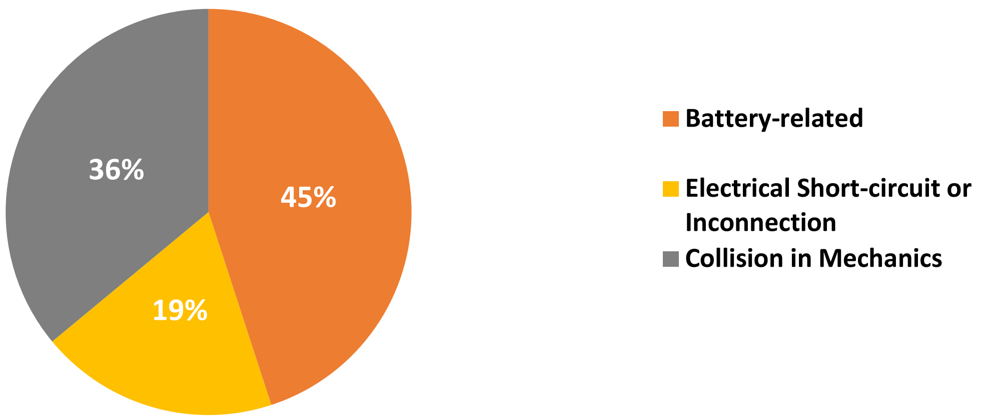
Table 2.2 Aug 2020 Battery Monthly Installations by Supplier

	Supplier	Aug 2020 Installations	Major EV Clients		
1	CATL	2,434,287	Geely	BMW	NIO
2	LG Chem	727,335	Tesla	Renault	Porsche
3	BYD	708,847	BYD	Dongfeng	Changan
4	CALB	271,608	GAC	Changan	Geely
5	Gotion High-Tech	186,306	(Mainly supplying Electric Bicycles)		
6	PHYLION	121,212	Wuling		
7	Farasis Energy	109,487	Benz	GAC	BAIC
8	EVE Battery	78,525	Benz	BMW	Hyundai
9	Lishen	53,105	JAC	Wuling	
10	DFD Chem	52,903	BYD		

Source: GG-II. (2020). GGII : August monthly installations topped 5GWh, changes seen in TOP 6-10, information on major EV client of each is retrieved from online news reports

A similar case also occurred with a battery made by LG Chem, the top supplier of EV batteries by global market share. In October 2020, there was mass media coverage of a total of 13 incidents involving Hyundai Motors' Kona EV. An investigation by the South Korean transportation agency found fault with the batteries supplied by LG Chem (Su, 2020). According to XUE (2020), battery-related issues have accounted for 45% of fire incidents on electric vehicles.

Figure 2.8 Causes of Fire in EVs



Source: XUE, M.-f. (2020). The Applications of the Security Technologies on NEV. Internal Combustion Engine and Parts

The regular occurrence of EV fires has motivated carmakers to better screen suppliers and establish a more diversified battery supply mix. For example, Mercedes-Benz, which has a supply deal with CATL, announced it would take a 3% stake in Farasis Energy, worth more than 100 million yuan (Jiemian, 2020). Beyond the mitigation of supply chain risks, having more suppliers can promote market competition as larger suppliers can take over smaller rivals and ultimately form an oligopoly. In some cases, an abundance of suppliers can enhance negotiating and pricing for upstream enterprises, as they have less of a dependence on each supplier. Notably, one of the things that set this year's subsidy policy apart from previous years' is that China's Ministry of Finance (2020) left the technical benchmarks unchanged, in contrast to previous years when it set higher battery density requirements. The government has also encouraged car manufacturers to pursue a better level of safety in their products.

Another area that is expected to be more ESG-aware in this industry is technical innovations. In the EV sector, manufacturers have tried to improve battery switching technology. As batteries age, their charge capacity shrinks, and the vehicle range shortens. Customers worry that they might need to purchase new batteries after about eight years of usage. On December 18, State Grid Electric Vehicle Service Co. announced that it would launch a state-level battery switching innovation in Suzhou. The national government has also backed battery switching as normally only EVs priced under RMB 300,000 can be granted subsidies, but those equipped with a battery switching option are not subject to this limit.

The battery switching technology offers an option other than charging. NIO offers its Battery as a Service (BaaS) initiative, under which customers rent instead of buy their car's batteries. For a standard range NIO ES8 featuring a 70kWh battery that costs RMB 450,000 in China with the bonus deducted, customers who opt for a BaaS edition can buy the car for RMB 380,000 and rent the battery for RMB 980 per month (NIO Inc, 2020).

However, battery switching has a checkered history. Founded in 2007 with the mission to "make batteries as convenient as gasoline", Better Place looked to create a network of battery switching stations where drivers can have their used batteries replaced with fully charged ones in 1-2 minutes. In preparing its business, Better Place obtained about USD 850 million in funding from Israel Group and other institutional investors, including HSBC Group and Morgan Stanley. The company reached a deal with Renault-Nissan under which the carmaker would produce 100,000 Renault Fluence Z.E. EVs tailored to the battery specifications of Better Place. Better Place launched its battery switching network in Tel Aviv, Israel, but the market response was disappointing. The company had spent about USD 500,000 on each switching station but accumulated just 750 registered customers. The company went bankrupt in 2013 owing more than USD 500 million (Gunther, 2013) . Tesla launched a battery switching initiative in 2013 but it also attracted little interest among car owners (Tesla, 2013; Zhang, 2015).

Seven years after the failure of Better Place, the global EV market has evolved considerably. The price of a standard-version Renault Fluence Z.E at that time, according to a review by Burt (2012), was GBP 22,195, and its range was claimed to be 115 miles. In 2020, a GBP 26,995 MG Motor 5 EV can support 214 miles of driving on one charge. Tesla (2020) also noted that the range of its Model S vehicles had increased from 265 miles in 2012 to 391 miles in 2019. In 2013, global EV stock was 220,000 units and in 2019 it was 4.79 million (International Energy Agency, 2020a). Better Place would probably experience something different if had started up now. But in the long term, it is not certain whether the demand for this technology will flatten as cars feature longer ranges. Besides the costs, another factor that complicates the deployment of battery switching is the lack of standardized batteries (Avci, Girotra, & Netessine, 2015). Each station can only support a certain fraction of the fleet if this issue persists. Battery switching would be a more attractive choice once it is more widely accepted and battery standards are coordinated as it would result in lower costs and shorter switching times.

