

# A Comparison of Electric Vehicle Industry Policies Between China and The United States

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**Abstract.** Against the background of global vehicle market fluctuations, the annual sales of global electric vehicles continued to grow, showing a good development trend. In the global EV industry, China is the leader in the power battery supply chain, EV production, charger installation, etc. The U.S. is overall ranked third. After the background illustration and industry policy sorting, the paper illustrates the different top-level national EV industry strategy designs in China and the U.S., then compares the 2 countries' policies from the dimensions of fiscal policies, R&D policies (focusing on battery development), and supporting infrastructure construction. The analysis shows that in the development of batteries and the construction of supporting infrastructure (charger), compared with China's policies, the overall policy planning of the United States lacks coherence and central authority, and the development of its battery industry lacks the cooperation of enterprises under the leadership of the central government. The 2 countries have different preferences in fiscal and taxation policies, and the credit system represented by California Zero Emission Vehicle in the U.S. is more flexible and spontaneously guided than China's.

**Keywords:** Electric vehicles; battery; charger.

## 1. Introduction

As the main part of transportation, electric vehicles (EV) play a major role in the realization of energy transmission and emission reduction in various countries and the realization of global Net Zero Emission 2050 goal. Against the backdrop of a contracting global auto market, the electric vehicle industry saw another record high in sales in 2022. Three markets dominated global EV sales. In 2022, more than half of the EV in use worldwide are in China and the United States was the third largest EV market with the highest sales growth rate in the world. Although both are major developing countries of EVs, China far surpasses the United States in terms of sales volume, output. But not until 2015, the U.S. was the largest EV market followed by China. The aim of the passage is that by sorting out the two countries' policies and strategic objectives in the development history of the EV industry, comparing the different strategies and corresponding outcomes of the two countries in 3 dimensions: the government's financial support policies, the facility infrastructure support policies and research and development (R&D) policies (focusing on the key component, EV power battery). It's analyzed that the U.S. has advantages in financial supporting system for its innovative supply side credit system; China has advantages in infrastructure policies with long-term continuous employment and guiding in the charging system's technological breakthrough directions. Also, China's policies for the battery supply chain are effective with multi-year plannings and successful corporations-government collaborations.

## 2. Background

A vehicle can be defined as electric if it is self-contained with a battery or classified as a plug-in hybrid [1].

## 2.1. China

### 2.1.1 EV sales

In 2022, the sales of electric vehicles in China were: 4400000 cars, and 1500000 (PHEV, plugged-in hybrid EV) with a total 81% year-on-year growth rate [2]. China has the most extensive EV product portfolio with nearly 300 available models. The market share of BEV and PHEV was 13.3% [3].

### 2.1.2 EV Battery

In 2022, China accounted for 76% of global EV battery production capacity and ranks first in power battery output. China's EV battery production capacity in 2021 was 655 GWh [4]. China has built the world's strongest power battery industry ecology [6], it has dominance in raw material mining by domestic and overboard investments. China leads the refining process with high global supply share in midstream products, power battery manufacturing equipment, and battery swapping [5]. The country has the lowest price of batteries in the world.

### 2.1.3 Chargers

In 2022 there were 5.21 million charging points in China with a 50% year-on-year growth rate [6]. In 2019, China's share exceeded 50% of the global total.

### 2.1.4 Trade

In 2022, China represents over 35% of electric car exports, and its share of global battery manufacturing capacity was approximately 75%.

## 2.2. The U.S.

### 2.2.1 EV sales

In 2022, the sales of electric vehicles in the U.S. where: 800000 cars (BEV, Battery EV), and 190000 (PHEV, plugged-in hybrid EV), with a total 57% year-on-year growth rate. There were fewer than 100 models available.

### 2.2.2 EV battery

In 2022, American EV battery demand grew by around 80%. The country took up 7% of global EV battery production capacity, and its EV battery production capacity was 57 GWh in 2021 [7].

### 2.2.3 Chargers

In 2022 there were more than 136,500 public EV chargers in the U.S., in near 53,800 charging locations. There are more than six times as many public charging posts as recorded private charging posts.

### 2.2.4 Trade

U.S. global export share of electric vehicles peaks in 2019 and has been below that of China, South Korea and Europe since then [6].

## 2.3. Comparison

China's decade-long pilot and subsidy programs drove electric vehicle technology's fast-paced advancement. China's battery production and EV Sales outpace the U.S. a lot, but Chinese EVs' average battery capacity [8] and driving range [6] remain lower than the U.S. China's population density of charging stations is also higher than the U.S.

