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STATE SUPPORT OF ELECTRIC VEHICLE INDUSTRY IN CHINA: THE DRIVING FORCES, ACTIONS AND PERSPECTIVES

Nowadays, the electrification of the automotive industry in some regions symbolises the transition to a sustainable economy. Moreover, these changes were initiated by regulatory authorities, and not only consumers and manufacturers. The article summarizes the results of the first decade of implementing Chinese governmental policy promoting sales of electric vehicles.

Our goal is to acquaint the Russian-speaking audience with the successful practise of state support of the emerging industry. As we focused on reviewing and analysing the information, the main research method is the survey of open sources and academic literature. In the first part of the article, we reported the key role of China in the global electric vehicle market and identified the main driving forces in the transformation of the national automotive industry. In the second part, we closely examined the actions taken by the Chinese authorities to ensure an increase in the share of electric vehicles. In the third part, we summarised and analysed the possible short-term changes, as well as discussed the impact of the described processes on the global economy. The implementation of the aforementioned policy enabled a breakthrough, allowing Chinese automotive industry to reach the leading position in terms of sales and production of electric vehicles. Therefore, this research can be used for both the adoption of successful practice and analysis of the influence of the emerging electric vehicle industry on the Russian and global economy.

Keywords: automotive industry, electric vehicles, state support, regulatory authorities, China, subsidies, new energy vehicle mandate, air pollution, lithium battery, charging infrastructure

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1. Introduction

Transport is one of the key elements of modern society and the global economy. On the one hand, the production of vehicles and their components is an important industry for many developed countries. Vehicles are among the largest consumers of energy resources. Modern transport system ensures both the delivery of goods from producers to buyers and global mobility of the population. On the other hand, vehicles are a cause of premature death and a source of environmental pollution. Petroleum used for fuel production causes geopolitical conflicts and wars, and its extraction and transportation can lead to major environmental disasters.

Due to the critical importance of transport, any significant technological and conceptual changes in vehicles and transport infrastructure should be timely monitored for both short- and long-term assessment. Recently, electromobility has become one of the main trends in the automotive industry, which can be easily tracked, for example, using annual Global Automotive Executive Survey, published by KPMG[1]. Simultaneously, the growing popularity of electric vehicles (hereinafter, EV) clearly demonstrates a significant transformation of the automotive industry, i.e., the increasing role of the government as a driving force of change. Thus, approximately 77 % of executives surveyed by KPMG agree with the statement that nowadays regulators determine the key directions for the development of the automotive industry, and the status of automobile companies evolves from progress architects to the executors.

The difference in government regulations of the automotive industry in various regions can be clearly demonstrated by comparing EV sales charts in the USA, Europe, and China (Figure 1). It should be noted that this graph and those presented further report data for electric passenger cars; while the study of commercial EV production and sales is certainly interesting and important, it is beyond the scope of this article. The EV sales in the United States (Figure 1) demonstrate a relatively slow linear

[1] 20th KPMG Global Automotive Executive Survey 2019. Retrieved from: https://automotive-institute.kpmg.de/GAES2019/ (Date of access: 13.02.2020).

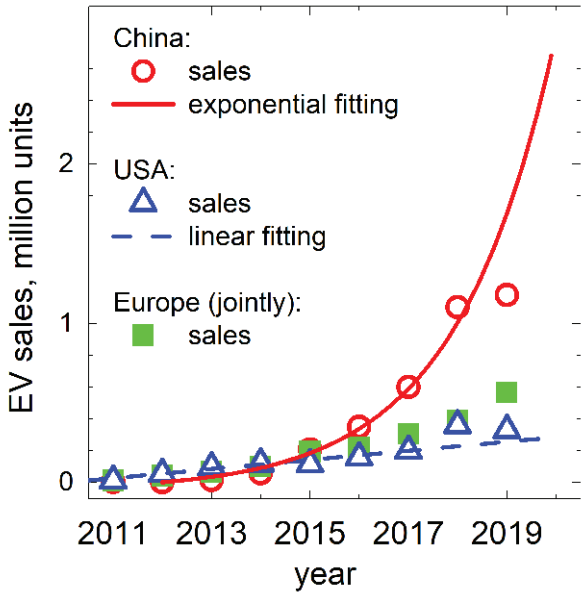

Fig. 1. *Comparison of sales growth of electric vehicles in different regions. The dots represent actual sales, the lines show exponential (China) and linear (USA) approximations*

growth (annual increase of about 35 thousand electric cars), indirectly indicating that regulators' policy can be considered moderate. The deviation from the linear approximation observed for the EV sales in the United States in 2018 is caused not by a successful government programme, but by breakthrough sales of Tesla Model 3, which amounted to almost 140 thousand in 2018[2]. The EV sales in Europe were growing slightly faster, but the growth rate was not enough to bring the total European EV sales even close to those in China (Figure 1). In contrast to the United States and Europe, China experienced exponential growth in sales up to 2018, demonstrating the effectiveness of the stable government policy in the field of transport electrification. However, in 2019, the growth practically stopped, thus raising a question about the sustainability of electric transport adoption both in China and globally.

