

SWOT Analysis of Future Trends in BEV-related Technologies: Xiaomi Automobile Co., Ltd's Latest Product as a Case Study

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Abstract: The new energy vehicle sector has benefited from numerous subsidies in response to the World Environmental Protection Organization's and governments' calls for a reduction in carbon emissions. Battery-electric vehicles (BEVs), the kind of EV with the lowest carbon emissions, have gained popularity in the automotive industry. Using a battery system as a power system not only improves efficiency but also ensures that it does not pollute the environment. Along with other technological advancements like the incorporation of cutting-edge chips in the central controls of the vehicle and latest AI systems, the convenience of BEVs for consumers keeps increasing. This paper introduces the new technology systems included in the latest products launched by Xiaomi, such as the new battery system, smart driving system, and all-round AI system. Then more analyses of the strengths, weaknesses, opportunities, and threats of BEVs in the future with the impact of new technology. The analysis not only raises some of the technical issues that need to be addressed in BEVs today but also points to the crisis that will exist in the BEV market in the future. After analyzing the situation, some recommendations and directions for in-depth research were given. And take Xiaomi's latest BEV product as an example to further do a SWOT analysis of Xiaomi's strategic development into the BEV market.

Keywords: SWOT Analysis of BEV, Future Automotive Market, Xiaomi's BEV, Intelligent Systems, Product Analysis

1. Introduction

Protecting the environment is a major concern for people today, and technological development is also the most discussed topic. Both of them are inextricably linked in the present society. Unlike HEVs and FCEVs, BEVs have a faster acceleration-start braking system, lower maintenance costs, and a longer battery life. The advent of battery electric vehicles has also made improvements to the world's environmental problems, such as improved air quality, reduced consumption of fossil fuels, and reduced ambient noise. With the introduction of the Tesla battery electric vehicles in 2010, the automotive market has seen a new wave of eco-friendly ideas.

According to statistics, as the most popular new energy vehicle, electric vehicle sales are growing at a high rate. Fig.1 shows worldwide sales of PHEVs, FCEVs and BEVs for the period 2010-2023. EV sales growing rapidly from 2020 onwards and BEV sales increasing by more than two million

per year. With more large companies like Huawei and Xiaomi joining the EV industry, some experts analyze that EV sales will exceed 30 million within a decade.

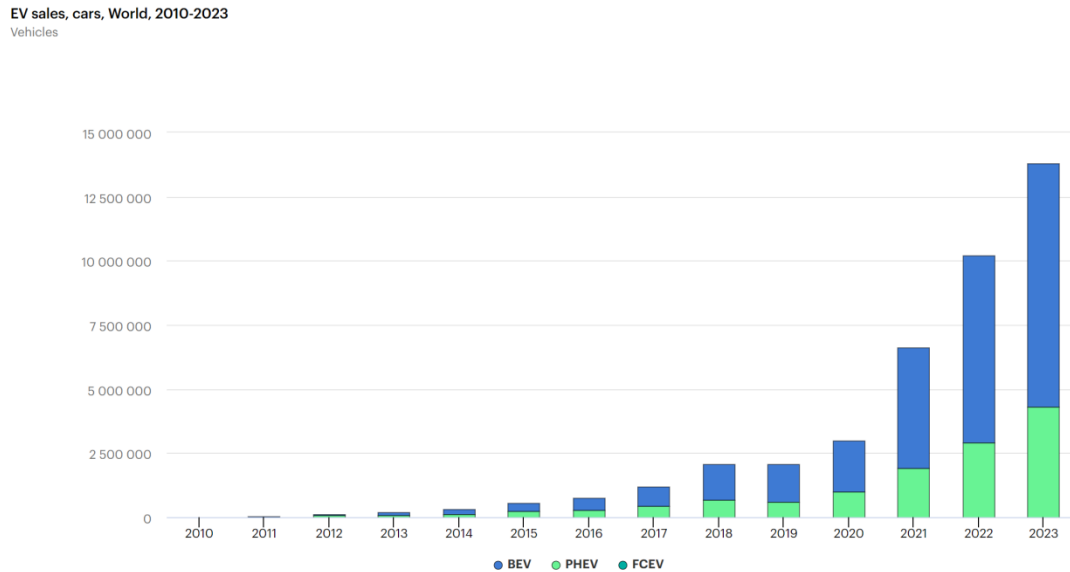


Figure 1: Global EV sales between 2010 and 2023 [1].