### 3. Policies

#### 3.1. China

##### 3.1.1 Top-level design

China pays attention to the long-term strategic layout of the electric vehicle industry [9], and various localities implement policies and measures according to the deployment of the central government. Chinese government has been laid emphasis on EV's R&D since the 8th 5-year-plan (1990-1995) by listing it in the national science and technology research planning. Then in the 10th 5-year-plan (2000-2005), "Plan 863", a major project for EVs was set up, and the industrial development pattern of "3 horizontals (powertrain, drive motor, power battery) and 3 verticals (BEVs, hybrid electric vehicles/HEVs, fuel cell electric vehicles/FCEVs)" was established. Since 2009, in order to cope with the global financial crisis, and to promote the auto industry upgrade with emission reduction, the "Ten Cities, Thousand Vehicles (TCTV)" project put in 100 HEV buses, developed 10 cities every year within 3 years, and launched 1,000 new energy vehicles (NEVs, EV included) for operations in each city's public and government fields as first promotions. TCTV project allowed NEVs to be developed first in the public domain, marking a new stage of development for the automobile industry. This stage also opened large-scale NEV purchase subsidies. In the "12th Five-Year (2010-2015)" National Strategic Emerging Industries Development Plan, NEV was set as one of the 7 national strategic emerging industries. In 2012, BEV was established as the main development direction (HEV in 2004). In 2016 and 2017 further requirements were put forward for the implementation of intelligent development, market-oriented development and supporting facilities. Proposed in 2020, NEVs will become the main products of China's automobile sales by 2035 according to NEV Industry Development Plan 2021-2035. By 2030, the share of new/clean energy-powered transportation will be around 40%. In 2023, a goal was put forward that by 2025 80% of new public sector vehicles will be EVs.

##### 3.1.2 R&D guiding and support

China's national policy support for EV is mainly to clarify the development direction and tasks of each stage, and to provide R&D subsidies. In 2001, the 863 Plan was launched, which incorporated hybrid, pure electric and battery fuel vehicles into the major scientific and technological projects of electric vehicles. It strongly promoted the early development of China's EV industry. In 2007, the Ministry of Industry and Information Technology pointed out that it would focus on research on hybrid technology. In 2009, the "Plan for the Adjustment and Revitalization of the Automobile Industry" stipulated that 20 billion yuan of funds would be arranged to support the technological transformation of enterprises in the way of loan interest subsidies. In 2011, the central government invested 738 million yuan in national funds for the major project of "Electric Vehicle Key Technology and System Integration (Phase I)". The "12th Five-Year Plan" National Strategic Emerging Industries Development Plan (2010) supports the full adoption of the "pure electric drive" technology transformation route. In 2015, it was revised that the scope of R&D activities applicable to the super deduction policy will be further relaxed from 2016, and the scope of research and development expenses will be expanded. In 2019, the requirements for the technical level of subsidized enterprises were raised to promote industrial technological progress. In 2020 and 2021, industrial technology development roadmaps have been released successively. As shown in Table 1, China's EV battery supply capacity ranked first in the world and the rapid development behind it is inseparable from the continuous support under the attention of the state:

**Table 1** China's EV Battery Development Key Policies

| China's EV Battery Development Policies   | Summary of Key Contents   |
|---|---|
| NEV Production Access Management Rules (2007)   | The development and manufacture of complete EVs, cells, and key battery materials such as electrocatalysts, electrodes, composite membranes, and bipolar plates have all been included in the scope of national encouragement with incentive policies.  |
| Energy Saving and New Energy Vehicle Industry Development Plan 2012 ~ 2020 (2012)                                 | Speed up the development of battery key materials and refining equipment, promote the large-scale battery production. Improve the R&D system with innovative enterprises as the main body, market-oriented, and "combining industry, academia, research and utilization". Encourage cross-industry resource sharing & global cooperation. Emphasis on patent establishment. |
| Financial Support (2012)  | A total of > 3-billion-yuan financial support was given to 25 selected projects.  |
| New Material Industry Development Guide (2016)  | Improve the relevant compliance standards of NCM and NCA materials in the EV field.   |
| Measures for the Management of Cascade Utilization of Traction Batteries for New Energy Vehicles (2020)           | A series of regulations and recycling incentives have been made for the cascade utilization of new energy vehicle power batteries. Strengthen battery life cycle supervision.   |
| 14th Five-Year Plan for the Development of the Raw Materials Industry 2021-2025 (2021)                            | Technological novelties in key materials: R&D for more environmentally friendly, productive mining methods and materials (Salt Lake lithium). "Urban mines" to support extensive lithium, nickel, cobalt, and tungsten recovery.  |
| Administrative measures for the re-use of NEV batteries (2021)  | Require companies to take responsibility for battery recycling, the quality and environmentally friendly disposal of reused batteries.  |
| Administrative Measures for the Announcement of Lithium-ion Battery Industry Standards (Draft for Comment) (2021) | Limit excessive production expansion in Lithium battery industry. Put forth technical specifications for minimum energy density (no less than 180 watthours per kg), recycling, and the promotion of solar power use throughout the production process.   |
| Photo credit: Original  |   |

