BRIEFING

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Nine trends in the development of China's electric passenger car market

Prepared by Yidan Chu, Hongyang Cui, and Hui He

China formally kicked off its vehicle electrification journey over a decade ago when it released its first new energy vehicle (NEV) development plan in 2012.[1] The country has now produced and sold more NEVs than any other country or region and is a significant driving force behind the global transition to electric vehicles (EVs).[2] At the same time, China continues to face several challenges, including the need for more competitive native brands, supply chain security for raw materials and components for vehicle manufacturing, and the development of adequate charging infrastructure.

Using market data collected from many sources, this briefing identifies and summarizes nine major trends in China's EV market development since 2012.[3] The focus is on the major achievements and current challenges, and on battery electric and plug-in hybrid electric passenger cars, which are hereafter referred to collectively simply as "EVs." (Hydrogen fuel cell electric vehicles are not included because of their negligible share of the market compared with the other two types. Additionally, the trends are not presented in any particular order.)

TREND 1. EV PRODUCTION AND SALES ARE ROBUST, AND EXPORTS WERE WEAKER UNTIL RECENTLY.

Figure 1 shows the change in China's global share of EV production, EV registrations, and EV battery production. The dips in EV production and registrations in 2020 resulted from the COVID-19 pandemic, which caused many factories that make EVs, EV batteries, and other components to pause production for months; at the same

1 China State Council, "Energy-saving and New Energy Vehicle Development Plan (2012-2020)," (2012), http://www.gov.cn/zwgk/2012-07/09/content_2179032.htm. In China, "new energy vehicle" is an umbrella term that encompasses battery electric, plug-in hybrid electric, and hydrogen fuel cell electric vehicles.

2 Hongyang Cui and Dale Hall, "Annual Update on the Global Transition to Electric Vehicles: 2021," (ICCT: Washington, DC, 2022), https://theicct.org/publication/global-ev-update-2021-jun22/.

3 In global comparison sections, sales are taken from registration data from EV Volumes, export data included. For China-only analysis, unless otherwise specified, all data analyzed is insurance data of EVs produced in China. Some of the data analyzed only goes until 2019 or 2020.

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time, consumer demand for EVs was severely depressed.[4] Despite this, China did not fail to meet its target of cumulative production and sales of 5 million NEVs by 2020.[5] Meanwhile, Europe's EV market surged in 2020 and was a larger share of the global market than the previous year.[6] This surge was mainly attributable to the stricter light-duty vehicle CO_2 emission standards and large EV tax incentives that were added as part of COVID-19 economic recovery packages.[7]

Figure 1 shows that it was not until 2017 that China had a noticeable share of EV exports.[8] China's share in the global export market remained at around 2% from 2017 to 2019 and then reached 6% in 2020. Cumulatively, from 2012 to 2020, China's EV exports were just above 60,000 cars, which was 3% of the global total over that period. A limited international brand reputation and inadequate capacity to meet various quality standards in different countries were major barriers that hindered Chinese carmakers.[9]

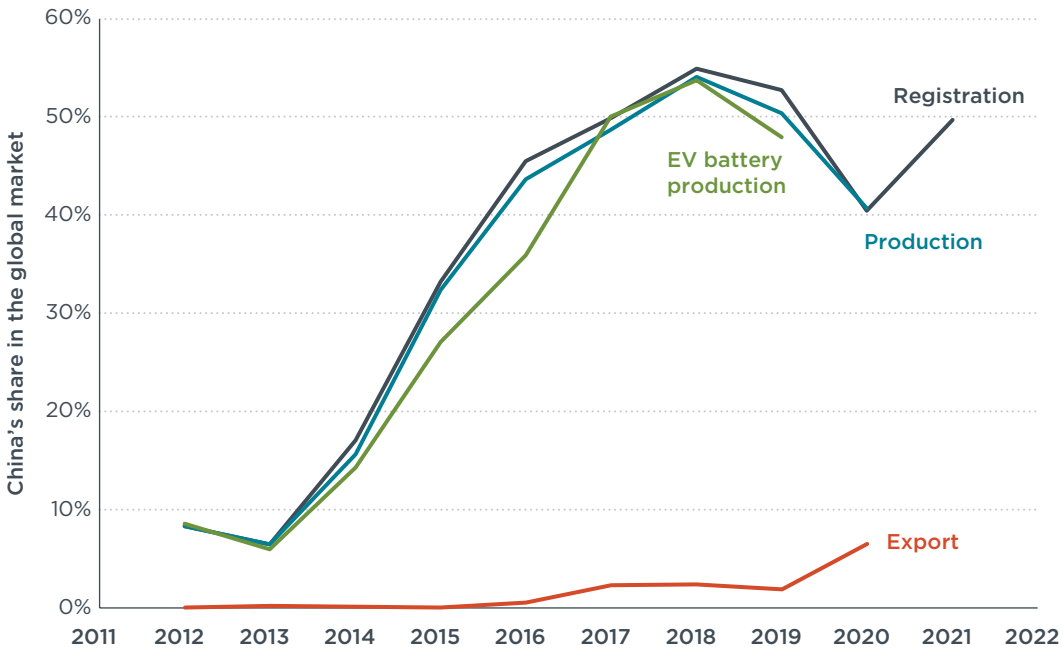

Figure 1. China's share of global electric passenger car production, sales, export, and EV battery production, all from EV Volumes for the periods for which the data have been analyzed by ICCT.

