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Anhui LIGOO: A Battery Management System for New energy Vehicles

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Ming Xu was the chief executive officer (CEO) of Anhui LIGOO New Energy Technology Co., Ltd. (LIGOO). In 2014, he was trying to decide whether to turn again to the field of new energy vehicles (NEV) to realize the company’s initial dream or persist with battery management system (BMS) in the field of communications and coal mining.

Since its launch in 2010, LIGOO had focused on becoming China’s innovative leader in the field of NEVs, focusing on the technology of BMS. In 2012, LIGOO worked with BMS in the communications and coal mining industries through a strategic transformation that was the result of a weak reception for NEVs in China. It was not until 2014 that the market for NEVs began to develop rationally and government policies were enacted that strongly promoted the development of these vehicles. Should LIGOO continue to focus on BMS in the fields of communications and coal mining to survive? Or should it start its second strategic transformation by focusing again on BMS in the field of NEVs?

THE COMPANY

LIGOO, established in February 2010, was a Chinese high-tech company specializing in the technical research, product development, and system integration of BMS. Almost all members of the core team had graduated from the University of Science and Technology of China and completed the sub-subject “BMS of electric vehicles,” part of the government-funded “863 Program” (or “National High-Tech R&D [research and development] Program of China”). LIGOO took the lead in passing TS16949 and CE certification.[[1]](#footnote-1)

LIGOO’s core technology had a reputation for “enabling the battery to think.” The implementation of large-capacity, high-efficiency, long-life, trusted electric power management had been successfully applied in the electric vehicle (EV) that was used by the United States’ White House.[[2]](#footnote-2) LIGOO, owning the proprietary intellectual property rights and the most advanced technology in the field of BMS, “developed a product line of 11 series and 29 types through the operation of industrialization.”[[3]](#footnote-3) Moreover, BMS was widely applied in EVs, new energy access, smart grids, and power supplies in rural areas.

As a leading provider of BMS manufacturing and service, LIGOO was committed to providing the best products and services to global energy manufacturers, solution providers, and end users. LIGOO gained a stable market share among top BMS manufacturers, which included Nissan Motor Co. Ltd., State Grid Corp. of China, China Mobile Communications Corporation, and China Shenhua Energy Co. Ltd. LIGOO provided energy-saving and emission-reduction technology in a scientific and controllable manner, thereby offering a continuous driving force for sustainable use of new energy and social advances. Within just two years, LIGOO had gained a leading position in the industry. Because LIGOO owned the original BMS technology, it was one of 23 companies chosen as “2013 Technology Pioneers” by the World Economic Forum in September 2012.[[4]](#footnote-4)

Xu, LIGOO’s CEO, previously had co-founded the public company Anhui USTC iFLYTEK and had served there as executive vice-president responsible for market operations, brand development, and inner management. He had then joined Dell Computer (China) Co., where he had taken charge of key client markets in Eastern China. In 2010, Xu set up LIGOO and became chief executive officer. Xu was one of the 10 major economic trendsetters in China in 2013.[[5]](#footnote-5)

LIGOO AND the BMS INDUSTRY

As early as 2001, in order to promote and develop energy-savings and NEVs, China established some major strategies for EVs in National High-Tech R&D projects (e.g., the “863 Program”) and identified the basic principles of strategic development of EVs.[[6]](#footnote-6) During the development of traditional cars, China had experienced a technology gap of more than 30 years compared to advanced levels throughout the world. During pure EV technology development, however, the technological gap was not that large; development was almost at the same level as in other countries, and in areas such as zinc air battery and lithium battery research, China was the world leader.

In 2008, the electric car was widely used during the Summer Olympic Games in Beijing and was highly praised.[[7]](#footnote-7) Subsequently, the Ministry of Science and Technology launched the “Ten Cities, Thousands of Vehicles” program to promote the development of EVs in 10 pilot cities. By 2010, 10,000 energy-saving vehicles and NEVs had been produced. In 2009, inspired by a series of incentive policies, domestic automobile enterprises increased R&D for EVs and related investments. China’s EV industry had entered a new stage of development.