Despite such high sales of BEVs, they still leave a lot to be desired battery-wise. In contrast, FCEVs have cheaper and more cost-effective battery systems. According to professional organizations, fuel systems could drop as low as \$22 per kilowatt by 2050 [2]. The battery system of Xiaomi's latest product adopts a dual-motor mode and has a total power of 495 kW. It has a CLTC pure electric range of between 700-830 km. While the BEV's new battery system costs more than the FCEV's, it has a better range and power. But Xiaomi, the company that developed this project, was not initially a car-making company. Xiaomi used to sell mobile phones as its main and it came the smart home and other series of products. Then it entered the manufacturing and selling of battery electric cars in 2021. BEV batteries are now more effective at supplying energy but dangers such as spontaneous combustion, short circuits, and leakage still lurk in them. Although the government has enacted several welfare policies related to BEVs, issues such as the cost of charging and the energy consumption of the electricity supply remain unresolved. The HyperEngine V8s, the new super motor to be fitted to BEVs, will create a new wave in the automotive market for battery electric vehicles. The motor efficiency of Xiaomi HyperEngine V8s is 98.11%. Strength and efficiency go hand in hand thanks to the differentiated thickness design of its silicon steel sheets, which combine 0.35mm ultra-high-strength silicon steel sheets for the rotor and 0.2mm ultra-thin silicon steel sheets for the stator. Furthermore. The conventional 54-slot, 6-pole design patent blockage is broken by the introduction of high-performance neodymium-iron-boron permanent magnets, which use an 8-layer Hairpin flat wire winding with a slot fullness of up to 77%. Xiaomi raises the process and winding method to increase the slot filling rate, which raises the motor's output power and efficiency.

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leads to excessive carbon emissions from power supply farms. This is putting the cart before the horse. Nowadays, the BEV market is highly competitive, but many people ignore the safety hazards that come with it. Technological development should not only be for the sake of capacity and efficiency but also for the sake of the environment and safety.

2. Latest Technological Advances in Lithium Batteries

Studies on how to raise the specific capacities of the cathode and anode of lithium batteries, as well as the specific gravities of active ingredients, etc., in order to increase the density of lithium batteries [3]. Designing the cathode section of a high-capacity Li-ion battery by changing the electrode structure, using a solid electrolyte, modifying the separator, and optimizing the liquid electrolyte [4]. Researchers explore dendrite formation and failure in lithium batteries using various types of separators in an effort to build high-performance lithium batteries [5]. As the most commonly used battery for electronic devices, further development and upgrading of the performance of lithium batteries is still in the laboratory stage. As the performance of products such as BEVs continues to improve, the design of lithium batteries will need to be further accelerated to keep up with the power needs of these devices.

3. Literature References

The SWOT analysis model is used in several fields. It provides a clear picture of the strengths, weaknesses, opportunities, and threats of the thing being analyzed in its relevant field. Strengths are the advantages of the thing that make it stronger than others and weaknesses are the disadvantages that make it weaker than others. Opportunities are characteristics that will shine in the future market and threats are potential risks in the market.

3.1. Strengths of BEVs With New Technology

Xiaomi Auto Co., Ltd has advanced technology integration such as artificial intelligence, autonomous driving, and integrated batteries. Xiaomi's self-developed Xiaomi Pilot is a new intelligent self-driving technology. Not only can it drive itself on motorways like a traditional smart driving mode, but it can also perform detailed parking functions in very demanding conditions. This technology enables novice drivers to get more help, such as reminding drivers to watch out for passers-by, warning of oncoming traffic, and helping people with poor parking skills to automatically park in the right spot. It can also enable older drivers to properly relax during the driving process, without having to be mentally tense all the time. (This does not mean that drivers can commit offences such as driving under the influence, driving while fatigued, and so on. It also doesn't mean that the driver can blame the intelligent driving system after committing traffic offences.) Xiaomi Smart Cabin technology allows all occupants of the car to maintain a comfortable posture as well as the ambient temperature. It adjusts the position and temperature of the car seat according to each person's height, leg length, weight and other factors. Basically, it can keep all the occupants of the car relatively comfortable. The Xiaomi HyperEngine V8s features a two-way full oil cooling system as well as an S-shaped three-dimensional oil circuit design. The dual-circulation three-dimensional oil circuit gives the stator part a 100% larger cooling area, allowing for a maximum temperature reduction of 20 degrees, while the rotor part uses the patented S-shaped oil circuit, which increases the cooling area by 50% and achieves a maximum temperature reduction of 30 degrees. Meanwhile, the staggered design of the stator silicon steel stack adds 7% to the effective heat dissipation area. High-power motors are now cooled using just oil using three-dimensional oil circuits with dual-circulation stator cooling. The basic idea is to enhance the circulation system to cool the stator with more oil. Maintaining a steady temperature is necessary to enable the motor to operate at its peak efficiency. Millet this motor to

perform more complex tasks, such as cooling areas, three-dimensional circulation, oil circuit designs, or more inventive tasks.