In order to understand the peculiarities of the modern automotive industry in China, this article will 1) briefly examine the reasons why Chinese authorities are so dedicated to support the EV market growth, 2) study a set of government support actions, and 3) briefly analyse the possible consequences of the Chinese policy's transformation for the global automotive industry.

2. The reasons of EV support in China

First, it is necessary to understand the driving forces of the change. In 2009, China became the largest automotive market in the world [1]. In the same 2009, the state project "Thousands of Vehicles, Tens of Cities" was launched, thus symbolising the beginning of the systematic support for EV adoption in China [1]. Why did the Chinese government need to initiate a significant transformation of the entire industry, the world's largest passenger car market? There are three main groups of reasons for government EV support: environmental, economic, and political. A clear understanding of these reasons is very important, as they are these driving forces of changes in the automotive industry both in China and around the world.

2.1. Political reasons

The growing number of cars on the roads of China has led to the fact that oil consumption in the country was steadily increasing [2] and in 2013 China became the largest oil importer in the world [3]. Simultaneously, contrary to another major oil importer, the United States, oil imports in China prevail over their own production, and the share of imported oil in China exceeded 60 % in 2015 [4]. The growing dependence of the Chinese economy on oil-importing countries can be seen as a potential threat to the country's sustainable development [5–7].

The first step to mitigate risks was the creation of strategic oil reserves, so crude oil imports to China grew faster than its domestic consumption. In addition, China reformed its economic policy

[2] EV sales. Retrieved from : http://ev-sales.blogspot.com/ (Date of access: 13.02.2020).

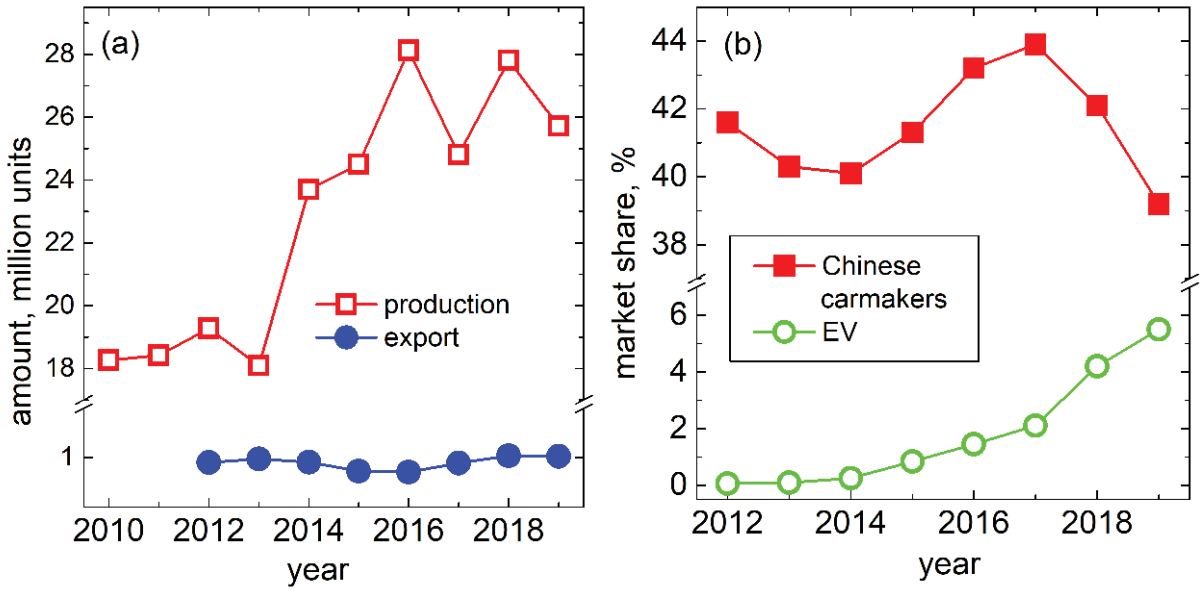

Fig. 2. *A) Annual production and export of cars; b) changes in the share of local manufacturers and electric vehicles in China (Source: Data of China Association of Automobile Manufacturers. Retrieved from: http://www.caam.org.cn/ (Date of access: 20.02.2020))*

in the field of oil refining, reducing restrictions on both imports and exports. Since mid-2015, China has granted crude oil import licences to independent refineries in northeast China. The second step was the geographic diversification of imports. China experienced the largest decline in domestic oil production in 2016, and by 2017, 56 % of China's crude oil imports were from Organization of Petroleum Exporting Countries (OPEC) countries. OPEC countries and some non-OPEC ones, including Russia (Russia surpassed Saudi Arabia as China's largest source of foreign oil in 2016) agreed to cut crude oil production by the end of 2018, allowing other countries to increase their market share in China in 2017.[3]