### 3.1.3 Subsidies, tax credits and credit system

In 2009, the "Interim Measures for the Management of Fiscal Subsidy Funds for the Demonstration and Promotion of Energy-Saving and New Energy Vehicles" gave one-time subsidies to the pilot cities of the "Ten Cities, Thousand Vehicles" project to promote the demonstration and promotion of EVs: the subsidy standard is mainly based on the comparison between NEVs and similar traditional vehicles. According to the fuel savings rate, HEVs were split into five subsidy classifications, with a

maximum subsidy of \$6,888 per vehicle; for BEVs, the maximum subsidy was \$8,265 per car. In 2010, the "Notice on Carrying out the Pilot Program of Subsidies for Private Purchase of New Energy Vehicles" was issued, and the maximum subsidy amount for HEV and BEV remained unchanged. The energy-saving vehicle subsidy policy newly implemented since 2011 increased the technical requirements of energy-saving vehicles included in the subsidy, such as reducing the average fuel consumption per 100 kilometers to 6.3L (the old version: 6.9L), thereby urging automobile manufacturers to adopt new technologies and to further promote EV promotion with upgraded products. In 2013, the "Notice on Continuing the Promotion and Application of New Energy Vehicles" was issued, allowing EV consumers to pay after deducting subsidies from the sales price. The basic price differential between new energy cars and comparably priced conventional vehicles is used to set the subsidy standard. Given considerations like scale impact and technological advancement, new regulations have been introduced almost every year since 2014 to realize the reduction of subsidies, and at the same time increase the EV technology threshold for subsidy (power battery density, energy consumption requirements of EV) 2 years later than originally aimed, NEV government subsidies phased out at the end of 2022, and will gradually shift to EV use and charging [10].

**Table 2** China's Subsidy Program for New Energy Passenger Vehicles (Non-Public Domain)

|      |                            | Unit: 10 thousand yuan |      |      |      |      |      |      |      |      |      |
|------|----------------------------|------------------------|------|------|------|------|------|------|------|------|------|
|      | All-electric Driving Range | 2013                   | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
| BEV  | $80 \leq R < 150$          | 3.5                    |      |      |      |      |      |      |      |      |      |
|      | $100 \leq R < 150$         |                        |      |      | 2.5  | 2    |      |      |      |      |      |
|      | $150 \leq R < 200$         |                        |      |      |      |      | 1.5  |      |      |      |      |
|      | $150 \leq R < 250$         | 5                      |      |      | 4.5  | 3.6  |      |      |      |      |      |
|      | $200 \leq R < 250$         |                        |      |      |      |      | 2.4  |      |      |      |      |
|      | $R \geq 250$               | 6                      |      |      | 5.5  | 4.4  |      |      |      |      |      |
|      | $250 \leq R < 300$         |                        |      |      |      |      | 3.4  |      |      |      |      |
|      | $250 \leq R < 400$         |                        |      |      |      |      |      | 1.8  |      |      |      |
|      | $300 \leq R < 400$         |                        |      |      |      |      | 4.5  |      | 1.62 | 1.3  | 0.91 |
|      | $R \geq 400$               |                        |      |      |      |      | 5    | 2.5  | 2.25 | 1.8  | 1.26 |
| PHEV | $R \geq 50$                | 3.5                    |      |      | 3    | 2.4  | 2.2  | 1    | 0.85 | 0.68 | 0.48 |