All electric vehicles (EVs) have the advantage of emitting fewer airborne pollutants, and the model that emits the least amount of greenhouse gas (GHG) of any EV today is the BEV. Study after study shows that throughout the past ten years, the GHG emissions from plug-in hybrid electric cars (PHEVs) have dropped by a factor of 2.5 times, while the emissions from hybrid electric vehicles (HEVs) have declined by a factor of 2. This data is compared to GHG emissions from conventional vehicles (CVs). However, battery electric vehicles (BEVs) have 3-6 times less emissions compared to HEVs and PHEVs [6]. BEVs are one of the most environmentally friendly ways of traveling today, as they do not produce any air pollutants from the powertrain while driving. Apart from air pollution, there are many other types of pollution in our lives, such as light pollution, noise pollution, nuclear pollution, and so on. Unlike conventional cars, BEVs have a special powertrain that causes almost no noise pollution during normal driving. At the same time, there is a danger that pedestrians will not notice the oncoming car in time. Because of this, Xiaomi's latest smart driving tech also includes incoming alerts and alerts for pedestrians. The former alerts the driver to the movement of living beings around them, while the latter alerts some pedestrians to the presence of a vehicle passing in front of them by emitting a special alert sound. The BEVs with new technology have added many more convenient AI modes as well as a number of systems to prevent hazards while retaining the previous reduction in pollution.

Additional features that set BEVs apart from other CVs and EVs are their high range and quick acceleration thanks to the HyperEngine motor and CTB technology. Due to the high performance of BEVs and their protection of the environment, national governments are also encouraging the use of BEVs to varying degrees with policy incentives. One common feature of all the tech products developed by Xiaomi is interoperability. The interoperability of Xiaomi's products is reflected in smart home systems such as controlling audio with mobile phones and air conditioning with speakers. This time, the BEV developed by Xiaomi can also be controlled by mobile phones. This is nothing but a further increase in the convenience of using the vehicle and monitoring it, while also increasing the importance of the Xiaomi account. The mobile apps can also be controlled through the vehicle's center console while the vehicle is in motion. This is not only a new BEV attempt, but also a new step towards full AI coverage of life. These are the bright spots of BEV's.

The Xiaomi BEV also features an ultra-fast charging system that solves the problem of the long-range of traditional BEVs, allowing it to charge from less than 10 percent to 90 percent in half an hour. As an established technology company, Xiaomi has a huge user base. The company not only develops mobile phone chips but also gradually enters the smart home and even car industry. It was the first company in China to enable users to control all products including mobile phones, air conditioners, refrigerators, and even cars by using a single account, and it has won many fans over the years. Xiaomi is no less well-known globally, with a user base that exists regardless of continent or country. This has led to a lot of interest in the Xiaomi vehicle and is also one of the strengths of the Xiaomi BEV in the traditional market.

3.2. Weakness of BEVs With New Technology

The performance of BEVs under Xiaomi's new technology is much improved, but the cost of their production is an issue that cannot be ignored. Lei Jun, founder and CEO of Xiaomi Group, has said that making the first successful BEV vehicle took a total of more than 3,400 people three years to spend more than 10 billion yuan. Xiaomi vehicle manufacturing plants are already established and well-established and have many AI-controlled manufacturing shops. Despite the time cost savings of doing this, the cost of raw materials and batteries is still high. And vehicle drivers have to think about battery range costs and the longevity of BEVs.