The first two steps reduce the political risks of dependence on oil imports, but do not solve the problem of its growth. The simultaneous increase in the EV share and increase in domestic electricity production by renewables can be considered as a more convenient way of ensuring political stability by switching from energy imports to its domestic production.

2.2. Economic reasons

As the largest consumer of automotive products, China can use EV support to boost domestic production. The annual car production amounted to 25.7 million units at the end of 2019. However, both domestic market and export of Chinese cars did not grow in recent years (Figure 2a). The share of Chinese manufacturers in the local automotive market was also not growing (Figure 2b), rather, it tended to decrease, so the Chinese government needed to find new growth points for their automotive industry.

There are two possible reasons why government support of EV industry (in China, the abbreviation NEV (new energy vehicles) are used to designate EV) could help China to achieve the growth of domestic production. First, the share of local brands among electric cars is incomparably higher than that among petrol ones. At the end of 2019, there were only three foreign models, namely, Tesla Model 3, BMW 530Le, and VW Passat GTE, among the 20 best-sold EVs in China (8th, 12th, and 18th places, respectively)[4]. Moreover, the growing EV popularity creates prerequisites for successful competition in the premium sector, where the positions of foreign brands are especially strong. Thus, the sales of two models of Nio (one of the new premium EV brands in China) in 2019 amounted to more than 20 thousand units, and the Nio ES6 model only slightly fell short of the top twenty. The best-sold electric car was the relatively expensive model BAIC EU-series with a price tag of about $ 32,000.

[3] EIA. China surpassed the United States as the world's largest crude oil importer in 2017. Retrieved from: https://www.eia.gov/todayinenergy/detail.php?id=34812 (Date of access: 20.02.2020).

[4] EV sales. Retrieved from: http://ev-sales.blogspot.com/ (Date of access: 20.02.2020).

Besides boosting domestic sales, EV support could help China to increase its auto exports. China is now perceived as a global leader in EV production and sales. In 2019, more than 1.2 million of electric cars were sold in China, while in the USA EV sales were about three times lower (Figure 1). Such a significant advantage of the Chinese EV market and the domination of domestic brands allow Chinese companies to gain unique experience and prepare significant production volumes. Manufacturers of EVs and traction batteries have obtained unique arrays of big data on the features of EV operation in various weather/climatic conditions and under various driving scenarios. The higher the sales, the more data they gain and, accordingly, the more opportunities to improve the EV quality. Rich experience, accumulated data, and constructed production facilities altogether create good prerequisites for the global expansion of Chinese automakers in the future.

2.3. Ecological reasons

The problem of air pollution in China has been extremely vexed for decades. According to the Ministry of Environmental Protection of China, in 2014 the ambient air quality in 66 of the 74 largest cities in China did not meet national standards [8]. Over the past 20 years, road traffic emissions have increased by 45 %, accounting for 17 % of CO_2 emissions in China in 2015. Transport is far from the only source of atmospheric pollution [9], but both ten years ago [10] and now [11] the contribution of fuel combustion vehicles remains significant.

Earlier, the economic losses from air pollution were often underestimated, but now such studies have become more popular [12, 13]. The total investment in air pollution control in the Beijing region alone amounted to RMB 800 billion spent from 2013 to 2017 [8]. An increase in the level of pollution in a particular region or city leads to a decrease in its attractiveness and an outflow of the population, which can be tracked, for example, by the dynamics of housing prices depending on the level of air pollution [14]. Switching to electric transport together with increasing the share of less polluting power plants can help improving both the environmental and economic situation in China.

3. Measures for EV support in China

To enable the growth of EV popularity, the Chinese government consistently implemented measures, designed to stimulate an increase in EV production and consumption.

All measures can be roughly divided into five categories:

— research and development (R&D) funding;
— financial support for EV buyers (subsidies);
— charging infrastructure deployment;
— introduction of preferences for EV buyers and owners;
— economic stimulation measures for EV production growth.

The preliminary stage of Chinese EV industry formation began with the scientific and engineering groundwork. In 2001, the development of EV technologies was included in the State High-Tech Development Plan (i.e. 863 Program) [15]. In 2006 alone, the government allocated RMB 1.16 billion ($184 million) to support R&D under this plan[5].