The recent growth in exports is the result of years of development during which many Chinese firms implemented international strategies and built innovation hubs and

4 Zhangyong Qin, "The Automobile Industry Under the Epidemic: China's Industrial Chain Catches a Cold, While the World's Automakers Sneeze," *Autodealer*, April 3, 2020, https://www.dongchedi.com/article/6811489485604258316?zt=default.

5 Yidan Chu, "China's New Energy Vehicle Industrial Development Plan for 2021 to 2035," (ICCT: Washington, DC, 2021), https://theicct.org/publication/chinas-new-energy-vehicle-industrial-development-plan-for-2021-to-2035/; Xinxin Zhang, "China's New Energy Vehicles are Gaining Momentum, with Three Consecutive Years' Annual Sales Exceeding One Million," *Xinhua News*, August 26, 2021, http://www.gov.cn/xinwen/2021-08/26/content_5633571.htm.

6 In this paper, Europe refers to the European Union Member States, the United Kingdom, and four European Free Trade Association countries: Iceland, Liechtenstein, Norway, and Switzerland.

7 European Environment Agency "CO_2 Performance of New Passenger Cars in Europe," September 26, 2022, https://www.eea.europa.eu/ims/co2-performance-of-new-passenger; The European Automobile Manufacturers' Association, "Overview – Electric Vehicles: Tax Benefits & Purchase Incentives in the European Union (2020)," July 9, 2020, https://www.acea.auto/fact/overview-electric-vehicles-tax-benefits-purchase-incentives-in-the-european-union/.

8 In this paper, exports are vehicles assembled outside of a country but then sold within that country.

9 Zheng Bin, "Chinese Electric Car Sales is Speeding up in Europe," *People's Daily*, February 24, 2021, http://finance.people.com.cn/n1/2021/0224/c1004-32035400.html.

factories outside China, especially in Europe.[10] Beyond the data analyzed in Figure 1, which only covers exports through 2020, data from the China Association of Automobile Manufacturers and China Passenger Car Association shows that China's EV exports increased significantly in 2021 and 2022, reaching 300,000 by the end of 2021 and then 499,000 by the end of October 2022. Still, over half of the exported EVs were non-native brands such as Tesla.[11] China's national government now encourages native EV producers to explore markets overseas and will support those enterprises in many ways, including by developing sound legal consulting, testing, and certification systems.[12]

TREND 2. CONSUMERS ARE MORE ACCEPTING OF NATIVE BRANDS.

Native brands now dominate the domestic EV market in China, but the same is not true for the domestic internal combustion engine (ICE) market. As shown in Figure 2, native Chinese brands had over 70% of the EV market in 2021, and eight out of the top 10 original equipment manufacturers (OEMs) by annual sales were native Chinese.[13] However, less than 40% of ICE passenger cars sold in the country in 2021 were made by native Chinese brands, and only four native Chinese OEMs were among the top 10 OEMs by annual sales.