Along with the loss of control of BEVs, spontaneous combustion while charging, and leakage in recent years, some drivers have questioned the safety of BEVs. Even Tesla's BEV has had similar problems, so that's why Xiaomi's BEV is also questionable. As a common battery system for BEVs, lithium-ion batteries are a major cause of accidents. It is subject to sputtering and spontaneous combustion when subjected to collisions, contact with water, and prolonged high loads. Conventional means of extinguishing fires cannot prevent the accident vehicle from further burning or exploding. Especially in winter and summer, the batteries of BEVs often fail. During cold weather, the BEV's batteries can have their power affected by the temperature. This can result in less energy being supplied for acceleration and affect the braking system. When the BEV enters cold and hot environments, the driver is faced with the question of whether or not to use the air conditioning. The use of air conditioning consumes a portion of the energy, leading to a reduction in range. This is currently one of the biggest issues regarding BEVs battery range [7]. In addition to the temperature, the resistance of the vehicle and the use of air-conditioning also reduce the power consumption of BEVs. BEVs are affected by rolling resistance at low speeds and air resistance at high speeds. Energy consumption is higher when the air conditioning is turned on at high temperatures than when it is turned on at low temperatures [8].

Xiaomi's BEVs have a lot of technological innovations, but they are still not competitive in the automotive market. The reason for this is that established automotive companies like Tesla, BYD, and others have long since divided and dominated the BEV market. Even the products of Tesla, the world's top BEV seller, are subject to varying levels of quality. Xiaomi, as an emerging force in BEVs, can only really get a share of the BEV market by continuously developing more advanced technology under the premise of quality assurance. Xiaomi BEV's charging posts are expensive but less practical, while the number of Xiaomi charging stations is small. These are where Xiaomi BEV's shortcomings currently lie. Despite the appealing new technology of the Xiaomi BEV, the cost of purchasing a Xiaomi BEV is still on the high side for most people. In the eyes of most car enthusiasts, a Tesla product at the same price point may be more cost-effective. Though it may be considered inferior to BEVs such as the Model series in terms of automotive performance, Xiaomi's breakthroughs in BEV tech innovations as a tech company origin is a key factor in taking the future BEV market. As mentioned above the biggest feature of Xiaomi products is interoperability. Although the BEV market has not developed a battery system that completely avoids safety hazards, it is possible to monitor the status of the car in real time through the interoperable regulatory system of Xiaomi products. Even in the event of a breakdown, the system can be the first to detect abnormalities in the status, so as to facilitate timely escape or rescue. This kind of interoperability cannot be replicated by other BEV companies.

3.3. Opportunities of BEVs With New Technology

As mentioned above, Xiaomi's BEV, which incorporates the latest technology, is an emerging force. It currently only has a place in China's car market, but the world car market is still ruled by Tesla Motors. As Xiaomi's other products have been well received on the international front, many people in Asia America and parts of Europe are looking forward to its latest automotive offerings. Moreover, Xiaomi's BEV products are more focused on practicality and occupant experience, and the integrity and efficiency of its industrial chain meets the conditions for entering the international market. This represents that it is not difficult to open the international market for Xiaomi's BEV products. After taking the Chinese market as the first market and achieving success, it can even compete with Tesla Motors for the dominant position in the global automotive market.

Due to Xiaomi's own high level of influence and visibility, the company can also collaborate with many large car companies in the future market. With the successful development of the Xiaomi HyperEngine V8s, more and more companies will try to partner with Xiaomi Motors Ltd. It is just

because the test data of the V8s may become the world's leading data, and Xiaomi's integrated battery technology in cooperation with BYD has reached the world's leading level. The collaboration can further deepen the impact that technology brings to BEV owners and create new co-brands like the AITO series produced by HUAWEI in collaboration with SERES.

With the greenhouse effect, global warming, and other hazards. Governments around the world are promoting new energy products and setting up incentives for them. Norway has one of the highest taxes on car purchases, but it has exempted vehicle registration tax and value-added tax to encourage Norwegians to buy BEVs. The government's main objective is to reduce carbon emissions from local traveling vehicles. The enactment of these two car purchase welfare policies has had a large and substantial impact on BEV purchases [9]. In addition to tax policies, the Norwegian government has established a number of policies that appear to be superior to diesel vehicles (DVs) and petrol vehicles (PVs). Examples include lower ferry fares, reduced parking costs and lower tolls. The cost of parking alone is 20 per cent less for EVs than for PVs and DVs [10]. Under the influence of these related policies, the world is gradually moving towards buying and driving EVs. As BEVs have the lowest carbon emissions of all current EVs, it is all the more important for the government to promote them. Moreover, Xiaomi's BEV incorporates a more convenient AI system and a more durable battery system than other BEV vehicles, which makes it an unlimited opportunity in future automotive market.