3.1. EV subsidies

After the preliminary phase of EV-oriented R&D, the Chinese government launched a federal subsidy programme for new EVs purchase.

The first pilot round of federal subsidies began in January 2009 and lasted until December 2012. Subsidies extended to the purchase of EVs in 25 pilot cities including Beijing, Shanghai, Hangzhou, Dalian, and Shenzhen. The project was primarily aimed at electric cars for the corporate market and buses, but in 2010, the programme included the private sector of EV [4]. On June 1, 2010, the Chinese government announced the "NEV demonstration project", an EV demonstration project with subsidies for the purchase of EVs by individuals in five cities. The subsidy value was up to RMB 60,000 for the purchase of an all-electric battery EV (hereinafter, BEV) and RMB 50,000 for a plug-in hybrid (hereinafter, PHEV). In US dollars, these amounts were approximately 9,300 and 7,600, respectively, at the exchange rate for June 2011. The cities participating in the pilot programme were Shanghai, Shenzhen, Hangzhou, Hefei, and Changchun. The subsidies were paid

[5] Jieyi Lu. Comparing U.S. and Chinese Electric Vehicle Policies. Retrieved from: https://www.eesi.org/articles/view/comparing-u.s.-and-chinese-electric-vehicle-policies (Date of access: 20.02.2020).

directly to carmakers, not to consumers. The subsidy value decreased after the sale of 50,000 units of the given EV model [1, 3].

At the end of the trial period of federal subsidies, the Chinese government decided to extend the programme for another three years (the second round of NEV demonstration project). The project for the second round has covered 39 city groups, totalling to 88 cities. A complete list of these cities can be found, for example, in [3] or [4]. In the second phase of the programme, subsidies were also provided directly to automakers who sold EVs to users at a price reduced by the subsidy value.

In 2013, the Ministry of Industry and Information Technology of China (MIIT) made significant changes to the subsidy programme. The subsidy for the PHEV was reduced to RMB 35,000 (US $ 5,600), while the subsidies for the BEV varied from RMB 35,000 (US $ 5,600) to RMB 60,000 (US $ 9,600), depending on the EV range per one charge (Figure 3). Subsidies were provided only to buyers of domestic brand cars [3].

In the next two years, the subsidy value was subsequently reduced by 5 % in 2014 and by 10 % in 2015 (relative to 2013). In 2016, it was announced that EV subsidies would end by 2020 with a gradual decrease by 20 % every year until 2019 [15–19]. However, it should be noted that Chinese government demonstrated flexibility and instead of a monotonous reduction of subsidies, it increased the value of the maximum subsidy twice, in 2016 and 2018. This step was possibly intended to compensate for the introduction of another indicator influencing the amount of the subsidy, namely, the value of the specific energy density for traction battery. Under the new rules, EVs with the battery characterised by a specific energy density ranging from 90 to 120 Wh/kg could apply for a subsidy. If the specific energy density exceeded 120 Wh/kg, subsidies for cars with a 150 km range increased by RMB 4,000 compared to cars with the same range, but with a lower energy density [20]. This action was taken to support not the automotive industry itself, but the lithium battery industry (which is a key element for the EV adoption), and to achieve technological parity between local manufacturers and those from Japan and South Korea. The same goal was pursued by the MIIT when they introduced the so-called "White List" in 2015, restricting access to subsidies for EVs, produced by foreign companies. This list restricts limits access to subsidies for foreign EV producers by limiting the number of eligible traction battery manufacturers. No EV with traction battery produced by companies not included in this list could qualify for the subsidy [17].

In 2018, the requirements for EV applying for a subsidy were updated once again [19]; the most serious changes occurred in 2019 [18]. First, all vehicles with less than 250 km mileage were excluded from the support programme. Second, to obtain the maximum subsidy, the EV should have used a battery with a specific energy of more than 160 Wh/kg. In addition, the most important change was the reduction of subsidies by more than two times (Figure 3). It can be assumed that the authorities considered 2019 as the final year of the 10-year subsidy programme, and in 2020, the federal subsidy programme was supposed to be terminated, at least in the form described above.

It should also be noted that EV support in the form of subsidies was carried out not only at the federal level, but also at the level of local authorities (regional governments and municipalities). For example, Beijing and Shenzhen launched a joint programme to provide additional subsidies equal in value to federal ones (a more detailed description of the forms of regional support for EV can be found in the review [3]). However, in 2016, the central government imposed a cap on local subsidies of up to 50 % of the amount provided by the federal government, and in 2019 a ban was introduced on regional subsidies for passenger electric car (with an exception for EV using hydrogen fuel cells, as well as for commercial EV). Instead, the central government obliged the regions to continue developing EV charging infrastructure and services. We can suggest two reasons for such action: ensuring a more even distribution of EV penetration among the population across the country (avoiding polarisation of the country into more and less developed regions), as well as preventing abuse of some manufacturers and subsidy fraud. In 2015, five auto manufacturers caused about RMB 1 billion ($ 158 million) in loss to the central government through malfeasance[6]. The centralisation of subsidies allows complete control over the emerging EV market.