Behind this policy development, Xu had discovered by investigating that although the overall level of quality of domestic batteries had steadily improved, frequent accidents were happening with the use of EV batteries. With the many bottlenecks that restricted the development of domestic EVs, BMS technology was not yet mature; this was undoubtedly one of the factors causing the problems. Xu believed that BMS was a link between batteries and users, and that, having become a standard component of NEVs, it would occupy a more prominent role over time. He realized that BMS R&D projects, primarily conducted by graduate students, were not sufficient for showcasing the systems’ qualities. Xu recognized that timing was critical to achieve success in the new industry; therefore, he contacted Liu Yu, the backbone of the EV–BMS team at the University of Science and Technology of China, to get timely support. With deep camaraderie from having attended the same school, strong technical backgrounds, and a passion for entrepreneurship, the two hit it off immediately. LIGOO was established with Xu as chairman and Liu as general manager. LIGOO focused on repositioning itself as the leader in the electrical control system industry and becoming China’s innovative leader in the field of NEVs.

In 2009, about 30 manufacturers were specializing in BMS products in the domestic market. Most companies were small in terms of both size and core technology. Large-scale car manufacturers had not yet made strategic plans for developing NEVs, and they invested less in R&D for BMS. For example, the investment by BYD Company Ltd. (BYD) in R&D for BMS was only ¥11 million[[8]](#footnote-8) in 2009, far below its R&D investment for other products.[[9]](#footnote-9) Moreover, the BMS products developed by BYD were mainly used for EVs developed by the company itself.

BMS was usually referred to as the “brain” of EV power battery systems, and together with power battery and vehicle control systems, they constituted the three core technologies of EVs. BMS improved battery use to prevent overcharging and over-discharging of the battery and to extend the battery life. In addition, BMS monitored battery and vehicle status to ensure the safety of EV performance. BMS were used for EVs, underwater robots, base stations in the communications industry, and spare batteries for sheltered rescue tanks in mines. In general, BMS needed to accurately estimate the state of charge, dynamic monitoring, and battery balance.

Later, lithium batteries were used as the main driving power of EVs, providing the advantage of high-energy density for more stable performance. However, the quality of lithium batteries was not easy to control during mass production; there were, therefore, some minor differences among the batteries produced. Because of the different operating environments, battery aging, and other factors, not only did inconsistencies among the batteries become more serious, but also battery efficiency and battery life decreased. Serious problems such as the batteries causing fire and other safety issues could arise because of overcharging or over-discharging.

BMS helped measure the use of the battery pack to protect the battery from overcharging and over-discharging; maintained the balance within each battery; and analyzed and calculated the battery power, converting it to the understanding of battery life information to ensure its safe use. In 2012, the growth of the global BMS market output increased by more than 10 per cent.[[10]](#footnote-10) At that time, many companies planned to enter the BMS industry, including vehicle factories, battery factories, and related automotive components plants, to grasp the core technology of the EV industry.

In general, China’s BMS market participants fell into the following three main categories:

*Power battery enterprises*: Most of these companies adopted the “BMS+PACK” mode and mastered the core technology, from battery power core to battery pack. These enterprises included BYD, Contemporary Amperex Technology Co. Ltd., and China Aviation Lithium Battery Co. Ltd.

*Vehicle companies*: These companies were less involved in the electric cell and achieved access to the BMS market through mergers and acquisitions, strategic co-operation, and strategic alliance. Large vehicle companies focused on BMS; for example, Changan Automobile Co. Ltd. (Changan), Beiqi Foton Motor Co. Ltd., and Geely Auto had specialized R&D teams for BMS.

*Professional third-party BMS enterprises*: Domestic third-party BMS enterprises occupied the main position. Their technological accumulation gave them a natural advantage. There were many participants in this category, with large differences in technology. The enterprises at the forefront of competition in China were Shenzhen KLClear Technology Co. Ltd. (KLClear), Huizhou E-POWER Electronics Co. Ltd. (E-POWER Electronics), and LIGOO.

Positioning

China’s policy documents “New Energy Vehicle Demonstration and Promotion Notice”[[11]](#footnote-11) and “Notice on Carrying out the Private Purchase of New Energy Vehicles Subsidy Pilot”[[12]](#footnote-12) of 2010 created a favourable external environment for LIGOO’s development. In addition, LIGOO benefited from the nearly ¥300 million in special subsidies from Anhui Province for NEVs. In 2010, from February to the end of the year, LIGOO’s turnover was about ¥600 million. Although the company’s performance was good, its market share was less than 15 per cent (see Exhibit 1). Thus, for LIGOO, one reason for development was to catch up with KLClear and E-POWER Electronics, which had a combined market share of more than 60 per cent.