3.4. Treats of BEVs With New Technology

Xiaomi's latest BEV has incorporated a lot of new-age technology and could have a place in the international automotive market shortly. As one can see, the world of technology is advancing rapidly and products are changing at a pretty fast pace. This new BEV tech from Xiaomi may still dominate in the short term, but new more convenient, and safer tech may come along and replace existing tech a decade from now. So, it is important to keep the current stage of mass production and further develop more practical techs in order to maintain dominance. All BEV purchasers are concerned about the cost of power and the longevity of their vehicles in addition to the threats posed by technological and product obsolescence. As the hottest vehicle type in today's automotive market, the BEV market is particularly competitive, with companies such as BYD, ZEEKR, Tesla, NIO, and many others eyeing them. To stand out from these brands, technological innovation is not enough. Nowadays, the new-age youth are more inclined to be unique or a minority, so personalization for different types of users or buyers could be the focus of future productions.

Compared to the pressure of competition in the market, the issue of safety hazards is a top priority. Xiaomi's CTB integrated battery technology, despite solving the range problem, its longevity and hidden dangers are issues that cannot be ignored. Battery leakage, spontaneous combustion, and other problems cannot be completely prevented so far. It is also unavoidable that the system short-circuits, AI fails to wake up, and the vehicle loses control and cannot be operated normally after a collision or irregular operation. Battery energy storage systems are currently the most significant challenge facing the battery market. Its versatility, flexibility, and cost of production are still the main obstacles. The lack of global standardization of batteries is also a barrier. Different requirements and policies do not allow battery manufacturers to easily design energy storage systems. Today, market regulatory policies are also lagging compared to energy storage systems [11].

Putting the cart before the horse is another problem that needs to be taken into consideration and one of the challenges that will need to be overcome in the future. The Government has established a policy to promote the use of BEVs to reduce carbon emissions and mitigate GHG. However, the presence of a large number of EVs has significantly increased the demand for power supply from conventional power plants. Conventional power plants are generally fossil fuel power plants, so GHG and carbon emissions have not really been reduced much. CO₂ has just gone from being produced directly to being produced indirectly.

4. Three Years of Honing a Sword - Xiaomi's Latest Products

Xiaomi's most successful BEV vehicle to date is the Xiaomi SU7, which features five core technologies. These are Xiaomi HyperEngine, Xiaomi HyperCasting, Xiaomi Smart Cabin, Xiaomi Pilot, and CTB technology. As the culmination of over 3,000 people's three-year endeavor, the Xiaomi SU7 will bring a rich sense of technological experience to the buyer. This product embodies the charm of fusing technology and vehicles everywhere.

4.1. The Advantages of Veteran Tech Companies Stepping Into the Automotive Market

Unlike traditional car companies or products made by tech companies in collaboration with car companies, the Xiaomi SU7 is a BEV developed in-house by Xiaomi. as a veteran tech company, Xiaomi is very experienced in tech integration. It is the first company to incorporate systems including intelligent self-driving and mobile phone remote monitoring of status into a BEV. It's a bold and successful step. Xiaomi has a huge user base globally, which is one of the reasons why it is getting a lot of attention for building cars. Despite all the scepticism, Xiaomi has managed to develop the Xiaomi SU7. With its large user base and innovative technology, the Xiaomi SU7 has been a minor success in China and is expected to make its way to the international market.

4.2. Innovative Technology Solves Traditional Problems and Delivers New Experiences

Xiaomi SU7 not only solves the common problems of small BEV battery capacity and slow charging efficiency, but also provides a full range of AI system services. Intelligent Autopilot and self-parking technology are some of the boons for novice drivers. The real-time broadcast of the car's immediate vicinity in the center screen also provides the driver with the opportunity to be aware of the surrounding area at start-up or while driving. The highlight of the new technology remains the interoperability unique to Xiaomi products, which allows car owners to log in to their Xiaomi account and use their mobile phones to control the vehicles.

4.3. Continuously Innovating, Creating Market Opportunities and Enter the International Market

Mobile phones and chips, the focus of the earliest Xiaomi products, are no longer enough to satisfy its corporate ambitions. In March 2016, Xiaomi began releasing a new line of smart home products and quickly became a leader in the space. This BEV product breakthrough innovation has also brought new markets for Xiaomi and with the encouragement of BEV-related policies, there are many market opportunities and unlimited potential. Despite its recent entry into the automotive business, Xiaomi's manufacturing efficiency and chain completeness should not be undervalued. A typical Xiaomi SU7 can be manufactured in 40 quantities every hour; few other professional automakers can match this level of efficiency. A robotic arm driven only by artificial intelligence (AI) makes up the body of the manufacturing line, saving labor costs and minimizing output time. This capacity is more than enough to enter the international market.