[6] Jieyi Lu. Comparing U.S. and Chinese Electric Vehicle Policies. Retrieved from: https://www.eesi.org/articles/view/comparing-u.s.-and-chinese-electric-vehicle-policies (Date of access: 20.02.2020).

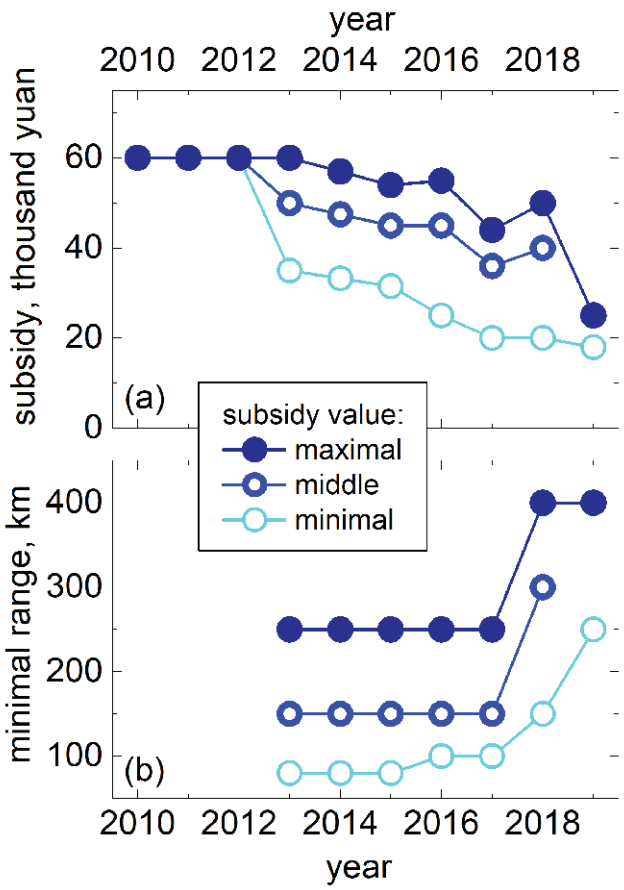

Fig. 3. *Dynamics of changes in a) the federal subsidy to purchase an electric vehicle, b) the requirements for distance on one charge travelled on a subsidised electric vehicle*

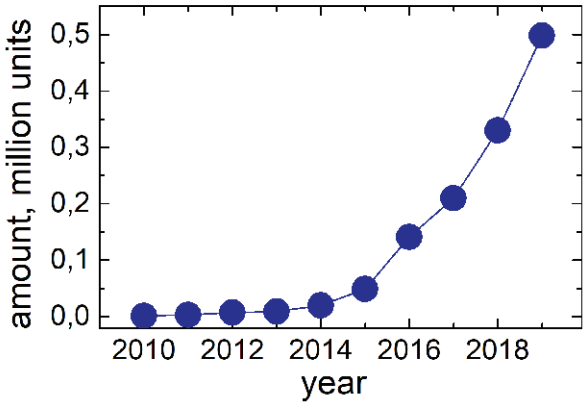

Fig. 4. *The total number of installed public charging stations in China in 2010–2018*

3.2. Infrastructure projects

Besides direct financial actions stimulating consumer activity, there are several measures unrelated to the EV price. Assuming that poor network of EV charging stations may prevent a buyer from choosing an electric car, the Chinese government implemented various forms of state support for the deployment of charging infrastructure. The number of public charging stations in China was constantly growing (Figure 4): from 2010 to 2015, the number of stations increased from 1,122 to 49,000; the total number increased to 141,000 by the end of 2016, and up to 214,000 in 2017 [21]. In 2018, the number of stations increased to approximately 330,000 units. [22], which, taking into account about 480,000 home charging stations, allowed reaching the number of 0.8 million charging stations for passenger cars in China [23]. As of November 2019, the number of public charging stations in China has grown to half a million[7].

In 2015, MIIT issued Guidelines for the Development of Electric Vehicle Charging Infrastructure (2015–2020), reporting that the total number of charging connectors was planned to be increased to 4.8 million by the end of 2020 [24]. Considering the growth rate of the number of charging stations and the fact that one public charging station is equipped with several connectors, this goal is reachable.