Photo credit: Original

In 2011, the "Vehicle and Vessel Tax Law of the People's Republic of China" added provisions: BEVs, FCEVs and PHEVs are free of vehicle and vessel tax, and other hybrid vehicles are taxed at half the applicable tax rate for similar vehicles. In 2014, the "Notice on Exemption of Vehicle Purchase Tax on New Energy Vehicles" was issued to reduce the cost of car purchases for consumers. The policy has been extended several times, considering that EV is in the critical period of development and the policy can stimulate NEV purchase effectively and the pandemic background as well. Most recently in June 2023. As shown in Table 2, NEV purchase tax exemption is applied to NEVs brought in 2024.1.1-2025.12.31 (exemptions < ¥30,000) and 2026.1.1-2027.3.31 (exemptions < ¥15,000). Alongside providing R&D subsidies, the Chinese government also offers policies that benefit EV producers in terms of corporate income tax exemptions, the credit system, and investment projects. In the new "Enterprise Income Tax Law" promulgated in 2007, it is stipulated that enterprises in high-tech industries supported by Beijing shall be taxed at a reduced rate of 15%. Many parts and components of NEVs fall into this category. In 2017, four ministries including the Ministry of Industry and Information Technology and the Ministry of Finance jointly issued the Parallel Management Regulation for Corporate Average Fuel Consumption and NEV Credits, making China's EVs officially enter the credit era. CAFC and NEV Credits are calculated independently, but the

principle is the same: the difference between the actual value of the enterprise and the target value of fuel consumption stipulated by the state is converted into points according to certain rules. If the CAFC points are positive, they can be carried over to future years in proportion or transferred to affiliated companies. If the NEV points are negative, only positive NEV points can be purchased to offset the balance. If the NEV points are positive, they can be sold to companies with negative points at a ratio of 1:1. [11] Automobile manufacturers must be able to create and sell enough NEVs, or they will have to cut their own output of conventionally fueled vehicles or purchase NEV credits from other manufacturers. [12] Companies that do not compensate for negative points will be penalized with a moratorium on the production of fuel-intensive products. The revised new version in 2019 and 2020 required the gap between the actual value and the target value to be continuously narrowed. The revised new version in 2019 and 2020 requires the gap between the actual value and the target value to be continuously narrowed.

In the face of problems such as insufficient flexibility in the implementation of the "credit system" and large fluctuations in the price of points, the policy will be adjusted on a large scale in 2023: From 2024 to 2025, the scores of standard models of new energy passenger vehicles will be lowered by an average of about 40% compared with the previous stage; Establish a points pool system: When the supply of NEV credits in the whole industry is greater than the demand (supply-demand ratio > 2:1), the enterprise independently chooses whether to store positive credits for NEVs in the credit pool; when the market supply is less than demand (supply-demand ratio < 1.5), allowing businesses to withdraw stored positive credits. In addition, the compensation time for negative credits is extended; companies are allowed to carry forward the positive credits obtained from the purchase of NEVs. The newly released "Foreign Investment Law of the People's Republic of China" in 2020 stipulates that China will implement a provisional import tax rate lower than the most-favored-nation tax rate for a total of 850 items of new energy battery-related materials and parts [13].

#### 3.1.4 Installation of facilities

China has made all-round supporting requirements for purchase, use, and scrapping, which shows the country's determination to promote NEVs. In 2009, the central government required pilot cities and localities to provide certain policy support and financial arrangements for post-purchase guarantees, infrastructure and maintenance of NEVs. Some cities have hastened the development of public charging infrastructure in open spaces like parking lots and invested in the building of rapid charging networks and automobile battery charging stations. In 2011, in the "Notice on Further Improving the Demonstration and Promotion of Energy-saving and NEVs", in view of the current situation of insufficient charging facilities, it is required that the ratio of charging piles to NEVs should not be lower than 1:1, and the charging network must cover residential quarters, workplace parking spaces and charging piles are set up in government agencies, shopping malls, hospitals and other places. Governments of pilot cities are required to actively study the implementation of measures to exempt license plate auctions, lottery, and traffic restrictions for NEVs, and to introduce supporting policies in parking fees, electricity prices, and road tolls. In 2014, the Central Ministry of Finance began to continuously subsidize and reward the construction of charging piles for NEVs and issued the "Notice on Suggested Rewards for NEV Charging Facilities". [14] In 2015, in the "Opinions on Doing a Good Job of Electric Vehicle Charging and Swapping Facilities Telegraph Installation Service", it is pointed out that social capital should be actively introduced to improve the construction process, so that the distribution of infrastructure will be more reasonable. On the other hand, it will also allow Private charging facilities' installations to be more convenient. "Notice of the Ministry of Housing and Urban-Rural Development on Strengthening the Planning and Construction of Urban Electric Vehicle Charging Facilities" encourages local governments to promote the implementation of peak and valley time-of-use electricity price policies; establish a market supervision system for the competitive and structured charging service market. In 2022, the central government stated the target of installing charging infrastructure for over 20 million EVs by 2025 and encouraged regional governments to develop policy backing and subsidies for better charging services. It is proposed that the ratio of newly added public charging piles to the number of NEVs

promoted in the public domain should be 1:1. In 2023, it is proposed that by 2030, a high-quality charging infrastructure system with extensive coverage and complete functions will be built, so as to effectively meet the people's EV travel charging needs. Policies introduced in 2023 also encourages companies to provide high-quality second-hand NEVs for the rural market, encourages townships to promote the application of NEVs in government agencies and the public sector, and provide local buyers diversified post-purchase (charging) supports.