Governance: Disclosure is Decisive

The primary issue of corporate governance examined in this paper is the board of directors and the members' prior experience, as a company has to be run in a manner that is both innovative and precise to stand out from the countless EV start-ups in China. As a result of the fundraising process, an EV start-up in China usually has a board consisting of both people from the automotive sector and those from technology firms or investment ventures (Table 2.3).

As an example, NIO has a five-member board of directors, three of whom – including the company founder – have experience in the automotive sector. However, their previous experience is in retail, rentals and other services, not manufacturing. That may explain why NIO has provided its products with various after-sales services like BaaS. However, as opposed to Xpeng or LI Auto, none of the five members of NIO's board are graduates of a science, technology, engineering and mathematics (STEM) education. Xpeng's board has a strengthened level of expertise among the three, with five out of nine members who studied courses such as automotive engineering or computer science. Also, Xpeng's president and senior vice president have worked for the development center of the vehicle manufacturer Guangzhou Automobile Group Co (GAC). They are the only two directors out of all three boards with both STEM education and automotive industry experience. LI Auto was founded by Xiang Li, who is also the founder of Autohome, a well-known online platform for buying and selling cars. Two other board members are also from Autohome. None of the others have work experience in the automotive industry. Ya'nan Shen, LI Auto's president, and Xing Wang, a director, have STEM educational backgrounds. Notably, Wang is the founder and chief executive of Meituan, a Chinese e-commerce platform, which is also an institutional investor in LI Auto. This paper has also gathered information on the boards of Tokyo-based Toyota and US-based General Motors (GM), and BYD, all with decades of history. In comparison, established automakers have more diverse boards, particularly GM, which has board members from seven different areas, including pharmacies and retail. GM also has the most balanced gender structure among board members with five men and six women. Toyota has one woman on a nine-member board, while BYD has appointed just one female director on its six-person board. Each of the three has three members with STEM education experience.

Table 2.3 Board of Directors: New-Generation and Established Carmakers

	Members	Background Structure	M	F	STEM Edu
NIO	5	Automobile: Bitauto (1), Chery (1), Yixin (1)	5	0	0
		Finance/Investment (1)			
		Technology (1)			
Xpeng	9	Automobile: GAC (1)	9	0	5
		Finance/Investment (4)			
		Technology/Internet (2)			
LI Auto	6	Automobile: Autohome (3)	6	0	2
		Technology/Internet (3)			
Toyota	9	Automobile: Toyota (5)	8	1	3
		Technology/Internet (1)			
		Banking (1)			
		Government (1)			
		Athletics (1)			
GM	11	Automobile: General Motors (2)	5	6	3
		Finance/Investment (1)			
		Technology/Internet (4)			
		Government (1)			
		Retail (1)			
		Pharmacy (1)			
		Higher Education (1)			
BYD	6	Automobile: China North Vehicle Research Institute (1)	5	1	3
		Finance/Investment (2)			
		Engineering (1)			
		Banking (1)			
		Higher Education (1)			

Source: Publicly available information

With more institutional investors claiming sustainability is important to their investment considerations, ESG disclosures are vital for listed companies. In the past few years, we have observed that more companies have started to disclose their non-financial performance metrics. About 90% of S&P 500 companies reported their performance in terms of sustainability in 2019 (Vodovoz, Robinson, & Sullivan, 2020) while in 2011 only 20% did. In China, 518 A-share companies made disclosures on ESG in 2011 but in 2019 about 1,000 companies did so(MioTech). In the automotive sector, BYD started an annual corporate social responsibility (CSR) report in 2010 and BAIC's electric vehicle arm, BAIC BluePark, has made its first CSR report in 2020.

However, the extent of disclosure across EV start-ups in China remains patchy: none have reported on their efforts on sustainability (Table 2.4), while NIO has not released such information in the two years after its IPO.

Table 2.4 Sustainability Disclosures of Some Electric Carmakers

	Tesla	BYD	BAIC BluePark
Country of Origin	United States	China	China
Ticker	TSLA	SZ002594	SH600733
Non-financial Disclosure	Impact Report	CSR Report	CSR Report
Start Year of Disclosure	2018	2010	2019
	NIO	**LI Auto**	**Xpeng**
Country of Origin	China	China	China
Ticker	NIO	LI	XPEV
Non-financial Disclosure	None	None	None
Start Year of Disclosure	None	None	None

Source: Publicly available information

Such disclosure reports are an important channel for companies to make their ESG efforts known to by investors and other stakeholders and improve their profile, while relying on media might be less helpful. Based on data provided by MioTech mass media appears more interested in negative events than positive ones. An example is the news reports on four of the most recent positive environmental events and negative safety incidents concerning BYD (Table 2.5). The most-covered positive event involved four media agencies with four news reports monitored while the most-covered negative event involved six media agencies with 11 news reports monitored. The average number of reports per event tells the same story: for positive events, the number of reports and the number of outlets is about the same, while negative events account for more reports than news agencies. Readers are more attracted to negative reports, but companies should do more to publicize how they are engaged in climate change mitigation, social well-being, and sound governance because shareholders and potential investors care about both positive and negative events.