LIGOO established a leading position in the BMS industry at the Summer Universiade (an international university sports and cultural event), held in Shenzhen, in August 2011. To seize a promotional opportunity and improve the city’s ecological environment, the newest NEVs were to be used for transportation during the event. Shenzhen Wuzhoulong Motors Co., Ltd. (Wuzhoulong) and BYD were chosen to provide the vehicles. Wuzhoulong provided 1,511 vehicles including 1,350 single-deck hybrid buses, 20 double-deck hybrid buses, 53 pure-electric buses, 26 pure-electric minibuses, 60 fuel-cell vehicles, and two fuel-cell buses, which represented 75.1 per cent of all the NEVs used at the event.

There was, however, a bottleneck in producing BMS technology, so Wuzhoulong and BYD needed to acquire BMS technology from a third party and integrate that into their vehicle batteries. On the day of product commissioning, all bidders, including KLClear and E-POWER Electronics, the leading domestic manufacturers of BMS technology, were confronted with a problem: the distance between electrodes in the BMS products that had been made by the Wuzhoulong and BYD was too short thus leading to a significant leakage of electricity. Shenzhen, where the event was taking place, was in a low altitude area and had a subtropical marine climate. Further, Shenzhen had experienced a significant amount of rain the previous month, resulting in unusually high humidity. The high humidity caused too much water, which lead to the electrodes of BMS product to be connected together, resulting in short circuit of BMS and eventually leakage of electricity.

A company with the best solution to the problem delivered in the shortest time possible would likely be successful with a bid to provide the BMS technology. Xu and several top management personnel, as well as all of LIGOO’s technology and R&D personnel, flew to Shenzhen overnight. LIGOO’s early technology accumulation began to show its advantage. On the plane, Xu and the technical personnel developed five possible solutions, taking into account the temperature, humidity, dust, and other factors in Shenzhen. The team went directly to the event despite their fatigue and the muggy weather. They tested their solutions with raw materials obtained locally, and submitted a perfect and successful solution three days ahead of the deadline.

LIGOO won the bidding and received the most orders—supplying BMS technology for 1,100 of the EVs at the event. Thus began LIGOO’s popularity in the BMS industry. Its level of technology and efficiency in solving problems impressed the large vehicle manufacturers and laid a solid foundation for the company’s rapid growth. In the second half of 2011, LIGOO’s performance increased rapidly (see Exhibit 2).

The cold market

The market’s response to EVs was cold in 2011, even with policies encouraging their use. According to statistics from The Automobile Association, China produced 18,418,900 automobiles[[13]](#footnote-13) and sold 18,505,100 in 2011,[[14]](#footnote-14) while production and marketing of NEVs was less than 10,000 units. When Changan, BYD, and Toyota Motor Corp. introduced hybrid cars to the market, all received a cold response.

For customers, price was always a problem. The price of a BYD E6 (an all-electric car) was ¥370,000, and Chevrolet’s electric car, Volanda, was ¥498,000. These vehicle prices, even with EV purchasing subsidies, were much higher than the price of a traditional car of the same level. However, for manufacturers, production costs were always a headache. It was impossible to reduce the sale price without cutting production costs.

By the end of 2011, 243 charging stations and 13,283 AC (alternating current) charging posts had been put into operation nationwide, which was not enough for the huge number of vehicles (both the current number and the future expected number) in China.

In 2011, an electric taxi spontaneously exploded in Hangzhou. Other fires caused by battery leakage aroused people’s concerns about the reliability of EV technology. Of course, safety concerns would keep customers from purchasing EVs.

It was difficult for car manufacturers to make a breakthrough in the area of battery technology, making the development of new energy the most significant challenge to EVs. Existing bulky, heavyweight batteries, which lacked reliability, stability, and sustainability, had short product lifecycles. Other common factors also constrained the new energy development of EVs. The high cost of the battery system led to high vehicle prices, making it less possible for consumers to purchase. Shrinking market demand caused manufacturing to slow down, and rising manufacturing costs further boosted the price for NEVs, forming a vicious cycle.

If the problems could not be solved, NEVs would be expensive and difficult to sell to ordinary people in the middle class. Even with support from the Chinese government, the market still could not fully accept the NEVs. Market development was worse than expected and inevitably led to many obstacles for manufactures.

facing difficulties

LIGOO became the leader in the BMS technology industry less than two years after the company’s inception. However, the company saw its orders plummet 54 per cent from the beginning of 2012 to the end of 2012 (see Exhibit 2), which seriously affected the company’s normal operation. Moreover, the financial status of other companies in the industry was also not optimistic, with KLClear on the verge of collapse and more than 11 BMS manufacturers in bankruptcy, making it difficult for the rest to survive.