### **3.2. The U.S.**

In 1975, the "Company Fuel Economy Standard CAFE" was issued, and tax reduction incentives were provided for companies exceeding the standard requirements. The Alternative Automobile Fuel Act of 1988 and the Clean Air Amendment Act of 1990 both encouraged the production of vehicles with multiple fuels such as methanol and natural gas. In 1993, the Clinton administration promulgated the "New Generation Automobile Cooperation Program PNGV" to coordinate the human and material resources of the US government, national laboratories and the three major automobile companies with 758 subjects. In 2002, the Bush administration's "Freedom CAR" continued this combined development model, supporting the construction of hydrogen fuel cell vehicles and infrastructure. During this period, pure electric vehicles were unanimously resisted and attacked by public opinion from oil giants and traditional car beneficiaries [15].

#### **3.2.1 Obama administration**

After the financial crisis in 2008, there was an urgent need to develop emerging industries to support economic development. The Obama administration adopted energy reform policies and hoped to reduce dependence on oil and avoid a cycle of rising oil prices through the development of EVs. Fundings towards purchasing or leasing of low/no emission buses in Low or No Emission Vehicle Program were given. American Clean Energy and Security Act included: Taxpayers who purchase BEVs and PHEVs will be granted tax credits ranging from \$2,500 to \$7,500. In addition, the policy also allowed the U.S. [16] Department of Energy to provide financial support for EVs and smart grid technology and infrastructure. The Energy Policy Act proposed that individuals who install NEV-related infrastructure can obtain a 30% tax incentive for the cost of the facility. American Recovery and Reinvestment Act (ARRA) set up a US\$2 billion R&D fund for designing batteries, motors and other fields to support the R&D of core technologies and key components, and a US\$25 billion research fund to provide low-interest loans for these companies. The government directly invested in 48 research and development projects of NEVs. Also, Greenhouse Gas Limitation Rules aimed to lower CO<sub>2</sub> emissions by approximately 1.1 billion metric tons [17] and set graded CO<sub>2</sub> emission restricts to vehicles on different duty levels.

#### **3.2.2 Trump administration**

Since US President Trump took office in November 2016, he has favored the development of traditional energy sources such as oil, gas and coal, despised new energy sources, and opposed environmental issues such as climate warming. In 2017, a number of EV purchase credit policies were abolished. For example, the Advanced Technology Vehicles Manufacturing Loan Program (ATVM) – for advanced auto technology was cut [1]. Trump administration has repeatedly relaxed the requirements of the Corporate Average Fuel Economy, reducing the compliance costs of automakers and making it unnecessary to develop the EV industry to meet regulation requirements, which has brought negative impact on the US EV market.

#### **3.2.3 Biden administration**

Trump's negative stance toward EVs was in sharp contrast to the EV development policy of the Biden administration which is at an unprecedented intensity. After Biden took office in 2021, he proposed a goal: By 2030, 50% of new vehicles sold will be emission-free. [18] In April 2021, Department of Energy totaled \$19 million to fund 13 selected key mineral projects. The National Blueprint for Lithium Batteries (2021-2030) is intended to guide long-term development by setting

goals for the entire supply chain, which includes securing a base for upstream raw materials and key minerals as well as materials processing; creation of domestic electrode, cell, and battery pack manufacturing sectors; and recycling of key materials. In October 2021, the U.S. Department of Energy's Argonne National Laboratory made the announcement of the formation of Li-Bridge, a new public-private partnership designed to fill gaps in the domestic supply chain for lithium batteries. New personal tax credit bill regulation increased the maximum deductible amount for vehicles assembled in the U.S. Infrastructure Investment and Jobs Act (Bipartisan Infrastructure Law) uses 174 billion U.S. dollars (about 1.1 trillion yuan) to create its "electric vehicle plan". The IJA provided finance for upstream battery materials and refining as well as for production plants, battery manufacturing facilities, and recycling facilities, totaling close to \$3 billion, to promote the creation of sophisticated battery supply chains.