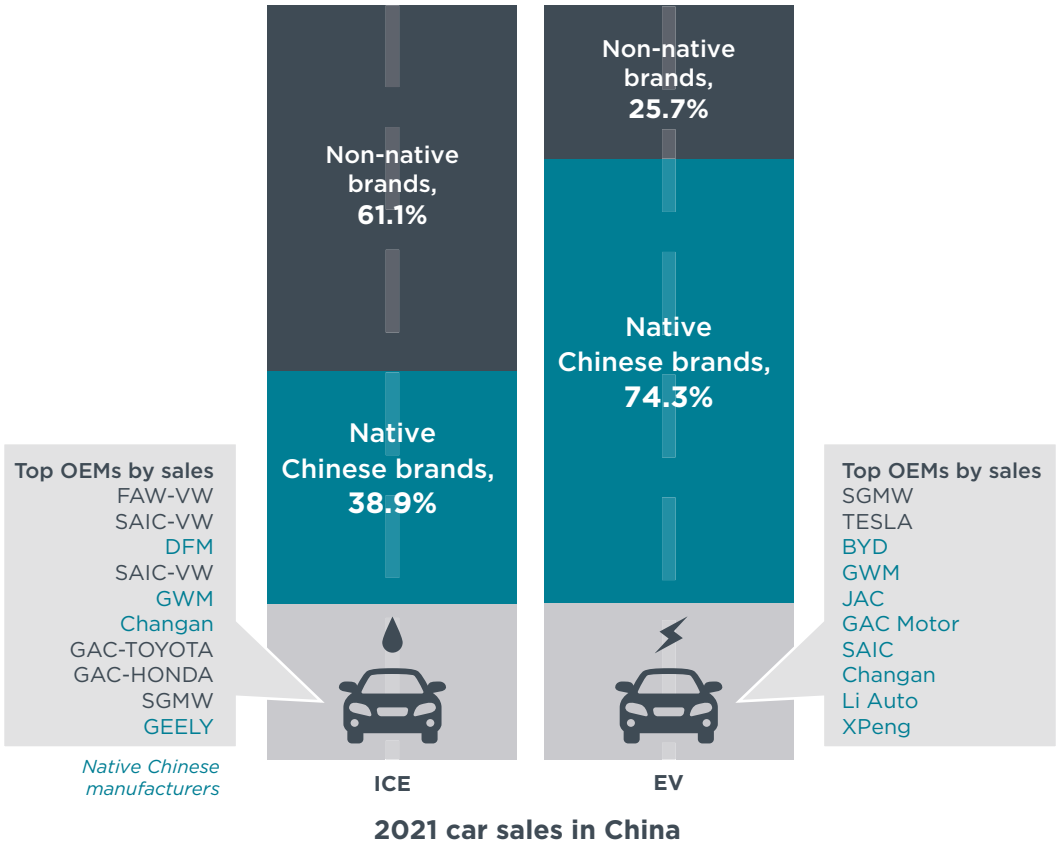

Figure 2. Brand origins of passenger cars sold in China and top 10 original equipment manufacturers (OEMs) by registration, 2021.

10 Gregor Sebastian, "In the Driver's Seat: China's Electric Vehicle Makers Target Europe," *MERICS*, September 1, 2021, https://merics.org/en/report/drivers-seat-chinas-electric-vehicle-makers-target-europe.

11 Zheng Liu, "Six Reasons Why China's Automobile Export Saw Breakthroughs," *Auto Review*, March 1, 2022, http://www.autoreview.com.cn/show_article-13197.html.

12 Chu, "China's New Energy Vehicle Industrial Development Plan for 2021 to 2035."

13 Brand information is from the China Association of Automobile Manufacturers.

TREND 3. POLICIES HAVE BEEN EFFECTIVE IN DRIVING TECHNOLOGICAL ADVANCES.

Over the years analyzed, the fleet-average electric range, battery capacity, and battery energy density of China's battery electric vehicles (BEVs) all increased while the fleet-average electricity consumption slightly decreased (Figure 3). This was accomplished through multiple policy efforts, including setting industry development targets, incorporating vehicle performance criteria into the requirements for purchase subsidies from the national government, and adopting an NEV credit management scheme that offered more credits for vehicles with superior technical performance. The fleet-average nominal range doubled from 2012 to 2021, and it reached 391 km in 2021. Battery capacity and energy density increased by around 60% during that period, and by 2021 these were 47 kWh and 141 Wh/kg, respectively.

From 2017 to 2021, the fleet-average electricity consumption of new BEVs registered in China dropped by a relatively modest 15%. Less policy emphasis was the key reason for this. China's energy consumption standard for EVs, GB/T 36980-2018, effective starting in 2019, was not mandatory and still is not. In addition, energy consumption was not incorporated into the national purchase subsidy program or as part of the NEV credit scheme until 2017. Note, too, that as China's fleet-average electricity consumption of new BEVs already reached 12.1 kWh/100 km in 2021, the goal of 12.0 kWh/100 km that was set for 2025 seems conservative.[14]