3.3. Preferences for EV buyers

Additional measures to stimulate a consumer demand are not limited to the development of charging infrastructure. For example, authorities in Beijing and Shanghai introduced monthly limits on the number of new licence plates for new vehicles in order to limit the number of vehicles in overpopulated cities with difficult traffic situations. The Shanghai Municipal Authority issues a certain number of licence plates for auction every month. In 2013, for example, its price was RMB 76,000 (about $ 12,600). To obtain permission to buy a car, potential buyers in Beijing must also participate in a car license plate lottery. In the lottery held in the same 2013, out of more than 1.74 million applicants, only 18,000 people received a licence plate [4]. Regional authorities use such auctions and lotteries to stimulate EV sales, and since 2011, preferences are given to EV buyers in all lotteries held in Beijing [25]. Some researchers highly appreciate the role of this measure; 6 regions using such preferences for EV buyers account for more than a half of national sales of electric vehicles [26].

Obtaining licence plates in large cities in China is becoming not only difficult, but also expensive for car owners, and local authorities are successfully using this feature as well. In several Chinese

[7] Liu Yuanyuan. China installed more than 1000 EV charging stations per day in 2019. Retrieved from: https://www.renewableenergyworld.com/2020/01/13/china-installed-more-than-1000-ev-charging-stations-per-day-in-2019/#gref (Date of access: 17.02.2020).

provinces and cities, EV buyers can obtain their licence plates without paying standard fees [17]. For example, savings can be up to RMB 100,000 ($15,900) for EV buyers in Shanghai[8]. Besides that, in some provinces and cities in China, EV drivers are allowed to use lanes for public transport, free parking, discounted EV charging, exemption from transport taxes and toll roads, special concessional lending programmes, and other forms of stimulating the demand for EV [17].

3.4. EV production stimulation

The measures to stimulate buying activity have been described above, but there is also the problem of meeting this demand. The measures that stimulate production growth include the introduction of a system of credits for EV production (NEV mandate policy [18]). This mandate policy sets the minimum percentage of electric vehicles sold by car companies. Lagging companies that do not meet this requirement have to buy credits from leading companies that exceed the established values (for example, BYD); otherwise, they will be fined. This approach is supposed to form a system of non-state financial stimulation for EV production and development.

According to the announced plans[9], in 2019 companies with annual sales of more than 30 thousand vehicles in the PRC market had to sell at least 10 conditional percent of EV, and at least 12 % in 2020 [18]. Simultaneously, the originally planned quota of 8 % at the end of 2018 was cancelled in order to provide companies with more time to adapt to new requirements. The use of the term "conditional percentage" is explained by the fact that for each model, a specially developed formula is used to calculate the number of credits. When assessing the fulfilment of quotas, the real percentage of sales is recalculated into conditional ones considering the number of credits for this model. At the same time, the real EV share of the sold cars can be 2–5 times less. A more detailed discussion of the credit system can be found in the related ICCT report [18].

It should be noted that this measure applies not only to local car manufacturers, but also to foreign companies. In addition, if earlier foreign manufacturers could ignore the desire of the Chinese authorities to increase the EV share since they could not qualify for subsidies, the introduction of credit system within NEV mandate policy forced them to reconsider their model range in China.

4. EV industry outlook in China

Most publications about government EV support in China [1, 3, 4, 5, 16, 24] noted the need to assess the success of the actions taken. The analysis of market data after ten years of these measures demonstrates their effectiveness. The consistency, stability, and complexity of the government economic policy of China in this direction were manifested in the fact that EV support did not stop after the first five years without a significant increase in sales (from 2009 to 2014), and also did not undergo dramatic changes after the first positive changes in 2015. EV support policy has improved every year, adapting to the current situation. The average size of the subsidy decreased (Figure 3a), the requirements for the quality of the subsidised products became more stringent (Figure 3b), local manufacturers of traction batteries were supported as well, and the national network of charging stations was constantly developed (Figure 4).

It should be especially noted that the actions taken not only provided the local EV market support but enabled its exponential growth in the first decade of the project. All other major EV markets, including the phenomenon of Norway with a 49 % EV share in 2018 sales, are characterised by linear sales growth. In our previous article based on the results until 2017 [27], we discussed whether the growth of the EV market in China can be described by an exponential dependence or two linear functions. The 2018 results provided a clear answer to this question. The exponential curve in Figure 1 was drawn for the first seven points (including 2017), but the results of 2018 (the eighth point) came up quite well.

The next question arises whether the analysis of EV sales chart (Figure 1) and measures to support the EV market (Section 3) can help to quantitatively assess EV prospects in China. Is it possible to predict prices for petrol cars and EVs? Unfortunately, we concluded that accurate forecasting is currently impossible, and such uncertainty may continue for at least several more years.