Table 2.5 Media Coverage on BYD's Most Recent Four Positive and Negative ESG Event

Positive Environmental Event	Event 1	Event 2	Event 3	Event 4		
Number of Medias that Cover	1	4	3	1		
Number of Reports	1	4	3	1	Average	2.25
Safety Accident	Event 1	Event 2	Event 3	Event 4		
Number of Medias that Cover	1	2	6	1		
Number of Reports	1	3	11	1	Average	4

Source: MioTech Technology. ESG Risks – MioTech

Investments in EVs and Their ESG Characteristics

Quick Takeaways:

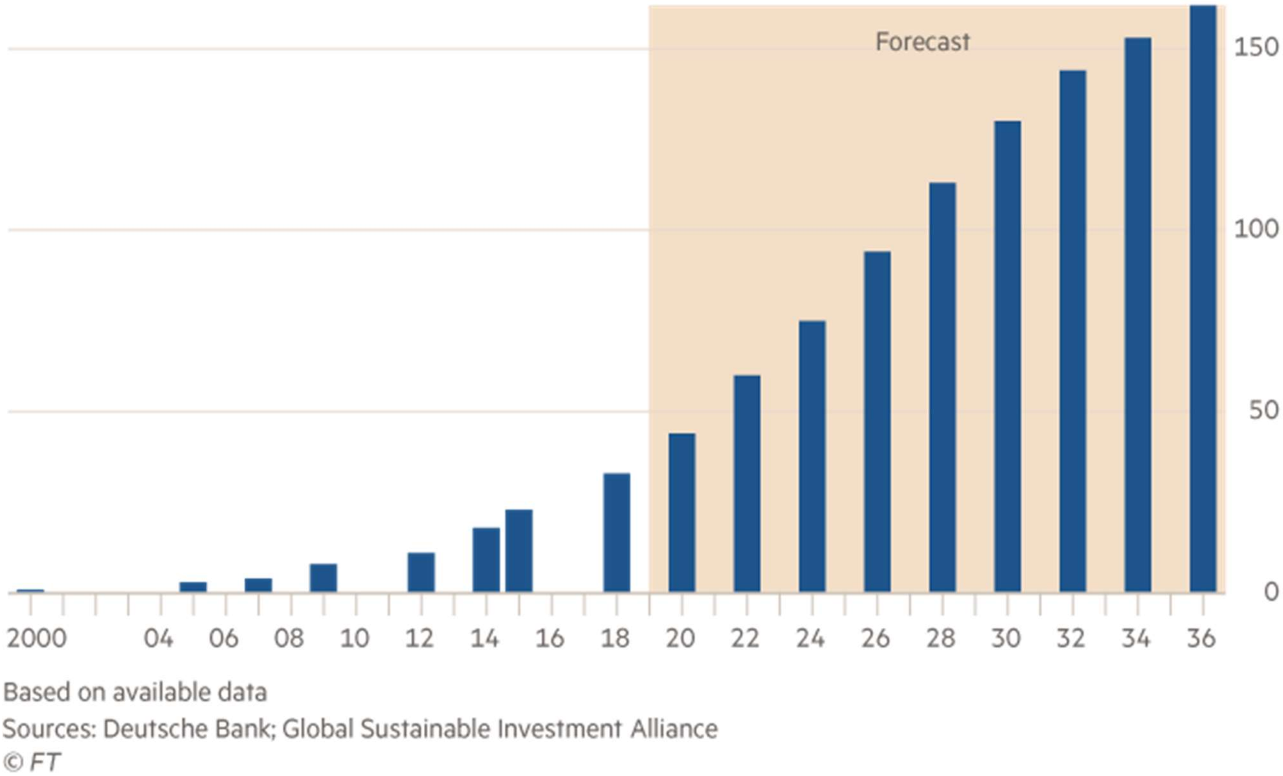
- Responsible investors play a dynamic role in investing in EVs both in the primary market and the secondary market, while other investors have also eyed the promising outlook of this industry.
- The rapid shift to clean energy has begun and electricity is a major part of energy consumption.
- EVs and their manufacturers are more open to other cutting-edge technologies, unlocking potentially high profits through the provision of value-added products and services.

Responsible Investors and Electric Vehicles: Secondary Market

On a global scale, according to Armstrong (2019), investments in ESG funds stood at around USD 40 trillion in 2019 and were expected to exceed 50 trillion in 2022 (Figure 3.1). With the task to decarbonize transportation, NEVs are an important aspect of potential new investment. In 2018, US fund manager Neuberger Berman – which has advocated that ESG factors are an important driver of long-term investment returns – launched its Next Generation Mobility Fund with the portfolio containing key enablers of autonomous driving, electrification and the

Internet of Vehicles (Neuberger Berman, 2020). Neuberger Berman said consumers' rising preference for EVs has the potential to double the sector's current USD 1 billion market value in the next decade.

Figure 3.1 Global Assets with an ESG Mandate



Source: Armstrong, R. (2019). Warren Buffett on why companies cannot be moral arbiters

Norges Bank Investment Management (NBIM), manager of Norway's Government Pension Fund Global, is another key pioneer in responsible investment, which since 2016 has sought to remove from its portfolio coal companies that derive more than 30% of their earnings from extracting thermal coal (Norges Bank Investment Management, 2016). Records show that NBIM has poured NOK 79.4 billion into environmental investments, out of the fund's total market value of around NOK 10.94 trillion (Norges Bank Investment Management, 2020). NBIM has taken an active role in investing in vehicle manufacturers (Table 3.1), including Tesla and BYD, loyal pursuers of electrification, with stakes of 0.45% in Tesla and 0.31% in BYD.

Table 3.1 NBIM's Holdings in the Largest Vehicle Manufacturers

	Year of Initial Investment	Initial Holdings (NOK, million)	2019 Holdings (NOK, million)	2019 Ownership
Tesla	2017	2,066	2,958	0.45%
Toyota	2002	1,235	20,795	1.02%
Volkswagen	1998	137	11,434	1.31%
BYD Company	2008	130	380	0.31%
Daimler	2007	4,080	6,755	1.30%

Source: Norges Bank Investment Management Official Site

The presence of ESG-aware investors in NIO, Xpeng, and LI Auto is also significant. The top 10 institutional investors of each of the three undertakings and whether they have manifested their integration of sustainability factors in their investments on official platforms, is shown in Table 3.2. It is seen that most of the investors in these companies have indicated their will to contribute to a sustainable society through financial means, especially in NIO, 19.97% of whose equity has been held by the eight responsible investors out of the 10 largest institutional investors. All 10 of the largest institutional investors of Tesla are ESG-aware, owning 26.25% of equity altogether, which explains why Tesla has recently given considerable attention to sustainability.