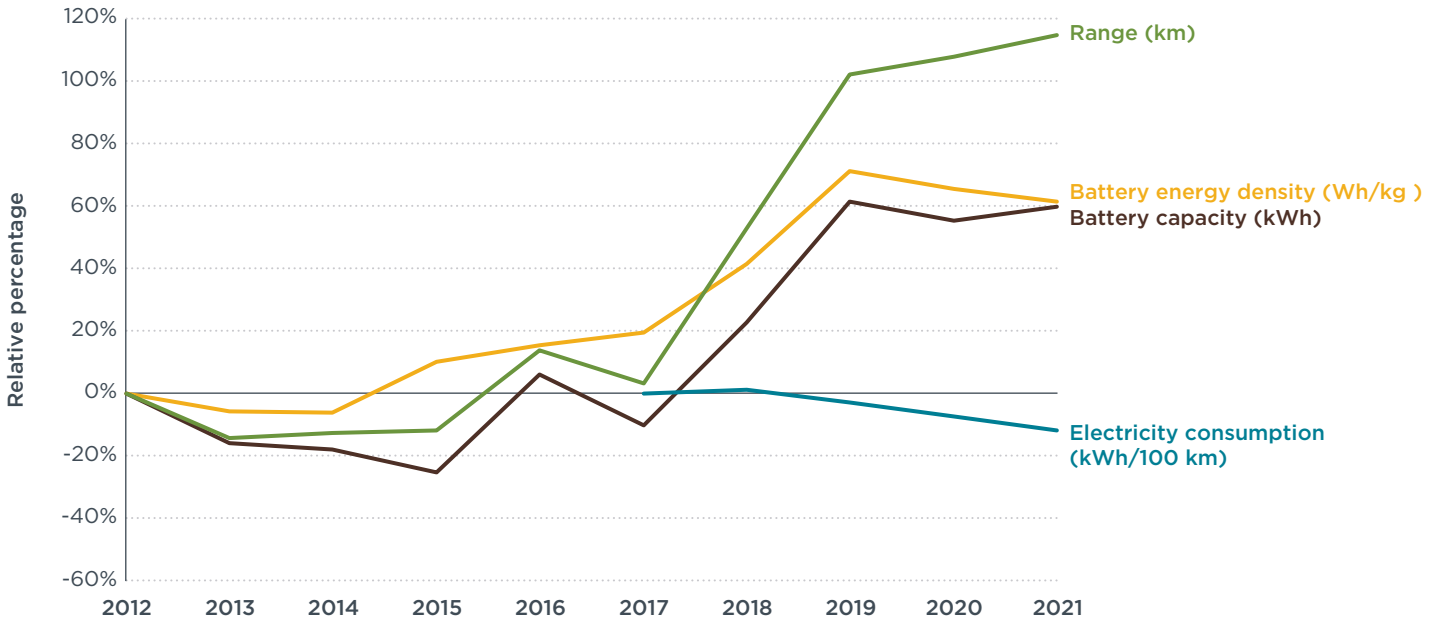

Figure 3. Fleet-average vehicle and battery performance indicators of battery electric vehicles registered, 2012–2021.

TREND 4. PURCHASE SUBSIDY IS NO LONGER A PRIMARY DRIVER OF THE EV MARKET.

China's national purchase subsidies used to be the crucial drivers of EV uptake, but this started to recede in 2019. Clear evidence of this is how EV manufacturers responded to the technical criteria for the electric range of their EV products to qualify for the national purchase subsidy program (Figure 4). The minimum electric range to qualify was gradually lifted from 80 km in 2013 to 300 km in 2020, and this is shown in the yellow dashed line in Figure 4. China also encouraged longer electric range products

14 Chu, "China's New Energy Vehicle Industrial Development Plan for 2021 to 2035."

by offering higher subsidies, and the limit for the highest level of subsidy granted was increased from 250 km in 2013 to 400 km beginning in 2018. Through 2018, the electric ranges of most EV models sold in China were between the two thresholds. However, starting in 2019, many BEVs registered broke the boundaries, and the number of registrations outside that range went up to nearly 80% of all new BEVs in 2021. This suggests that EV manufacturers were no longer designing their models solely from the perspective of obtaining subsidies and were instead responding to the diverse needs of consumers, some of whom prefer cost-effective models with less range and others of whom prefer more advanced models with better vehicle and battery performance.

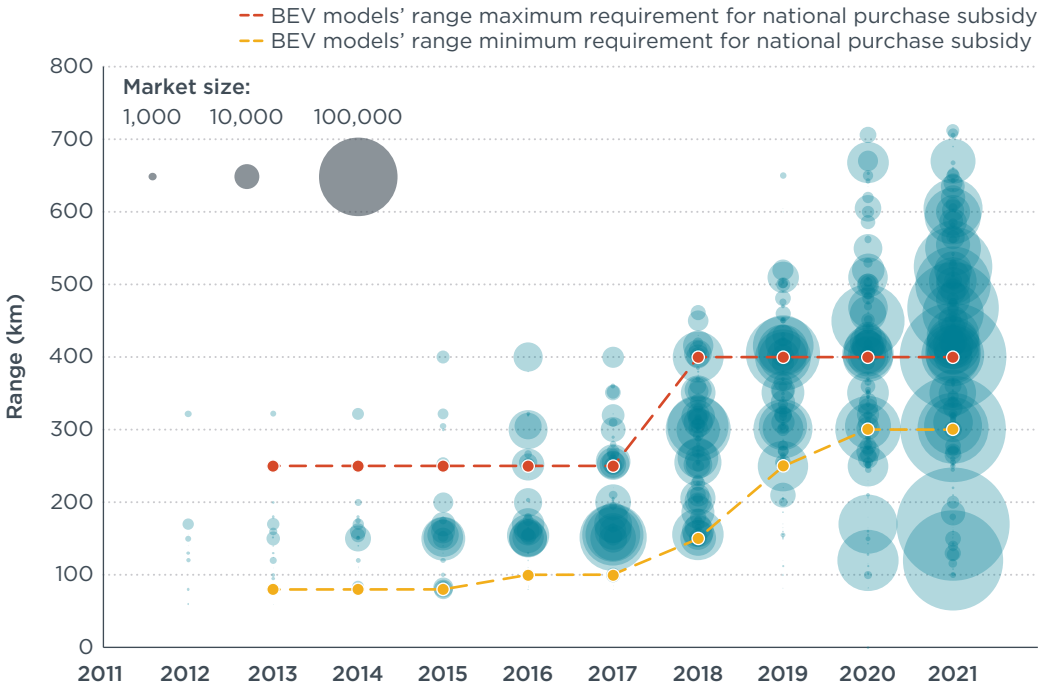

Figure 4. National purchase subsidy electric range benchmark and nominal electric ranges of battery electric cars registered, 2012–2021.

TREND 5. CHINA'S EV SALES SHARE HAS BEEN AMONG THE HIGHEST IN MAJOR MARKETS SINCE 2016.

Starting at 0.1% in 2012, China's EV sales share increased for 8 consecutive years and reached 14.5% by 2021. As shown in Figure 5, China was the world leader from 2016 to 2019 and was second only to Europe in 2020 and 2021. Subsequently, China's EV share soared to 25% for 2022 through the end of November.[15] Given the EV market performance in the last 2 years, China's NEV development target of about 20% annual sales share for 2025 is conservative.