[8] Jieyi Lu. Comparing U.S. and Chinese Electric Vehicle Policies. Retrieved from: https://www.eesi.org/articles/view/comparing-u.s.-and-chinese-electric-vehicle-policies (Date of access: 20.02.2020).

[9] Si M., Yu C. Rules set new targets for NEVs. Retrieved from: http://english.www.gov.cn/state_council/ministries/2017/09/29/content_281475892901486.htm (Date of access: 17.02.2020).

In 2019, a significant reduction in the subsidy programme led to a slowdown of EV sales (Figure 1). This outcome was predicted, for example, in [19] (although it happened earlier than expected) that showed the key role of subsidies at the current stage of the EV market in China, thus answering the question formulated in [4, 16]. We can assume that while the barriers and shortcomings of the programme listed in work [15] could not slow down the growth rate at the initial stage, they began having a noticeable negative impact in the transition period. Now we need to understand how long the Chinese EV market will be adapting to the new rules, when the key measure to stimulate the EV production and sales is not subsidies, but the system of credits within NEV mandate policy. If the period of instability of the Chinese EV market does not last long and new plans for the EV share for the next decade will be announced in the near future, then short-term forecasting may become reasonable. However, to understand that the market returned to sustainable growth and forecasting is possible, it is necessary to develop methods of operational analysis of market data. We suggest using the analysis of EV monthly sales for assessing the EV market stability. These data are freely available, but their analysis is not so common for scientific publications.

Even if the transition period will be successfully overcome, the emerging EV industry may face another challenge that could slow down the EV share growth in the long term. The question is whether the energy system in China is able to adapt to the growth of electricity consumption by the automotive sector [15]. The transition from the use of petrol/diesel to electricity requires a significant modernisation of the Chinese energy system; therefore, it is not very clear how quickly electrical power industry will be able to support the growth of the EV share. Moreover, speaking about solving the problem of air pollution, we mentioned that an increase in the EV share should be accompanied by an increase in the share of electricity obtained from renewable energy sources (hereinafter, RES). Analysis of recent studies suggests that there are some problems in China's government policy in the field of supporting the RES development [28–30], which seems to be a significant risk factor for rapid growth of the national EV industry. Accordingly, for an accurate quantitative assessment of the EV market prospects, it is necessary to update regularly the quantitative assessments of the prospects for the development of RES in China and study its impact on the EV market.

Speaking about qualitative assessment of the prospects, we can suggest that the period of exponential growth is over; however, after several years of uncertainty, the market will return to the growth. Such a forecast can be made due to the absence of prerequisites for a significant change in the vector of China's government policy. It can be confirmed by the extension of the subsidies and tax incentive programme for another two years as a reaction to the slowdown of the EV market growth in China due to the coronavirus pandemic[10]. These actions are expected, as the mentioned above drivers of change in China's automotive industry remain topical. China's dependence on energy imports stays significant, air pollution levels in major cities are high, and Chinese car exports are low. The traction battery industry in China, crucial for the EV progress, is also developing rapidly, and the dominance of China in this area in the coming years is unquestionable. Another confirmation of the success of the programme is the fact of the beginning of the long-awaited expansion of passenger EVs of Chinese brands to Europe. BYD announced the start of sales of its electric cars in Norway[11], and Aiways began its European sales by supplying several hundred EVs to Hertz's French Corsica division [12].

In any case, nowadays, the Chinese government has both a set of tools that effectively influence the development of the automotive industry in China, and the experience of successful implementation of these tools. Returning to one of the findings of the 20th survey of automotive industry executives by KPMG, the Chinese government has demonstrated to the whole world its skills as a change architect. It has the world largest automotive market, a developed EV industry, and the world largest capacity for the production of traction lithium batteries.

[10] China Extends Rebates for Electric-Car Purchases to Revive Sales. Retrieved from: https://news.bloombergtax.com/daily-tax-report-international/china-extends-rebates-for-electric-car-purchases-to-revive-sales (Date of access: 25.05.2020).

[11] BYD sets out European EV expansion strategy. Retrieved from: https://bydeurope.com/article/319 (Date of access: 25.05.2020).

[12] Hundreds Aiways U5 as rental car on French island Corsica. Retrieved from: https://www.wautom.com/2020/05/hundreds-aiways-u5-as-lease-car-on-french-island-corsica/ (Date of access: 25.05.2020).