Table 3.2 Top 10 Institutional Investors behind Chinese Electric Carmakers and Tesla, and their ESG Vision

NIO

Institutional Holder	Stake	Shares (m)	ESG
Baillie Gifford and Company	8.43%	108.94	Yes
Blackrock Inc.	4.13%	53.33	Yes
Vanguard Group, Inc. (The)	2.63%	34.04	Yes
State Street Corporation	1.60%	20.63	Yes
Renaissance Technologies, LLC	1.08%	13.94	Unclear
Shaw D.E. & Co., Inc.	0.88%	11.41	Yes
JP Morgan Chase & Company	0.79%	10.21	Yes
RWC Asset Advisors (US) LLC	0.79%	10.15	Yes
Susquehanna International Group, LLP	0.75%	9.69	Unclear
Carmignac Gestion	0.72%	9.25	Yes
ESG Investors' Stake	19.97%		

Xpeng

Institutional Holder	Stake	Share (m)	ESG
Aspex Management (HK) Ltd	1.07%	10.38	Unclear
Capital World Investors	0.88%	8.52	Unclear
Alibaba Group Holding Ltd.	0.68%	6.65	Unclear
FMR, LLC	0.58%	5.68	Yes
Blackrock Inc.	0.54%	5.29	Yes
PRIMECAP Management Co.	0.44%	4.28	Unclear
Matthews International Capital Management	0.44%	4.23	Yes
Tairen Capital Ltd.	0.42%	4.06	Unclear
Carmignac Gestion	0.41%	3.96	Yes
JPMorgan Asset Management	0.38%	3.72	Yes
ESG Investors' Stake	2.36%		

LI Auto

Institutional Holder	Stake	Shares (m)	ESG
Credit Suisse	0.69%	173.74	Yes
UBS Asset Management Americas Inc	0.41%	103.69	Yes
Morgan Stanley	0.38%	95.90	Yes
Bank of America Corporation	0.32%	80.82	Yes
Jericho Capital Asset Management, LP	0.24%	60.89	Unclear
TB Alternative Assets Ltd.	0.19%	47.79	Unclear
Blackrock Inc.	0.18%	44.48	Yes
Light Street Capital Management, LLC	0.16%	40.94	Unclear
FMR, LLC	0.15%	37.48	Yes
BAMCO Inc.	0.14%	36.27	Yes
ESG Investors' Stake	2.29%		

Tesla

Institutional Holder	Stake	Share (m)	ESG
Capital World Investors	5.51%	52.25	Yes
Vanguard Group, Inc. (The)	4.57%	43.28	Yes
Blackrock Inc.	4.01%	38.02	Yes
Baillie Gifford and Company	3.66%	34.71	Yes
Jennison Associates LLC	1.98%	18.74	Yes
State Street Corporation	1.66%	15.75	Yes
FMR, LLC	1.65%	15.62	Yes
Goldman Sachs Group, Inc.	1.24%	11.79	Yes
JP Morgan Chase & Company	1.20%	11.34	Yes
BAMCO Inc.	0.77%	7.32	Yes
ESG Investors' Stake	26.25%		

Source: Nasdaq, Inc. Official Site and Institutional Investors' Official Sites

A variety of financial products with a sole focus on NEVs are available in China, managed by some prestigious institutions. Three funds by SWS MU Fund Management, Guotai Fund and Harvest Fund have delivered outstanding yields in 2020 (Table 3.3). Managers of NEV-focused funds prefer component manufacturers, particularly batteries, to vehicle manufacturers. All three funds have taken a stake in CATL, and two of them in EVE Battery. SWS MU Fund Management is keen on investing in battery manufacturing and has generated the greatest return in the past year. Guotai Fund, which has a greater exposure to carmakers, manages the second most profitable fund of the three. However, the most diversified portfolio managed by Harvest Fund is the least profitable of the three.

Table 3.3 NEV-focused Funds in China: Main Investees and Return as of 23 Dec 2020

	SWS MU NEV Hybrid (001156)	Guotai CNI NEV Index (160225)	Harvest Smart Car (002168)
Top 10 Holdings			
Battery			
CATL	8.91%	5.40%	7.77%
Desay Battery			7.72%
EVE Battery	8.49%	4.98%	
Farasis Energy	4.65%		
Ganfeng Lithium		4.23%	
Sunwoda		2.98%	
Equipment & Software Solution			
Lead Intelligent		2.77%	
Yusys			4.31%
Joyson			4.61%
Electrolyte			
Tianci	4.63%	2.73%	
CAPCHEM	5.71%		
Completed Vehicle			
BYD		7.23%	
Changan		3.14%	
SAIC		4.08%	
BMS			
Sanhua	6.50%		
Power Generation			
Tongwei			5.82%
Inovance		6.54%	
Longi	5.48%		6.06%