15 He Wang, "2022 New Energy Vehicles: Increase and Differentiation in Market Penetration," *Xinhua Finance*, December 30, 2022, https://www.cnfin.com/yw-lb/detail/20221230/3777065_1.html.

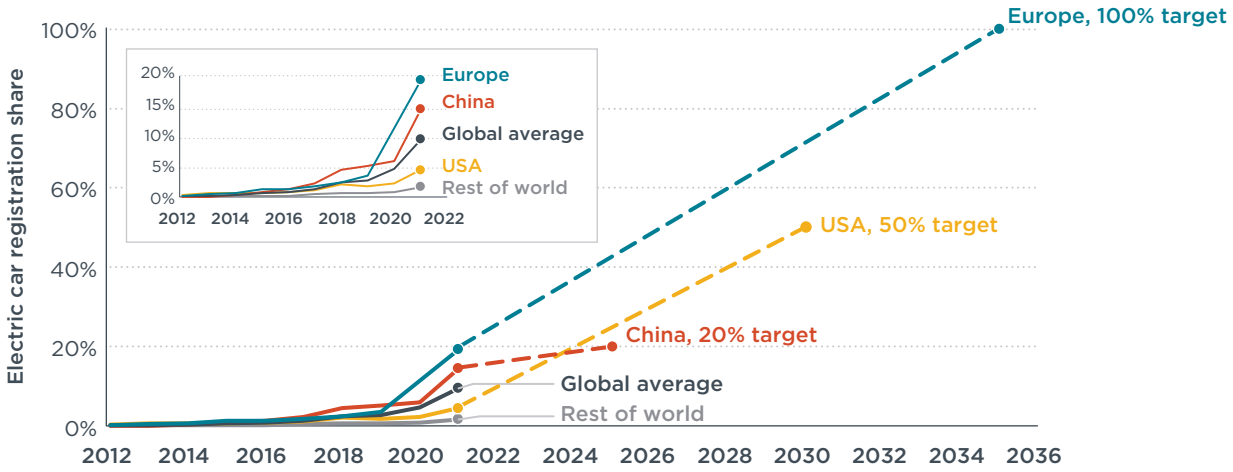

Figure 5. Electric passenger car registrations of China and global registration share, 2012–2021.

TREND 6. SALES OF NEW CARS IN THE MINI CAR SEGMENT ARE NOW ALL ELECTRIC.

China first achieved 100% electrification in segment A00, the mini car, in 2020 (Figure 6). The Wuling Hongguang mini EV was the best-selling EV model of this segment in China in 2021 and it alone was 13.5% of all EV car sales in the country that year. However, when considering all sales in the broader passenger car market in 2021, the A00 segment had a rather limited share, 4.1%. That is in stark contrast with segment A, the compact car, and the sport utility vehicle (SUV) segment, which together represented nearly 67% of the overall car market. As shown in Figure 6, only 13.2% of compact cars and 10.5% of SUVs sold in China were electric in 2021, and there is lots of room for further electrification.