With the problems brought about by the cold market, LIGOO’s original 12-person entrepreneurial team became a little depressed and struggled to unify their views. There were two main differences in opinions within the team. One view was that although government policy supported the new energy automotive industry, market demand was limited and, coupled with rising costs, profits were continuously compressed. This group wished to shift its funds and personnel to other industries and abandon the BMS industry.

The other view from the entrepreneurial team was that it was necessary to stick with BMS, even though the market was cold and LIGOO’s performance had been greatly affected. First, multinational battery companies were optimistic about the vast potential of the Chinese market and even invested in factories in China. In the next two years, China was likely to be more involved with promoting EVs to meet the increasing global demand for NEVs. Second, LIGOO’s technology accumulation was deep, especially after 2011, when it achieved a breakthrough in BMS active equalization technology. LIGOO’s accomplishment had caused a shock throughout the industry and had led to market development. It was unwise to give up that advantage. Finally, LIGOO had accumulated a large number of customers, and its technology and services had positively impressed customers, especially large car manufacturers. This large number of customers could create huge profits for LIGOO, which in turn could establish a good foundation for the future EV market.

However, certain gaps were not yet filled, even after years of co-operation. Eventually, seven people, led by Xu and Liu Yu, continued to work together at LIGOO in the field of BMS. Unfortunately, Zhang Xin, the technical director, and four other people withdrew their shares and turned to other industries.

the first transformation

Faced with the company’s poor performance and the loss of employees (37 employees left LIGOO—a drop from 105 persons in 2011 to 68 persons in 2012), Xu stood at the crossroads of the company’s development. He steadfastly believed in continuing R&D for BMS and was willing to listen to the voices of LIGOO’s employees, who expressed their opinions at a meeting.

Li Ming, who was responsible for the company’s marketing, spoke first:

The development of NEVs cannot succeed without the national policy support; however, when will the market really warm up? At present, the prospects of [the] whole BMS industry development are still unclear and we must jump out of the established model and shift our strategies for the company’s long-term development. However, during the strategic shifts, we need to carefully analyze our strengths and weaknesses.

Technical director, Zhang Jin, followed Li Ming:

Obviously, our company’s biggest advantage is the industry-leading technological accumulation and good reputation. For example, we utilize the improved D-Filter algorithm for the battery system parameters (such as dynamic battery voltage, current, etc.) to keep the bias of the collection accuracy less than 0.2 per cent. The breakthrough of BMS active equilibrium technology has our peers still imitating and chasing after us. What we have shown in Shenzhen in 2011 at the 26th Summer Universiade also gave a deep impression to BYD and other large car manufacturers. I think this is our biggest advantage if we continue to insist on doing BMS.

Qin Guoqing, the marketing director, was familiar with the battery market and suggested,

Based on the understanding of the national battery market, entering into the coal industry is a good choice. Standby power is stored in the rescue cabin. And the use of our technology will protect the underground mine workers in a better and safer way.

The deputy general manager, Liu Liang, then added,

The communications industry is accelerating the construction of base stations, which are in need of lithium battery control. And I believe that the transition to the communications industry is also a good choice.

At the meeting, some employees also suggested co-operation with tunnel projects, water conservation and hydropower, and smart wearable devices to foster diversified development.

After a calm analysis of the internal assessment and the industry environment, Xu organized a decisive meeting, where he allowed employees to make a decision using secret ballots. The results showed that communications, coal mines, and the tunnelling industry were the top three options for the company’s development. Considering the limited number of tunnels that could be constructed, Xu decided to enter the communications and coal mining industries. Although diversified development was conducive to LIGOO’s long-term development, it would disperse R&D and management to a certain extent, and the required early investment would put pressure on the company’s finances, which would not be conducive to solving the company’s plight. Therefore, Xu decided to give up the diversified development path.

new look

From the beginning of the implementation of the company’s strategic transformation to the second half of 2013, LIGOO not only survived the crisis but also significantly improved its financial situation. Its technical accumulation climbed to a higher level. In addition, due to the company’s business expansion into the communications and coal mining fields, BMS technologies in different areas were widely used and tested, which made LIGOO employees more confident about their own technology.