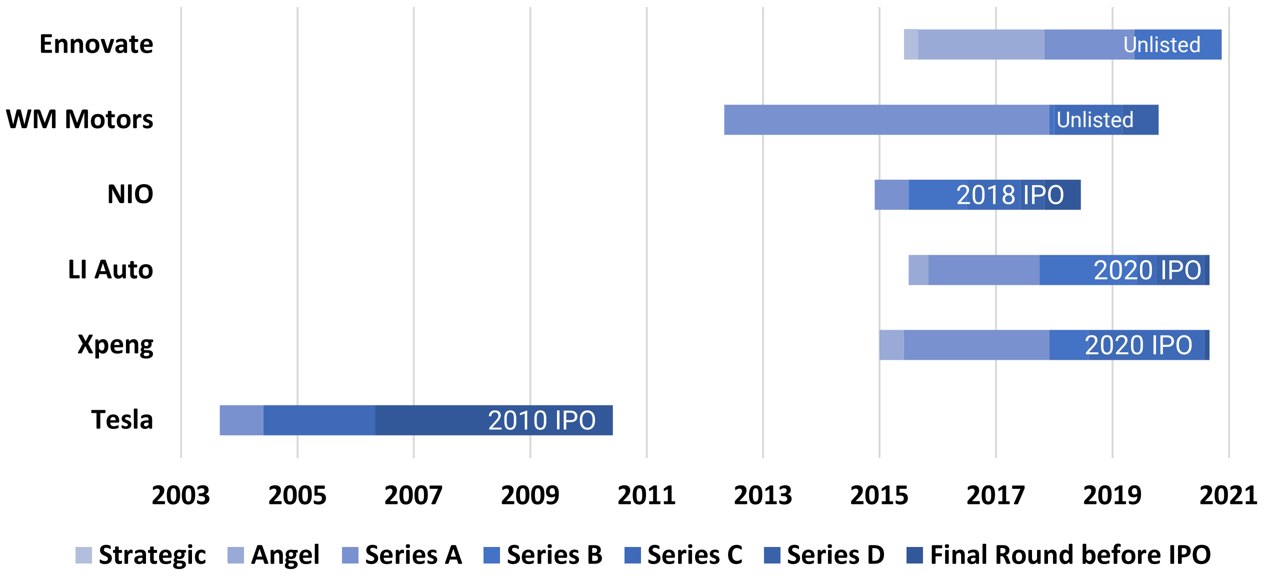
Other Battery Attachments			
Tuopu	5.66%		
Putailai	4.92%		6.18%
EASPRING	4.44%		
Dynanonic			5.04%
Kedali			4.25%
Accessories			
Xinquan			4.67%
Return TTM	**109.64%**	**92.48%**	**88.81%**

Source: Publicly available press releases

Responsible Investors and Electric Vehicles: Primary Market

Looking at the fundraising by several Chinese start-up EV manufacturers and Tesla, it can be seen that it took four to six years from the very first capital obtained (as a strategic investment or angel round) to a stock exchange debut. NIO was the quickest to finish the entire process, starting fundraising in 2014 and filing for an initial public offering (IPO) in 2018. In financing the business, NIO has obtained capital injections from Singapore-headquartered Temasek in series B+ funding, China Asset Management in series C funding, and one of its current major shareholders, Baillie Gifford, in series D funding. Temasek has a long history of embracing a sustainable investment philosophy, working towards net-zero carbon emissions from its investees by 2050 (Temasek, 2020), while China Asset Management is one of the few Chinese signatories of the United Nations-supported Principles for Responsible Investment (UNPRI) so far.

Figure 3.2 Fundraising of Major Chinese EV Start-ups and Tesla



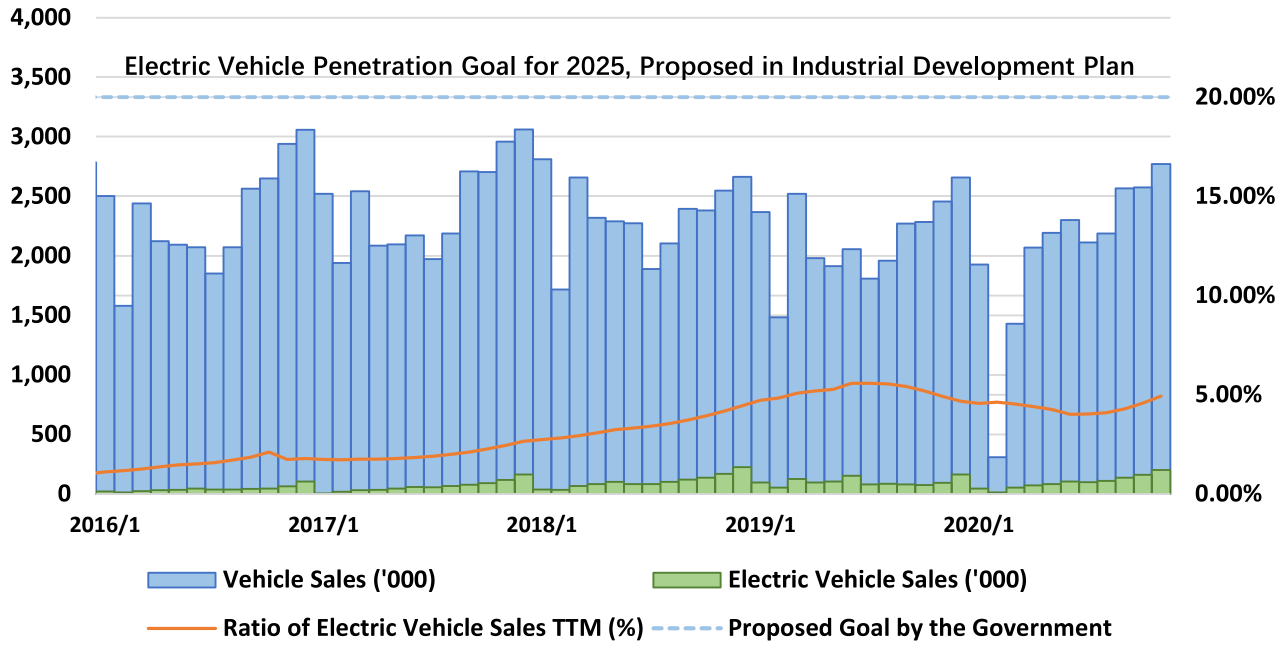
Source: Publicly available press releases, all the derivative rounds are not additionally marked in this figure, e.g., Series B+ is contained in Series B

Start-up EV makers can attract more sophisticated investors as funding progresses. WM Motors, which is planning an IPO, closed its first round of funding in 2016 with a USD 1 billion investment from Yuema Capital, a second-tier investment firm. Before its latest series D+ funding closed on 22 September 2020, in which SAIC Capital led the investment, it attracted funding from Baidu Capital, Sequoia Capital China and Tencent Investment. A similar tendency was also seen in Xpeng, which went public in August 2020. In its angel round in 2015, Xpeng raised tens of millions of yuan from a venture capital firm and an individual investor, but the investors' group widened in subsequent funding rounds, involving Alibaba, Foxconn and Hillhouse Capital, among others. In the last funding in 2020 before its IPO, Xpeng obtained investment from Qatar Investment Authority among others, with USD 500 million in total proceeds.