5. The impact of the EV progress in China on the global automotive industry and the economy of the Russian Federation

The further evolution of measures of EV government support in China strongly depends on the chosen development vector. In our opinion, there are two main directions, internal and external. The development of the domestic EV market will allow solving environmental, political, and economic problems. If China is able to maintain a high share of domestic car manufacturers in the local EV market and simultaneously ensure its stable growth, then due to the gradual displacement of foreign manufacturers, this will lead to an increase in car production even in the absence of growth in vehicle sales in general. However, given the change in EV support policy, it will not be an easy task. It should be remembered that the EV subsidy programme was limited to Chinese manufacturers and sales of foreign-brand EVs were negligible. The shift from subsidies to credits has led to the massive introduction of new foreign EV models. This will contribute to meeting environmental and political objectives, but may hinder the achievement of economic goals.

External development implies stimulating the export of EVs produced by Chinese brands to foreign markets. Due to the implementation of the subsidy programme, the EV export was unprofitable for Chinese companies through 2019. Domestic EV sales were beneficial to local producers in terms of both subsidies and credits within the NEV mandate policy. Thus, despite the success of Chinese companies in terms of EV production, even the most successful models are practically not represented in foreign markets. All we can mention is the media activity of Chinese manufacturers (announcements and long-term plans) and sales of commercial vehicles (electric buses and trucks) by BYD. As we noted in [27], the electric bus market in China is saturated and can no longer demonstrate such growth as the electric car market, so this step by BYD looks quite reasonable even without government support measures for the export of electric vehicles. Due to the significant changes in the government policy of EV support in China in 2019, Chinese EV brands are more likely to expand to foreign markets. However, keeping in mind the results of the KPMG survey mentioned at the beginning of the article[13], we can assume that the government policy of the Chinese regulators will be the determining factor. If such a task is explicitly formulated and supported by appropriate modifications of the EV support programme, then this external development will be feasible for the Chinese industry.

For a more accurate assessment of the future growth prospects of the EV market in China, it is necessary to wait for the publication of the new plans of the Chinese government for the fourteenth five-year period (2021–2025) and data on EFV sales in China in 2020 and 2021. Once this information becomes available, it will be possible to assess which path the Chinese EV industry will take (internal or external development). In any case, we will have the opportunity to observe the struggle between Chinese and international brands for EV buyers, at least in the domestic Chinese market, but, possibly, in foreign markets as well. As we noted above, the decline in subsidies supporting local brands and the resulting increased competition in the Chinese EV market have led to the reappearing of foreign models among the twenty best-sold EVs in China. It can be assumed that for many brands, China is becoming the main testing ground for new EV technologies. In any case, China's EV policy will play a key role in the further transformation of the global automotive industry.

Regarding Russia, understanding of the processes of transport electrification in China is interesting for several reasons. First, China's need for energy resources may change; for example, there may be a redistribution with a downward trend in the consumption of oil and petroleum products used for the production of automotive fuel, accompanied by an increase in the consumption of natural gas used to generate electricity. Second, an increase in the EV share in China may lead to an overproduction of gasoline cars and an increase in exports to the neighbouring Russia. Third, Russia can competently use its resource potential. The EV industry growth leads to an increase in demand for lithium, nickel, cobalt, manganese, graphite (natural and artificial), copper, aluminium, as well as rare earth elements for electric motors. In addition to growing investments in the mining industry, Russia can start building a chain for the production of traction batteries, from the extraction and processing of raw materials to the production of electrode materials, with further support of the electrochemical cells production. In this case, the country can transition to a full cycle of domestic production of solutions for energy storage, which can be used not only in transport, but also in energy. Finally, to develop our own action plan in a changing reality, it is necessary to understand which value of the EV share in the

[13] 20th KPMG Global Automotive Executive Survey 2019. URL: https://automotive-institute.kpmg.de/GAES2019/ (дата обращения: 13.02.2020).

global or regional automotive markets should be considered as a threshold one, indicating that global electrification is inevitable.

6. Conclusion

The study of China's experience of government support for the electrification of the automotive industry in the past decade is of considerable interest due to the rapid rise in EV popularity in this country. At the end of 2019, sales of light electric vehicles in China exceeded 1.2 million units, and their share reached 5.5 %. The complex of political, environmental, and economic reasons considered in the article suggests that the government programme for the development of the EV industry will be continued.

Despite the instability of the local EV market in China in 2019, the government programme of EV support in China can be considered successful. This happened due to both the complexity of measures (subsidies for purchases, a system of credits for car manufacturers, the charging infrastructure deployment, and the introduction of preferences for EV owners) and their systematic implementation. After the announcement of plans and target indicators, it will be possible to draw conclusions about the directions of further development of the EV industry in China. One direction includes the consistent growth of the domestic market with the gradual displacement of foreign brands, including premium brands. Another scenario focuses on the international expansion of Chinese manufacturers, who accumulated significant knowledge about the EV operation in different climatic conditions, developed the required technologies, and have significant production capacities of both EVs and traction batteries.

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