Of course, the accumulation of data was even more important. Over the course of more than a year, the technical staff collected a great deal of useful data, compared them with the simulation data in the laboratory, and continually optimized the technology. Compared with the early stage, the technology had improved, and the upgraded technology occupied a favourable position in the subsequent development. For example, in non-linear multivariable state estimation technology, LIGOO adopted a non-linear adaptive fuzzy control system method. Through the use of mean value theorem, a difficult control problem in the system could be solved by the fuzzy system design method. The control method was optimized by multiple acquisitions of data, which significantly improved the system’s stability and adaptive adjustment ability.

the decision

Xu still remembered the excitement when the notice “On Continuing on the Promotion and Application of New Energy Automobile” was issued by the Chinese government in September 2013. The notice meant that the state had begun to promote subsidies at the operational level, and had implemented industrial planning with stable expectations. It was the largest EV support policy at a national level since 2009. The Notice explicitly mandated that the accumulated number of NEVs over the following two years in large cities or key areas was to reach a minimum of 10,000, and in other cities or regions, the minimum number was 5,000. Over time, 39 cities or urban agglomerations were added to the new promotion list, with a total of 88 cities that would accumulate 240,000 new energy vehicles (5,000 vehicles for each city; 10,000 vehicles for each urban cluster) if these 88 cities could complete the scheduled tasks by the end of 2015.

In light of this, Xu felt that spring was arriving for NEVs, especially with the announcement by the government “to further promote the use of new energy vehicles” in February 2014, and the state council’s announcement of “guidance on accelerating the application of new energy vehicles” in July 2014. These two announcements issued by the Chinese government enabled the provision of a comprehensive plan, from EV standards and government subsidies, to accelerate the construction of charging facilities and other factors.

Driven by strong policy support, not only did large-scale vehicle manufacturers increase investment in the field of EVs, but also individuals were stimulated to buy EVs due to a new series of preferential policies, such as purchasing subsidies. Market capacity grew rapidly. Compared to the trend of NEVs in 2009, the current market was more aggressive.

If LIGOO continued to work on base station projects in the communications field, with a limited number of base stations, it would be soon be facing a saturated market. Also, upstream raw material prices had risen continually, resulting in increased production costs. Downstream firms were concentrated, which resulted in weak bargaining power for manufacturers in the supply chain. Effective control of price fluctuation risks could not be achieved, leading to quick incremental increases in BMS manufacturing costs. Xu compared procurement cost tables between May 2011 and May 2013 and found that, in addition to other costs, the average cost of BMS equipment production had increased by about 30 per cent, and the salaries of maintenance staff had also increased. The final profit was not very high; the average profit per BMS had fallen by about 20 per cent compared to 2011.

Under the circumstances, with national policy constraining the coal industry, development in that industry slowed. The trend of collapse was spreading. The utilization rate of standby power in rescue cabins was not very high. Slow equipment updates—an obstacle for companies to provide equipment for coal mine rescue capsules and evacuation holes—brought great distress and a sharp decline in market demand, which also affected LIGOO’s orders. For example, orders from Hunan Coal Mine Safety Equipment Co., Ltd. fell more than 40 per cent in the second quarter of 2013 compared to the same period in 2011.

At the same time, the NEV market had become hot again, and companies in the field of NEV BMS were excited that the government had actively implemented new favourable policies to the companies’ advantage and accelerated the layout of the market share of the NEV BMSt. BMS manufacturers that had transitioned to other fields realized the arrival of new opportunities and intended to return to the uncontested market space again. According to incomplete statistics, in February 2014, 25 original BMS manufactures had returned to that competitive arena.

Should LIGOO continue to focus its efforts on BMS in the fields of communications and coal mining? Or should it start its second strategic transformation journey by focusing again on BMS in the field of NEVs? Xu fell into deep thought.

EXHIBIT 1: China’s BMS manufacturers—market share, 2010

|  |  |
| --- | --- |
| **Company** | **Market Share (%)** |
| Anhui LIGOO New Energy Technology Co., Ltd. | 13 |
| Shenzhen KLClear Technology Co., Ltd. | 25 |
| Huizhou E-POWER Electronics Co., Ltd. | 37 |
| Others | 25 |

Note: BMS = battery management systems.

Source: Company documents.