The Inflation Reduction Act released in 2022 placed renewed emphasis on strengthening the domestic supply chain for electric vehicles, electric vehicle batteries, and battery minerals, as well as providing eligibility for tax credits. This has led to a cumulative investment of at least \$52 billion in the North American EV supply chain by major EV and battery manufacturers between August 2022 and March 2023 following the implementation of the IRA, with 50 percent of the investment going to battery manufacturing and approximately 20 percent going to battery assembly and EV manufacturing, respectively. In 2023 IRA guidelines, annual tax credit of up to \$7,500 for qualifying EV purchases is set for consumers who do not meet the high-income threshold: more than 40% of the value of key minerals for batteries and more than 50% of the value of battery components in the EV come from the U.S or countries that have signed free trade agreements with it [19].

### 3.3. Policies in California

The development of alternative energy sources such as ethanol fuel in the 1980s and 1990s caused severe deterioration of California's air quality, forcing the state government to focus on zero-emission vehicles [20]. California is the only state in the U.S. that has the right to formulate independent vehicle emission standards. The number of policies related to NEVs far exceeds that of other states. Now its promotion of NEVs has achieved remarkable results: In 2022, California sold 40% of the nation's zero-emission vehicles. [21]. In 1990, California introduced Zero Emission Vehicle (ZEV) regulations, and based on the regulations, introduced a "ZEV Credit System": setting credit targets to enable automobile manufacturers to promote R&D and expand the production scale of EVs. In the credit transaction system, companies obtain credits by selling NEV, and can sell excess credits to companies that have not achieved their goals. California's Cap & Trade policy sets the total annual greenhouse gas emissions, and the California Air Resources Board (CARB) associates ZEV with CO<sub>2</sub> emissions to further guarantee the promotion of clean vehicles. CARB has continuously introduced a number of comprehensive policies since 1990, including consumer tax reduction policy updates, infrastructure construction, ZEV sales targets, etc. Since 1990, Clean Fuel Vehicles Pilot Project provided certain tax breaks for car companies selling ZEVs. Clean Transportation Initiative (2007) made annual investment of up to \$100 million/year for: electric vehicles, charging infrastructure, medium and heavy ZEVs, etc. It gave economic incentives for enterprises, consumers and academic institutions, etc. Levelized Buyer Subsidy (2015), for single-income families with annual incomes below \$35,000 and households with annual incomes below \$60,000, the purchase subsidy is doubled to \$3,000, and the subsidy for BEV is increased from \$2,500 to \$4,000. ZEV Action Plan Priorities Update (2018) increase private investment in ZEV infrastructure, particularly in low-income and disadvantaged neighborhoods, with the objective of having 5 million ZEVs on our roads by 2030. Zero-Emission Vehicle Executive Order (2018) targeted 250,000 EV charging stations by 2025. Advanced Clean Trucks, ACT (2019) targeted that by 2035, 40% - 75% of automaker sales (varies by vehicle class and weight) are ZEVs (increasing target from 2024), with all new cars being ZEVs. Advanced Clean Cars Rule II (ACC-II) (2022) set target for 100% ZEVs in LDVs by 2035, starting with 36% sales requirement in 2026. [22] AB 1493, ACT (2002) required vehicles launched after 2009 to reduce greenhouse gas emissions by 30% in 2016. The Low Carbon Fuel Standard (2009)

established a yearly Carbon Intensity (CI) target. Transportation fuel providers offer credits for fuels (including electricity and hydrogen) that fall under the CI target. The goal is to decrease the carbon intensity within the transportation fuel pool by at least 20% in 2030 when compared to 2010. The Transportation Electrification Plan (2022) provides for a 40% reduction in Green House Gas (GHG) emissions by 2030 as compared to 1990 levels.

## 4. Comparisons

Since 2009, China has introduced a large number of policies to support the development of EVs, which are coherent in the top-level design. However, after the United States reached a prosperous period of policy support during the Obama administration, policy support measures were reduced during the Trump administration, and the policy implementation standard Relaxation has also led to the stagnation of industrial development. U.S. policy lacks coherence and integration with national resources. The two countries have similar paths in the promotion of EVs: first promoting EV in the public and business sectors with central financial support, and then in private purchases with corresponding fiscal policies. Since 2007 “Internal Revenue Service” in the U.S. adjusted personal income tax relief for consumers of NEVs, and China implemented private EVbuyer subsidies in 2010.

The two countries have different preferences when it comes to specific policies and policy implementation. This chapter compares the industrial policies of the two countries in terms of fiscal and taxation policies, supporting measures, and battery development policies.