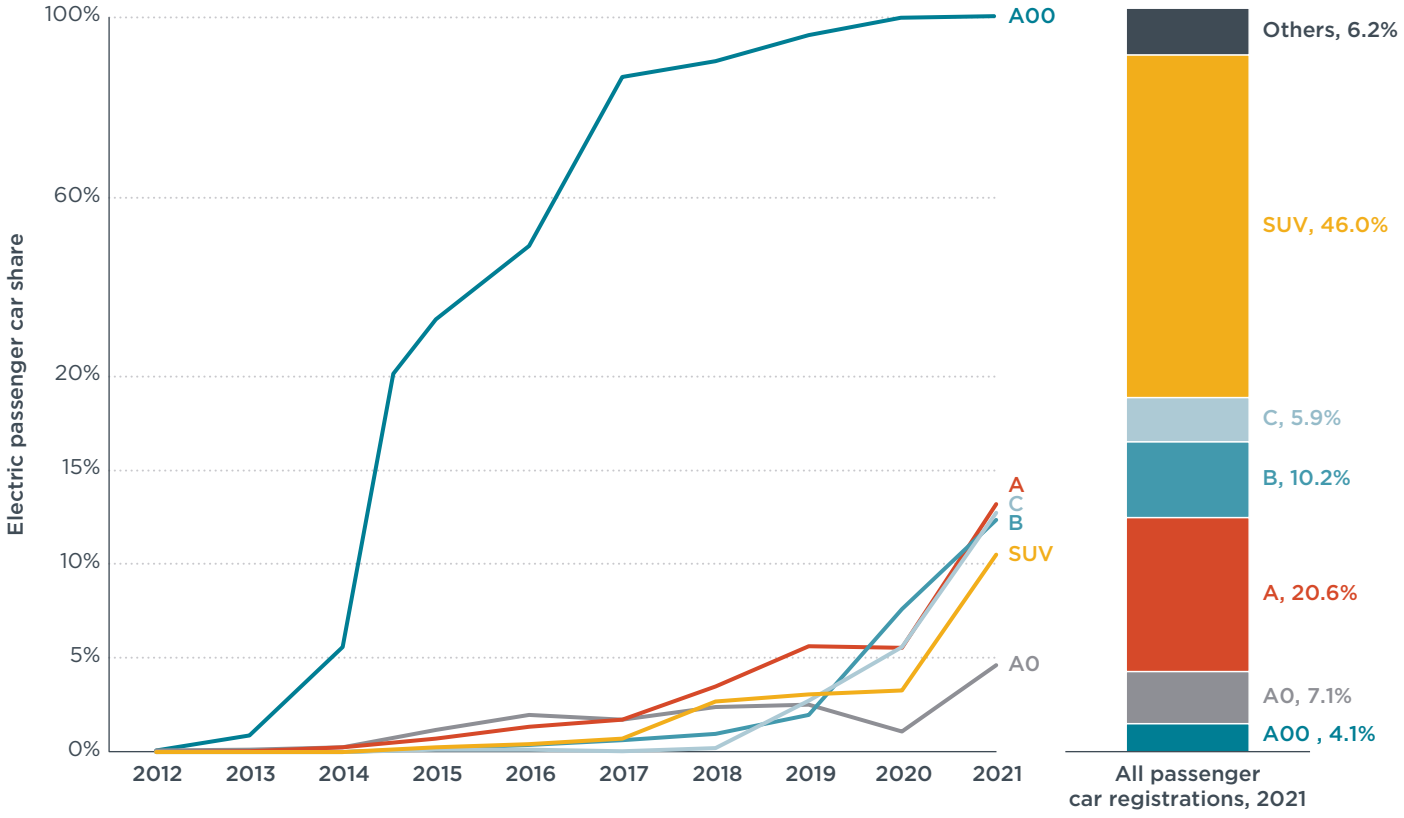

Figure 6. Share of new electric passenger car registrations by segment, 2012–2021.

TREND 7. CHINA HAS THE WORLD'S LARGEST CHARGING NETWORK, BUT THERE IS STILL WORK TO DO.

China has established the largest public and private EV charging infrastructure network in the world. By the end of 2021, China had deployed 1,147,000 public chargers, or nearly 65% of the world's total (Figure 7).[16] Among these public chargers, 41% were DC fast chargers, and that was the world's highest share of fast chargers. China also developed a private charging network of 1.47 million chargers by the end of 2021 and that ranked first globally.[17] However, there are still difficulties in installing private chargers in cases where parking space is limited or where there is limited support from property management companies in neighborhoods. Additionally, there are charging gaps in suburban and rural areas that cause concern for intercity travel and instances of insufficient facility maintenance and insufficient management of chargers by operators.[18]

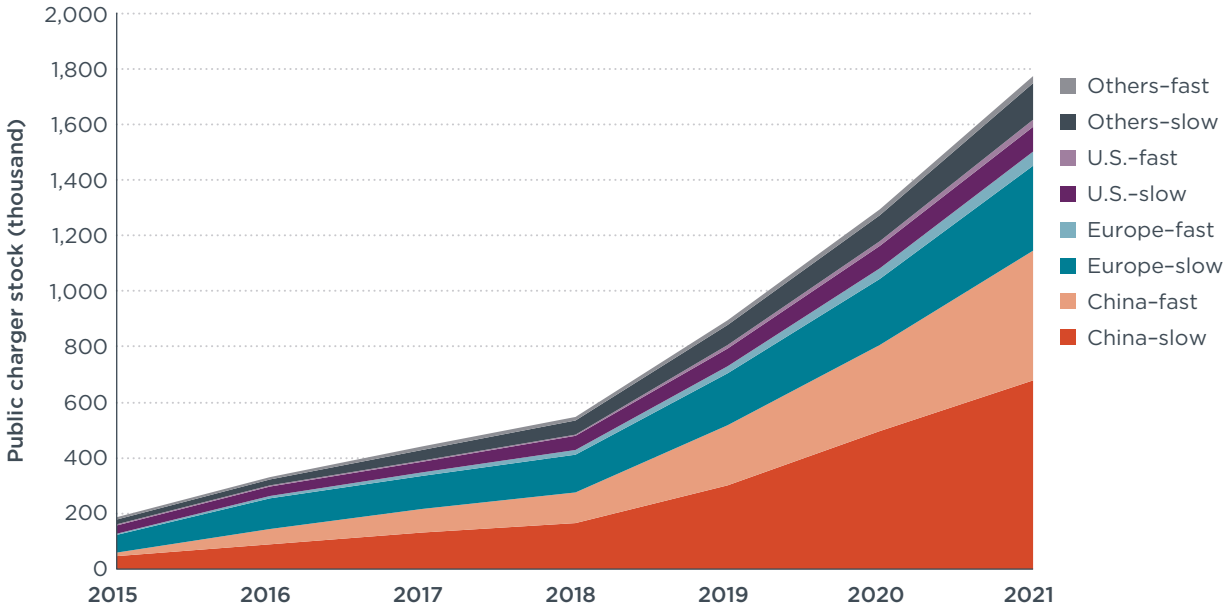

Figure 7. Installed public chargers by major markets, 2015–2021.

TREND 8. WHILE THE EV SUPPLY CHAIN IS NEARLY ALL DOMESTIC, SEMICONDUCTORS ARE THE EXCEPTION.

