

FESABILITY OF INTERNATIONAL TRADING

Production and Exportation of Lithium-Ion Batteries to EV

Manufacturers and Consumers in China

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Executive Summary

With the projected growth of the global electric vehicle market that is estimated to double in the next decade, the expansion of the battery manufacturing capacity will primarily depend on the auto market's electrification. Moreover, the market growth puts new requirements on the end-of-life phase and the recycling components. Therefore, the report provides a feasibility research study aimed at investigating the international initiative. It identifies the production and exportation of Lithium-Ion Batteries to the Chinese electric vehicle manufacturers and consumers as a business opportunity and discusses the gaps in the current market. The research also includes a look at the cost estimates that are bound to affect the company. Additionally, the report also includes recommendations for the company to ensure that it understands the policy frameworks and market systems for electric cars adoption. By doing so, the report discusses several aspects of the entire Lithium-Ion Battery business, justifying the business idea.

Chapter 1: Introduction

1.1 Justification of the Lithium-ion Battery Business

Climate change continues to pose a serious threat to the world's eco-system, and the effects may become even severe shortly if actions are not taken to mitigate these threats. Moreover, global warming has been felt by both the socio-political and economic aspects of society, as many factors contribute to these developments (National Research Council 2011). Urbanization, for example, has been the leading threat in the emission of greenhouse gases due to the new buildings being constructed almost every day as a result of booming real estate business. Their energy use and carbon emission have become uncontrollably high, trapping the gases inside the earth's atmosphere, and hence preventing the rays of the sun from going out from its outer ozone layer. Another crucial example, which the paper will discuss and focuses on in detail is the greenhouse gas emissions brought about in the motor vehicle industry. On average, the industry largely contributes to these emissions, especially in urban areas in both developed and developing countries. In urban areas, the risk factors resulting from these emissions include affecting the quality of life of people due to air pollution and the development of new diseases. The automotive sources that emit these gases are also an important factor that requires the report's attention. The pollutants emitted come from three automotive sources; the fuel system (evaporative), the exhaust, and the crankcase ventilation gases. The tailpipe exhaust from the motor vehicles is composed of a complex mixture of chemicals that involve liquids, gases, and solid aerosols such as; nitrogen oxide, carbon monoxide, non-methane organic gases, and formaldehyde, among others (Drozd et al. 2016). These pollutants combine with the rays of the sun to chemically form ground-level ozone. The mixture composition is dependent on factors such as; operating conditions of vehicle engines, type of fuel, and the impacts of emissions controlling devices built inside the motor vehicles. When these complex compositions are emitted into the atmosphere, they are transformed into other forms through complex atmospheric reactions that are chemical. Moreover, these chemical compositions are not static but dynamic and can be observed today. For example, the air quality that people in California are breathing today is different from what it used to be ten years ago. Therefore, in evaluating health problems associated with these emissions, such as the increase of chronic illnesses in the country, and the damage to the eco-system, an ever-changing implementation must also be exercised by both the government and the corporate world. To reduce and mitigate the percentage of emitted gases by the automotive industry, governments and corporations have worked for hand in hand to develop viable solutions and

innovative sustainability techniques to ensure success in combating greenhouse gases. From the government perspective, the formulation of laws, policies, and regulations to supervise the automotive industry in the United States has been its priority, both at the state and the federal level. On the other hand, automotive companies have been impacted by the government's strict policies and have come up with innovative solutions as a result. The automotive emissions have been significantly reduced by using seal-tank caps and the evaporative control system, which uses charcoal that is activated, capable of holding up to thirty-five percent of its weight in fuel vapour. Moreover, the motor vehicle users have also been brought into the action as their efforts are greatly needed in the fight against carbon emissions. The Minnesota, pollution control agency, argues that personal transport choices significantly impact air quality, adding how the motorists drive directly impact their surrounding environment (Sovacool 2010). Therefore, the agency promotes fuels, technologies, and driving habits that aim to reduce the emission of pollutants and fuel consumption for both the consumers and fleet operators. Additionally, MPCA advises that since most emissions from motor vehicles result from the fuel combustion, users can decrease emissions from these sources by "burning fuel, burning fuel cleaner, and burning cleaner fuel." Apart from the United States, other developed countries such as the United Kingdom, Germany, and China have taken a different approach. They have heavily invested and promoted electric vehicles' production by formulating strict policies and regulations to reduce the dependency on fuel. For example, Elon Musk, who is the CEO of Space-X and Tesla Motors, has brought in competition to other motor vehicle manufactures by producing electric vehicles which have plunged the prices of oil to drop and urging other companies to get on board or be left behind (Bagchi et al. 2020). I believe that these electric vehicles provide long-term and sustainable solutions to the fight against climate change. The EVs do not burn fuel and also do not have tailpipe emissions. Therefore, this new innovative industry has brought a new business opportunity and initiative that the company should take full advantage of and maximize its profits while also becoming a major player in the motor vehicle industry.