### 4.1. Subsidies, Tax Credits and Credit System

China adopts an EV policy system that is deployed by the central government and strictly implemented by local governments. In the documents issued by the central government (Beijing), financial subsidies are more preferred. Fiscal subsidies for EV consumers started first (2009-2022); then, in 2014, large-scale purchase tax reductions started and has reduced to ¥15,000. In the next step, China's will mainly focus on the dual credit system for enterprises. In the U. S., however, policy support means of tax relief is preferred, and the federal tax system is independent of the state tax agencies. California is the most representative state in terms of EV fiscal policy support. Unlike China, the state tends to base policy on legislation. On the other hand, among the various states, they will sign a memorandum of cooperation to achieve common goals and promote mutual supervision. Compared with China's unification for private buyers, California provides additional subsidies for low income level consumers to purchase EVs, which is more conducive to EV's promotion in the private sector. Compared with China's different subsidies for different power types, according to the dominant policies in different periods (the leading development strategy before 2008 was hybrid, and after 2008 it was BEV), the US tax policy maintains technology neutrality: no obvious tendency to support hybrid or pure electric vehicles, but they are treated equally according to the effect of energy saving or emission reduction. [23] Besides, the credit systems of the two countries have different emphases. China prefers reforms on the demand side, and its dual credit system implemented in 2017 is relatively traditional. It can be said that this credit system has no innovations except for some references to California's ZEV credit system. Before that, the ten-year high-speed development and promotion period mainly adopted consumer purchasing discounts. The United States—especially California as an example, since the initial stage of the industry in 1990, it has adopted a ZEV credit system that focuses on supply-side reforms. For a long time, the ZEV system has been under the "credit pool" system, so that enterprises do not have to compress R&D time and blindly increase the speed of product introduction due to concerns that their own R&D direction will not match future policy changes (Contrarily, there are many car companies in China that launch a car a year and make breakthroughs in hampering technology). The ZEV system is also associated with the CO2 emission reduction indicators under the Cap & Trade system, which fully guarantees the energy-saving and emission-reduction intention of EV development. Take Tesla as an example. According to its financial report, although the company has diversified businesses aside EV, its

Automotive regulatory credits cash income reached as high as \$81,462 million dollar with 21% annual growth in 2022 [22], which shows Biden administration's strong fiscal support on auto companies. This system has established an internal incentive and restraint mechanism for the development of EV in the U.S., and is an important driving force for the growth of electric vehicles [2].

#### 4.2. Infrastructure Construction and EV usage

As mentioned in Chapter 3, as early as 2009, when the "Ten Cities, Thousand Vehicles" was launched, China deployed infrastructure construction projects such as chargers, and Beijing basically introduced 1-2 central planning/regulation every year after that. In particular, in 2015, it was guided that social enterprises and capital should be introduced to the construction of charging piles. China currently presents a variety of charging pile operation models, including charging operator-led, car-maker-led, and multi-enterprise cooperation, among which there are NIO, Xpeng, and State Grid Corporation (SG) of China. The cooperation between SG (operator) providing energy supply and car companies providing customer groups can achieve win-win. When deploying EV usage policies, various localities strictly follow the country's phased goals, and generally adopt charging pile construction subsidies (both public and private), charging subsidies, traffic toll reductions, and free licenses (This is a particularly important incentive, as applicants often have to wait years to obtain licenses for their conventional vehicles.) and other EV privilege provisions. Policy frameworks for EV charging vary from country to country. While China's central government has made the development of an EV charging network a national policy with a multi-year plan, the U.S. federal government has played a minor role in EV charging, with a few state governments taking a proactive role [3]. Readily accessible charging away from one's house (or job) will be critical to EV growth [10], but research has showed that most states and towns examined had little to no policies regarding public EV charging [14]. According to Department of Energy's official [18], by 2023 California alone issued 22 policies with the topic around EV charging or parking incentives, but in the 3 states (Mississippi, Kentucky, Alabama) with the lowest PPI index they only had 2 or 3 policies related to these infrastructure policies respectively. Accordingly, by January 2019, California has more than 21,000 chargers (32% of the national total), and the three lowest-income states (Mississippi, Kentucky, Alabama) have fewer than two chargers per 10,000 people. In the overall U.S. market, IEA shows that the ratio of EVs to public charging piles was 18.2:1 in 2021 [11]. Fortunately, \$7.5 billion in federal money is intended specifically to assist the Biden administration in meeting its 500,000 countrywide charger goal under the Infrastructure Investment and Jobs Act (IIJA), which was passed in 2021. [16] In 2022, U.S. chargers witnessed a 19% growth [13]. And the lack in EV driving privileges is gradually solving.