Is ESG the Reason Why Investors Have Eyed Electric Cars

Responsible investors might want to support EVs as part of their effort in tackling climate change, but it does not mean that investors are interested only in protecting the environment. Investors who do not put heavy emphasis on ESG have also been in contact with electric carmakers for their future growth. In 2008, Warren Buffett's Berkshire Hathaway purchased 225 million Hong Kong-traded shares of BYD at HKD 8 per share and has not reduced its holdings since (cnTechPost, 2020). As of 31 December 2020, the shares accounted for 8.25% of BYD's total equity. BYD's H-shares were worth HKD 198.40 as of the close of 23 December 2020, marking a roughly 25-fold value increase. BYD has been attracting consumers with its low-emission vehicles whose sales have been closing in on the company's fossil fuel vehicle sales, particularly in the past few months. BYD has led the post-pandemic recovery in the Chinese automotive sector, reporting a 40.72% year-on-year increase in revenue in the third quarter of 2020. Berkshire Hathaway has rarely expressed a sustainability-related view of investing. According to Armstrong (2019), Buffett has said that he invested in renewable energy because of the tax credits available. Without environmental objectives, electric cars might still look appealing to investors who anticipate nothing but the maximization of value, and who are inspired by Tesla's share price performance. One derivative of the data on vehicle sales in China from 2016 (Figure 3.3) provided by CEIC Data (2020a) is that electric cars have been accounting for a larger part of vehicle sales in China but the current proportion is still only about 5% of total sales. This is quite far from the 2025 target that 20% of new cars sold are EVs.

Figure 3.3 Electric Vehicle Sales and Sum Vehicle Sales in China since 2016



Source: CEIC Data. (2020). China Automobile: Sales

Currently, many of the new electric carmakers have not yet started making profits due to high R&D costs, but it is foreseeable that such costs will continue to decline. By then shareholders can also expect to receive cash flows. Several investors listed in Table 3.2 are UNPRI signatories, a public demonstration of an institution's commitment to responsible investment, as shown in Table 3.4. Among the 27 investors, 16 are UNPRI signatories, but these responsible investors have shown more interest in EV manufacturers. Many of the signatories have exposure to two or more carmakers, unlike the non-signatories, all of whom invest in just one enterprise. BlackRock has a stake in all four electric carmakers and J.P. Morgan has a stake in three of them, while the most favorable combination for these signatories is investing in both Tesla and NIO.

Table 3.4 UNPRI Signatories in the Secondary Market Investors

Name	Investee(s)	UNPRI Signatory	Note (Parent Company or Subsidiary of a Signatory)
Alibaba Group Holding Ltd.	Xpeng	No	
Aspex Management (HK) Ltd	Xpeng	No	
Capital World Investors	Xpeng	No	

Jericho Capital Asset Management, LP	LI Auto	No	
Light Street Capital Management, LLC	LI Auto	No	
PRIMECAP Management Co.	Xpeng	No	
Renaissance Technologies, LLC	NIO	No	
Shaw D.E. & Co., Inc.	NIO	No	
Susquehanna International Group, LLP	NIO	No	
Tairen Capital Ltd.	Xpeng	No	
TB Alternative Assets Ltd.	LI Auto	No	
Baillie Gifford and Company	NIO TESLA	Yes	
BAMCO Inc.	LI Auto TESLA	Yes	Baron Capital Group Inc.
Bank of America Corporation	LI Auto	Yes	Bank of America Global Wealth and Investment Management
Blackrock Inc.	NIO Xpeng LI Auto TESLA	Yes	
Carmignac Gestion	NIO Xpeng	Yes	
Credit Suisse	LI Auto	Yes	
FMR, LLC	Xpeng	Yes	Fidelity Investments
Goldman Sachs Group, Inc.	TESLA	Yes	Goldman Sachs Asset Management (GSAM)
Jennison Associates LLC	TESLA	Yes	
JP Morgan Chase & Company	NIO Xpeng TESLA	Yes	J.P. Morgan Asset Management
Matthews International Capital Management	Xpeng	Yes	Matthews International Capital Management (Matthews Asia)
Morgan Stanley	LI Auto	Yes	
RWC Asset Advisors (US) LLC	NIO	Yes	RWC Partners
State Street Corporation	NIO TESLA	Yes	State Street Global Advisors (SSGA)
UBS Asset Management Americas Inc	LI Auto	Yes	UBS Asset Management
Vanguard Group, Inc. (The)	NIO TESLA	Yes	

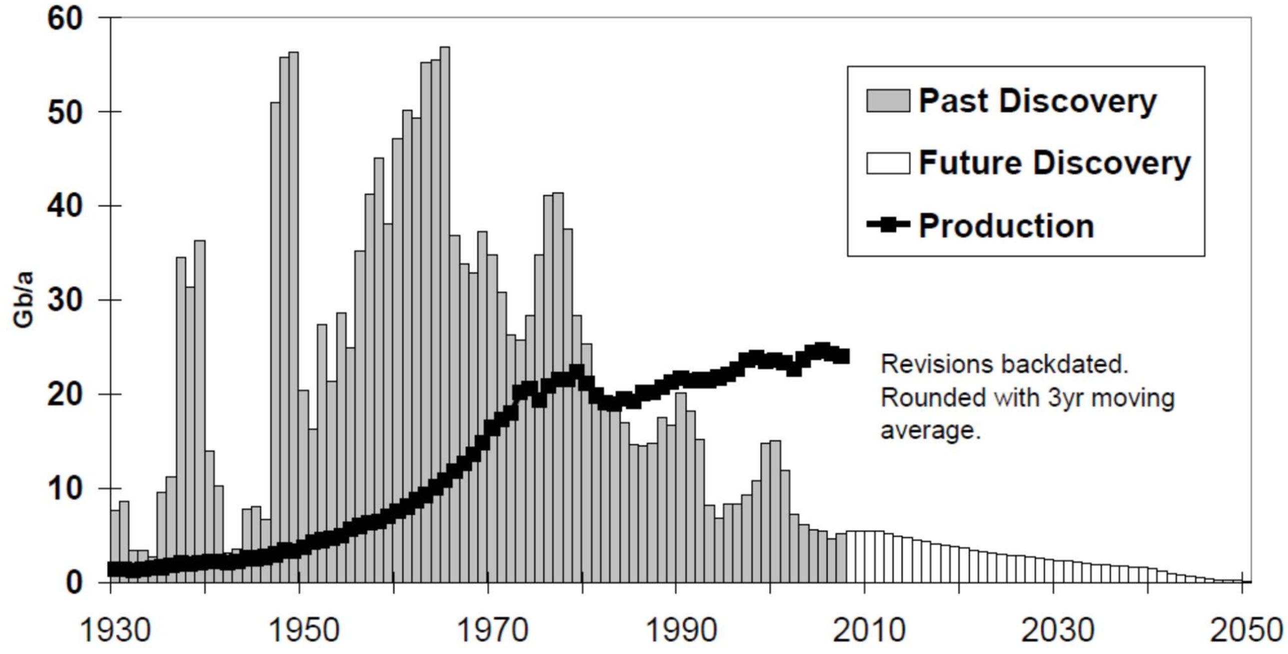
Source: United Nations' Principles for Responsible Investment Official Site