EXHIBIT 2: LIGOO—turnover and growth rate, 2011 to 2014

Note: LIGOO = Anhui LIGOO New Energy Technology Co., Ltd.; CNY¥ = Chinese yuan renminbi; CNY¥1 = US$0.16 on March 31, 2014.

Source: Company documents.

1. TS16949 certification was the technical specification of the international automobile industry, which was based on ISO9001. CE certification referred to a safety qualification mark that passed the international safety standard test. It was seen as a manufacturer's passport to open and enter the European market. [↑](#footnote-ref-1)
2. Anhui LIGOO New Energy Technology Co., Ltd., *LIGOO: The World-Leading BMS Provider, Company Profile 2012*, April 25, 2012, accessed December 11, 2017, www.LIGOO.cn/upload/201204/2012042573878609.pdf. [↑](#footnote-ref-2)
3. “Anhui Ligoo New Energy Technology Co., Ltd,” rssing.com (RSS data service), April 2, 2014, accessed May 7, 2018, http://battery2849.rssing.com/chan-50211590/all\_p1.html. [↑](#footnote-ref-3)
4. Silvia von Gunten, “Which Companies are Going to Change the World?,” World Economic Forum, August 28, 2012, accessed December 11, 2017, https://www.weforum.org/agenda/2012/08/which-companies-are-going-to-change-the-world. [↑](#footnote-ref-4)
5. Sina finance, “Xu Ming, CEO of LIGOO New Energy Technology Co., Ltd., Wins Top Ten Major Economic Trendsetters in China in 2013,” Sina Finance, September 16, 2013, accessed June 20, 2018, http://finance.sina.com.cn/china/20130916/223816777999.shtml. [↑](#footnote-ref-5)
6. Ministry of Science and Technology of China, “‘Energy Saving and New Energy Automobile’ Major projects in Modern Transportation Technology Application Guide for the 2006 Project of the National High-Tech R&D Projects (the ‘863 Program’),” Ministry of Science and Technology of China, September 27, 2006, accessed June 20, 2018, http://www.most.gov.cn/tztg/200610/t20061025\_36542.htm. [↑](#footnote-ref-6)
7. Beijing Organising Committee for the Games of the XXIX Olympiad, Preparation for the Games: New Beijing Great Olympics, page 151 and 170, August, 2010, accessed June 21, 2018, https://stillmed.olympic.org/Documents/Reports/Official%20Past%20Games%20Reports/Summer/ENG/2008-RO-S-Beijing-vol3.pdf. [↑](#footnote-ref-7)
8. ¥ = CNY = Chinese yuan renminbi; ¥1 = US$0.16 on March 31, 2014; all currency amounts are in CNY unless otherwise specified. [↑](#footnote-ref-8)
9. Research in China, “Global and China Power Battery Management System (BMS) industry report, 2014-2017”, Research in China, August, 2014, accessed June 22, 2018, http://www.researchinchina.com/UpLoads/ArticleFreePartPath/20140822131708.pdf. [↑](#footnote-ref-9)
10. China Industry Information Network, *Analysis of the current situation of China's Automobile Battery Management system Market in 2016-2022 and its Future Development trend report*, July, 2016, accessed June 21, 2018, http://www.chyxx.com/research/201607/430051.html#chart. [↑](#footnote-ref-10)
11. Ministry of Finance website, “Notice on Pilot Work of Demonstration and Extension of Energy-Saving and New Energy Vehicles,” the Central People’s Government of China, February 05, 2009, accessed June 21, 2018, http://www.gov.cn/zwgk/2009-02/05/content\_1222338.htm. [↑](#footnote-ref-11)
12. Equipment Industry Department, “Notice on Carrying out the Private Purchase of New Energy Vehicles Subsidy Pilot,” Ministry of Industry and Information Technology of China, June 04, 2010, accessed June 21, 2018, http://www.miit.gov.cn/n1146295/n1652858/n1652930/n3757018/c3757144/content.html. [↑](#footnote-ref-12)
13. “China Automobile Production Decrease 9.26% in December 2011,” China Association of Automobile Manufacturers, January 13, 2012, accessed December 11, 2017, www.caam.org.cn/AutomotivesStatistics/20120113/1505067047.html. [↑](#footnote-ref-13)
14. “China Automobile Sales Increase 1.38% in December 2011,” China Association of Automobile Manufacturers, January 13, 2012, accessed December 11, 2017, http://www.caam.org.cn/AutomotivesStatistics/20120113/1505067050.html. [↑](#footnote-ref-14)