#### 4.3. EV Power Battery

China's share of global EV battery production capacity has jumped to the top of the world (77%) as a direct result of more than a decade of Government policies throughout the entire battery production chain [15]. Battery material mining has been receiving policy attention since 2007. Central banks, working closely with the central government, have granted loans to companies, enabling Chinese suppliers to take ownership of mines and processing facilities in Africa, Australia, Europe, North and South America. CATL (a Chinese company, global leader in lithium-ion battery development and manufacturing) received over \$100 million in loans from state-owned banks (working closely with the central government) construct its lithium supply chain in China's western Qinghai region. Since 2012, China has proposed in the policy to speed up the manufacturing capacity of refining equipment. In 2017, the policy was introduced to focus on cultivating enterprises with advantages in battery cathode materials. policy guiding led to China's achievement with its 80% occupation of global battery raw material refining. Furthermore, the government produced a list of batteries that Chinese EV makers could use if they wished to be eligible for subsidies; the list excluded Korean and Japanese battery incumbents. The continuous reduction in the cost of power battery

production and the large amount of income from foreign exports have formed a virtuous circle for the development of the Chinese power battery industry and the growing output. In recent years, the Chinese government has enacted numerous rules on urban mining and battery recycling in order to boost resource usage efficiency. The situation in the United States is not optimistic. The Obama administration implemented a slew of regulations to encourage the growth of the EV industry, but it was too early for the U.S., resulting in high development costs, meanwhile struggling with weak demand for electric vehicles. A lithium-ion battery maker for major U.S. car brands, A123 Systems, received a \$249 million government grant in 2009 and its bankruptcy in 2012 can largely be attributed to the lack of enthusiasm for electric cars in the U.S. [8]. In 2014, when the oil price in the United States plummeted, there was less willingness to purchase EVs, making it difficult to provide research and development funds in this way. Moreover, the gradual application of US shale oil technology has reduced the willingness of low-energy car companies to develop EVs. During the Trump era, the overall support for the EV industry declined, and the epidemic shut down most factories, making it hard for battery production. Today, a few countries (such as China) own most of the minerals, and the lack of lithium in the United States hinders its rapid development. President Biden's Inflation Reduction Act of 2022 legislation placed \$200 billion to create an end-to-end supply chain of U.S. rare earth metals, lithium, and nickel that could be used for domestic battery production.

## 5. Conclusion

Chinese policies are more consistent and synergistic, but less flexible; EV policies in the U.S. EV industry leading states have a certain degree of innovation, however, the national policy introduction lacks coherence and resource integration capabilities. Both countries attach importance to fiscal and taxation policies. China pays more attention to consumer subsidies and the U. S. pays more attention to supplier tax relief. California's credit system combined with CO<sub>2</sub> emission reduction policies can endogenously stimulate enterprises to develop EV. China's long-term deployment of the power battery policy for the entire battery production chain led to its current leading position through government-enterprise cooperation, among which the government-backed material possession is very important. However, the United States cannot overcome the impact from other industries due to lack of attention in the development of EV. China's infrastructure construction has steadily achieved phased goals through good central-local deployment, combined with a large number of EV privileged measures to achieve EV promotion. In the U.S., due to the lack of central deployment, the policies of each state vary greatly, and the overall construction level is relatively low. EV provide economic and environmental benefits for both countries while being a win-win choice for car companies and customer needs. To ensure its leading position, China needs to continue the previous policy measures. China should further control the problem of lithium overcapacity and avoid lithium dumping; it will lead to lower global battery prices which could further depress margins for the industry. In the face of other countries ambitious 2030 EV battery target, China needs to further reduce the cost of battery production. It is necessary to continue to promote the physical recycling of batteries as the material cost of power batteries in China accounts for more than 75%. It is necessary to increase the dimension of the credit system assessment from the reality and link it with other energy-saving and emission-reduction indicators. Although there is many charging equipment in China, the number of charging piles per capita is small. It is necessary to increase the deployment of private and rural charging piles.

The U.S. has a bright EV future, it's anticipated that more than 26 million EVs will be on U.S. roads in 2030. The country has encountered clear policy turning point with high-quality supply blowing out under the guidance of policies. The States will strengthen resource integration by grasping the policy leverage of IRA and achieve technical breakthroughs in mineral refining or battery recycling with more State incentives issued. By virtue of capital advantage, the U.S. can gain material supplement from strong trade partners like Mexico, Canada, who have a lot of natural resources, including lithium. In the short term, the U.S. should continue to trade with China in the field of EV batteries for some win-win results. IRA plans require time to launch and to guarantee

profitability, while the overcapacity in China may provide supply at reduced prices, which will have certain advantages for the United States to participate in bilateral trade. Moreover, some major American car companies still need battery supplies from BYD and CATL during EV manufacture.

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