4.4. Stepping into the BEV market strategically

Xiaomi started as a chip and mobile phone developer and has been competing with Samsung, HUAWEI, and Apple since then. HUAWEI doesn't build BEVs directly but provides chip support, Samsung executives don't think there's sustainable profit, and Apple tried to build BEVs and failed. As everyone can see, being among those entering the BEV market is no easy task. Firstly, Xiaomi entered the smart home industry and then took an even bigger step to develop BEVs, both of which made a huge strategic contribution to Xiaomi. This strategic cross-industry development has laid a solid foundation for Xiaomi's future diversity in research and development of technology and

expansion of business. BEV competitiveness is closely related to the cost of existing battery systems, and its performance is also related to battery power. The best battery systems have not been developed to include features such as long life, fast charge and discharge, low cost and high capacity. In the future development of new BEVs, battery systems such as lithium-sulphur batteries, solid-state batteries and sodium-ion batteries may be most suitable [12]. Although the Xiaomi CTB integrated battery system has reached the pinnacle of performance in the current market, the development of new raw materials for making batteries is also a goal that can be strategically developed. Another area where Xiaomi's BEV is superior to similarly priced BEVs is impact resistance. Since 90.1% of the Xiaomi SU7's body is made of high-hardness steel and aluminum alloy, its body stiffness is very secure in dealing with accidental impacts. Its bodywork is made by a super die-casting machine that directly integrates the molding process, so it won't disintegrate easily when facing extreme conditions such as super convection air.

5. Market Potential and Risks Faced of BEV's Latest Technology

The Xiaomi SU7 is a hot topic even before it launches, whether that's expected or not. After its introduction, it promises to open up worldwide markets and has been favorably received. Xiaomi has achieved a significant milestone in its vehicle development and BEV market entry. Xiaomi has invested more than 10 billion in the production of Xiaomi SU7. Even though the BEV product has now achieved a stage of success in the automotive market, it is still unable to completely pay back its capital. And the acquisition of raw materials will continue to cost a lot of money. This will not allow Xiaomi to move on to the next strategic R&D product in a short time.

6. Conclusion

This present study focuses on the SWOT analysis and provides some suggestions to face the future BEV market with Xiaomi's development of new technology for BEVs. A SWOT analysis of Xiaomi's latest offering of BEVs has also been conducted and preliminary inferences about the market prospects of BEVs have been made. While illustrating its strengths, potential threats are also pointed out along with some drawbacks. Enhancing the technology for sensing, investigating inter-charging, optimizing the space frame, and boosting shareability are four key avenues to greatly increase the utility of BEV. There are already automotive policies in place that explicitly state the need for a low-carbon transition. Compared to HEVs, PHEVs, FCEVs and other types of EVs, BEVs have incentives in terms of purchase tax, parking fees and road tolls. The reason for this is that BEV powertrains operate without carbon emissions. China's BEV stockpile has grown at a very fast pace over the past three years. Despite the government's development of a series of incentives to promote decarbonisation of transport, further measures should be taken to promote electrification, decarbonize the grid, and strengthen the charging infrastructure. This could accelerate the low-carbon transition of China's passenger sector. This is one of the main problems facing governments everywhere in the world nowadays. Two additional research directions merit further development. One is battery replacement technology. BEVs can be recharged when their batteries run out of power, but it takes a long time. But battery replacement requires nine elements that need to be in place to create a business strategy for battery swapping, namely cost structure, revenue stream, customer relationship, key activities, value proposition, customer segmentation, co-build partnerships, key resources, and channels. Battery swapping requires prioritizing key resources, renewable technology equipment, and raw materials. This reduces the risks that can occur and creates value for potential consumers. The other direction is the already more mature digital twin (DT) technology. The technology with the greatest scope of application in BEV management is the DT. It can provide continuous monitoring, fleet management, predictive analytics, lifecycle management, and performance optimization for

BEVs. Ultimately, it improves battery life, reliability, safety, innovation acceleration, cost optimization, and sustainability. The future landscape of the automotive market has been initially defined, but Xiaomi's all-electric vehicle will need to continue to observe market turbulence before it can determine its next strategic development direction.

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