As shown in Figure 8, in 2021, 81% of batteries and 78% of electric motors for EVs sold in China were produced by Chinese manufacturers. In the medium and larger segments, which are mostly high-end cars, though, there was less self-sufficiency, with 49% for batteries and 47% for electric motors in 2021.

China has much less self-sufficiency when it comes to power semiconductors, especially insulated gate bipolar transistor (IGBT) power modules, which are an

16 "Data and Statistics," International Energy Agency, accessed December 20, 2022, https://www.iea.org/data-and-statistics/charts?q=charger.

17 China Electric Vehicle Charging Infrastructure Promotion Alliance, "Operation Status of the National Electric Vehicle Charging and Battery Swapping Infrastructure, 2021," January 12, 2022, https://mp.weixin.qq.com/s/Wkoo-0WdfnbX-0At4LyOxQ.

18 Ibid.; China Academy of Urban Planning and Design, "Annal Report on Electric Vehicle Charging Infrastructure in Major Chinese Cities," July 2021, https://tech.chinadaily.com.cn/a/202108/17/WS611b2c29a3101e7ce975efba.html; Zhongyang Yang, "EV Chargers Need to be Built and Managed," *China Economic Net*, October 7, 2022, http://finance.people.com.cn/n1/2022/1007/c1004-32540139.html.

advanced component of EVs that require sophisticated technology. Even after years of growth, less than 35% of IGBT modules used in EVs were made in China in 2021.[19]

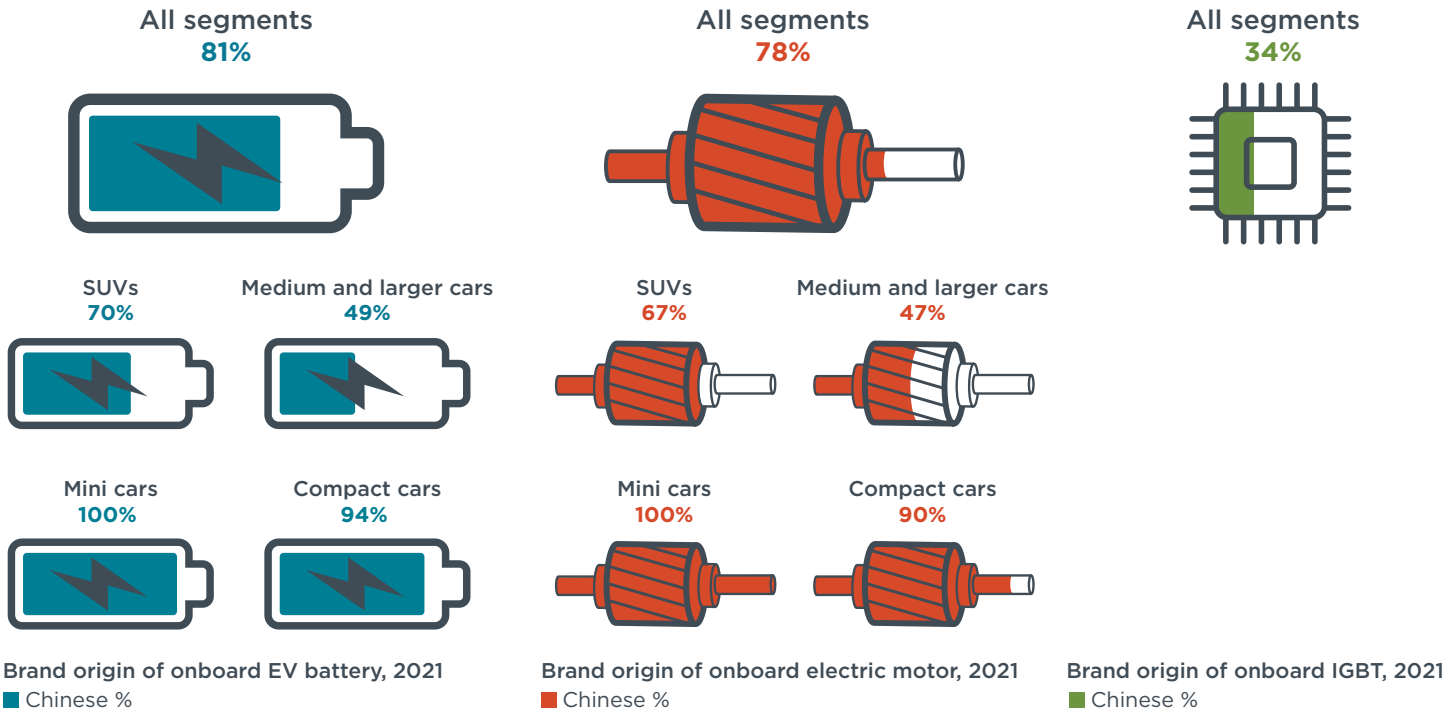

Figure 8. Brand origin of onboard batteries and electric motors of electric passenger cars sold in China in 2021.

TREND 9. GRAPHITE IS THE MOST SECURE OF THE RAW MATERIALS NEEDED FOR EV BATTERIES.