It is not obvious how much of an investor's initiative to invest in electric vehicles firms is derived from an awareness of ESG, given that 40% of those in the table are non-signatories to UNPRI. And despite its probable contribution to reducing emissions, to weigh the industry's environmental characteristics over other factors might not be optimal. What can be concluded, however, is that responsible investors have done their research on EVs and they are optimistic about the future of not just one company but the whole industry. Visiting this topic from the other side, to entirely phase out fossil-fuel energy in every sector is unrealistic and the migration to carbonless transportation should not direct ESG-aware investments out of established ICE vehicle manufacturers. Responsible investment requires an understanding not only of current performance but also knowledge of the drivers of the secular transition to a greener economy. Investors are not “responsible” because of their investments in companies such as Tesla or NIO, or companies producing renewable energy. The essence of being a responsible investor is to assist investees with the transition to a sustainable economy. With traditional carmakers stepping up the development of more electricity-powered models, funds are needed where they have encountered challenges, like Wright (2020) has pointed out that those with little experience in smart cars may not make progress in this competition because of shortcomings in areas such as software programming.

A Transformation in Energy

A provocative paper by Grantham (2011) reflected on how volatile oil prices since 1974, first surging from the long-standing position of about USD 16 a barrel (in 2020 dollars) to about USD 35 a barrel in January 1974 and peaking at almost USD 100 in 1980. However, the steady trend from 1974 to date is that oil production is in a growing deficit (Figure 3.4): that is, every year less oil is discovered and more is produced.

Figure 3.4 Oil Discovery and Production

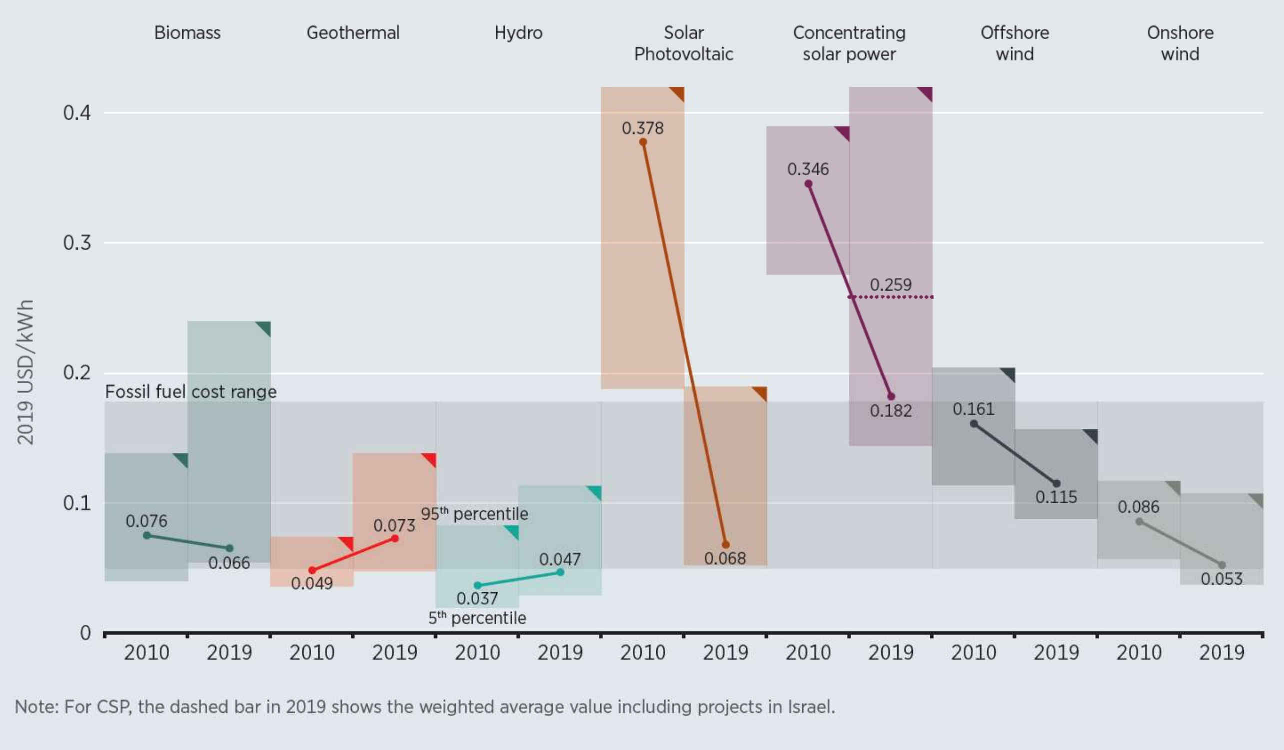


Source: Grantham, J. (2011). Time to Wake Up: Days of Abundant Resources and Falling Prices Are Over Forever

With the natural supply drying up and amid increasing price volatility, the market instinctively turned to renewables. White and Grantham (2019) posited that the equity index of wind and solar energy had a very similar movement, as coal and natural gas prices were relatively less expensive and more competitive when oil prices rose. Over time the investments in renewables have paid off and the industry has managed to reduce its costs to a fossil-fuel-comparable level. From 2010 to 2019, according to the International Renewable Energy Agency (2020), the global weighted average cost of power generated by solar power fell by 47.40%, and offshore wind and onshore wind respectively by 28.57% and 38.37% (Figure 3.5). Onshore wind cost less than the cheapest fossil fuels by 2019.