Five raw materials are vital to EV batteries—graphite, lithium, nickel, cobalt, and manganese—and China's graphite mining was 82% of all graphite mining in the world in 2021 (Figure 9).[20] This corresponds to China's massive graphite reserves, which were almost a quarter of the world's total in 2022. This contrasts sharply with the other four raw materials and is especially the case for cobalt; China's share of global cobalt mining was only 1% in 2021 and its share of reserves was only about 1% in 2022.

Despite limited control of the major raw materials for EV batteries, Chinese companies have become significant contributors to the world's raw materials processing and production of cathodes and anodes, which are upstream components of EV battery production.[21] This was accomplished through overseas investment and imports.

19 Sinolink Securities, "IGBT: New Energy Drives Growth and the Localization Rate Accelerates," May 12, 2022, https://pdf.dfcfw.com/pdf/H3_AP202205131565313770_1.pdf?1652454214000.pdf.

20 U.S. Geological Survey, "Mineral Commodity Summaries 2022," January 2022, https://www.usgs.gov/publications/mineral-commodity-summaries-2022. This paper also referenced the report series of years 2013 through 2021.

21 International Energy Agency, "Global EV Outlook 2022," May 2022, https://www.iea.org/reports/global-ev-outlook-2022.

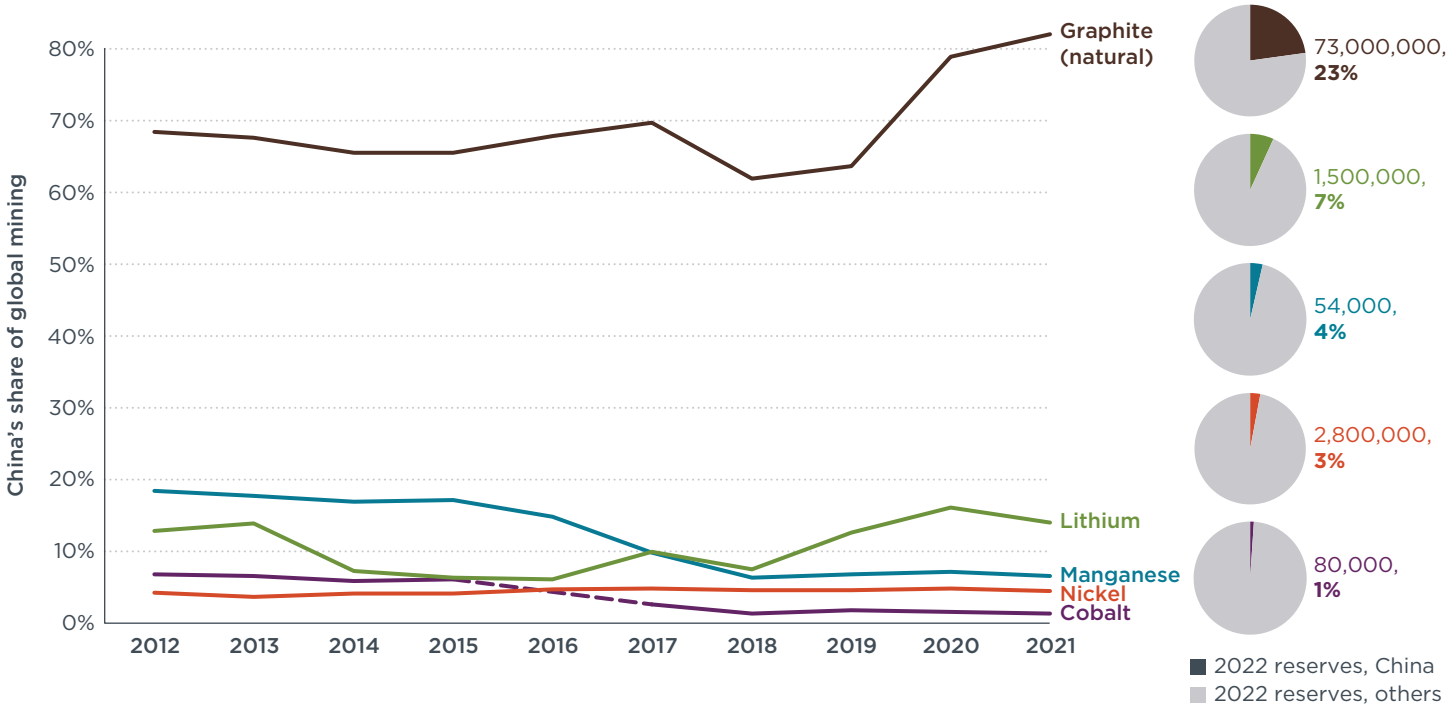

Figure 9. China's share of the global mining of battery raw materials from 2012 to 2021 and its share of the global reserves in 2022.

FINAL REMARKS

In the past decade, China became the world's biggest EV producer, EV consumer, and EV battery producer. Through continuous policy efforts, the country improved the fleet-average technical performance of new BEVs, including their range, battery capacity, and battery energy density. Nevertheless, there remain multiple challenges, including selling EV products made by native brands overseas, installing charging facilities and optimizing their operation, and addressing supply chain security and stability. We will continue to conduct research to assist smart policymaking that can support the transition to cleaner transportation.