The cost of solar photovoltaic, which used to be the most expensive source of power generation at USD 0.378 per kWh, underwent a phenomenal reduction of 82.01% to USD 0.068 per kWh in the decade to 2019. In 2009, solar photovoltaic was four times more costly than fossil fuels, but in 2019 the weighted average cost of solar photovoltaic was only USD 0.002 higher than fossil fuels. Lower costs of modules and inverters explained 62% of this reduction, while cheaper other hardware contributed 10%, and less expensive installation accounted for another 13% (International Renewable Energy Agency, 2020).

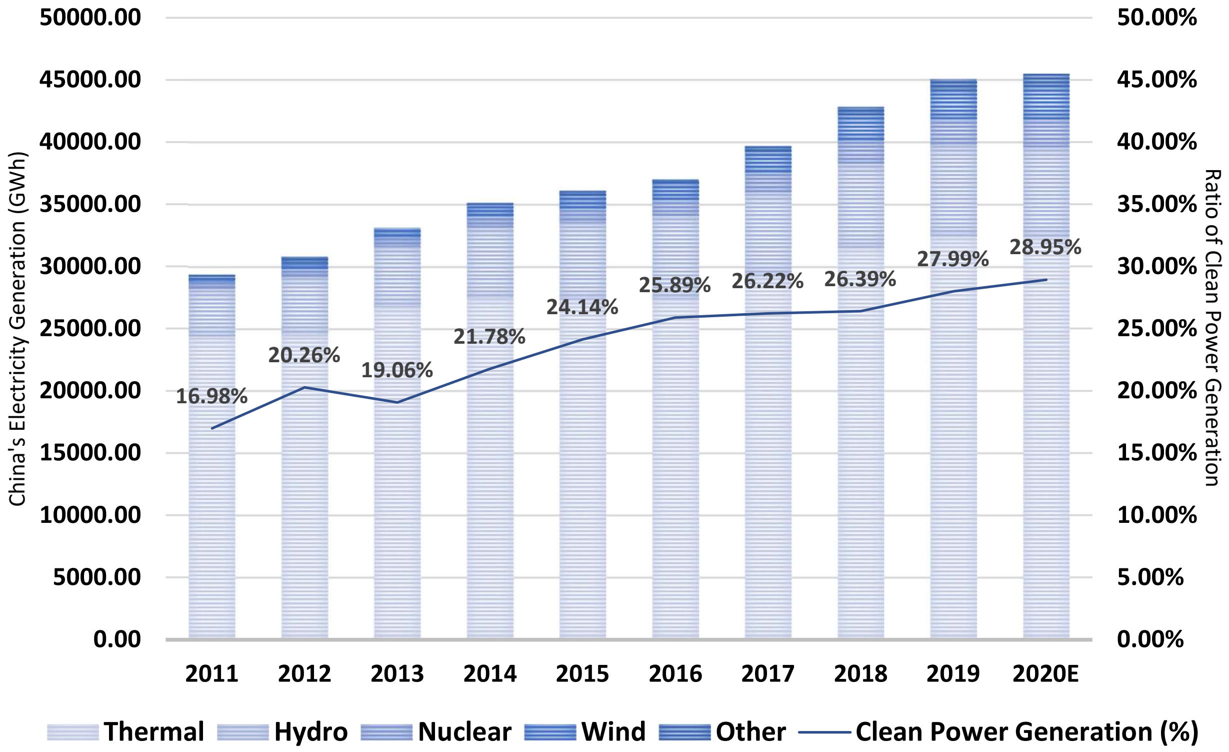
Figure 3.5 Power Generation Cost Comparison in 2010 and 2019



Source: International Renewable Energy Agency. (2020). Renewable Power Generation Costs in 2019

In China, the total system cost of solar photovoltaic was USD 794 per kW in 2019 – only India was more expensive in the sample. China has managed to cut down the average cost by 80% since 2010. Meanwhile, China has been reshaping its electricity generation mix. As seen in figures retrieved from CEIC Data (2020b), the proportion of electricity generated from clean sources has grown significantly since 2011 although high-carbon thermal electricity still has the biggest share. In 2019, 27.99% of the electricity was generated from clean sources and a higher proportion is conceivable in 2020 based on January-November data (Figure 3.6). On 22 September, President Xi Jinping announced at the UN General Assembly that China aimed to reach peak emissions by 2030 and carbon neutrality by 2060 in alignment with the Paris Agreement. He (2020) from ICCSD, Tsinghua University ,suggested that, to contain global temperature to less than 1.5 degree Celsius above pre-industrial levels, which is the goal of Xi's 2060 carbon neutrality deadline, China would need to form an energy system with net-zero carbon emission at least by 2050, where non-fossil fuel sources would be responsible for more than 90% of electricity generated and 85% of total energy demands. Consumers would be expected to derive 68% of their electricity source from non-fossil sources, up from 25%. The International Energy Agency (2020b) has suggested that under existing policies, projected global demand from EVs would be as seven times much in 2030 as today, reaching 551 TWh, with China accounting for 221 TWh of that total. The State Grid Corporation of China (2020) noted that by 2019, 430,000 charging stations have joined its intelligent Internet of Vehicles platform and delivered 14.82 GWh of electricity.

Figure 3.6 China's Electricity Generation Mix from 2011



Source: CEIC Data. (2020). China Electricity Production

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