1.2 Objective of the Report

The research objective was to provide an evaluation and analyze the investment advantages and opportunities brought about by the emergence of the electric vehicle industry in the UK, China, and the US through the production of Lithium-ion batteries by using secondary sources of data. Additionally, the study used a qualitative approach to understand which country's investment in electric vehicles' production had the most significant impact on an economic

scale concerning the production and exportation of Lithium-Ion Batteries. Moreover, the research also provides insight into the demand for the Lithium-Ion Batteries from the electric companies and the electric car consumers in the three countries while also highlighting the industry's future development trends.

1.3 Problem Statement

The sporadic growth in the urban population in the US, China, and the UK has led to an exponential increase in motor vehicles' purchase. As a result, vehicles' manufacturing and production have been traditionally centred on fuel-dependent engines due to external influences such as the oil industry. For a long period now, the emissions from these fuel-dependent engines have had detrimental effects on the environment. However, in the last two decades, the governments in the selected countries have put a lot of their efforts into formulating laws, regulations, and policies meant to reduce the emissions experienced in the automotive industry. Therefore, it has led to a need for green solutions and the emergence of electric vehicle companies such as Tesla Motors that have pioneered electric engines' production. These new economic and socio-political conditions have led to the need for Lithium-Ion Batteries that electric power vehicles, an industry that many companies have not heavily invested in. This provides an opportunity for the company to have a large percentage of the market share in the production and exportation of Li-Ion batteries to these companies and the electric vehicle consumers in the three countries.

1.4 Purpose of the Report

The purpose of the research was to determine the feasibility of an international business opportunity and identifying the target market for the product that the company could financially benefit from in the long-term. As such, the study compared and contrasted the investment advantages of Li-Ion Batteries in the three countries as a result of the emergence and production of electric motor vehicles, providing insight on the codes, policies, and standards that promote the process in the UK, China, and the US. Additionally, the study aimed at defining and discussing the process of production and exportation of the Lithium-Ion Batteries as well as the demand for the products in the three countries. Future trends in the electric vehicle industry were also investigated. Lastly, the research focused on the factors affecting the buyers' willingness to pay for EVs as well as their components (Lithium-Ion Batteries).

1.5 Significance of the Report

The study's objective was to determine the feasibility of an international business opportunity and identify the target market for the product that the company could financially benefit from in the long-term. The results are expected to enhance the company's knowledge of the codes, policies, and standards that encourage electric vehicle production and the buyers' willingness to purchase the electric vehicle attributes. The qualitative analysis that was conducted would also ensure that the report is feasible and has an evidence-based claim on the international initiative. Additionally, the information used previously concluded research to develop an evidence-based opinion on Lithium-Ion batteries' investment advantages. Moreover, the company would financially benefit from the feasibility research. Still, it would also be recognized internationally by the governments in its efforts to combat climate change through the production and supply of the Lithium-Ion batteries as a replacement for fuel-dependent engines and therefore improving its reputation.

1.6 Research Hypothesis

The research sought to theoretically and conventionally offer support for the identified hypothesis, which states that the investment advantages of Lithium-Ion Batteries offer long-term financial opportunities for the company to benefit from while boosting its reputation in the context of demand for electric vehicles and on the return on investments for the company.

1.7 Research Questions

The study, while presenting substantial claims and support for the international initiative, also looked to ascertain possible answers for the research questions stated below:

- Which country (target market) would have a more significant investment advantage for the company?
- What policies, standards, and codes exist in each country to promote the production of electric vehicles?
- What factors affect the buyers' willingness to purchase electric vehicle attributes (Lithium-Ion Batteries)?
- What factors influence and affect the production of Lithium-Ion Batteries?
- What will market-entry strategies be applied by the company?
- Which country has the most conducive environment to facilitate the growth of the business?
- What are the operational costs associated with the production and exportation of Lithium-Ion Batteries?

- What are the future trends in electric vehicle manufacturing that the company might invest in?

Chapter 2: Research Design and Methodology

2.1 Introduction

This part of the report presents the methodology by which the feasibility study was conducted. By delivering on the method, the information aimed to be more substantiated and evidence-based in its results. Therefore, this area of the report will provide a detailed insight into the methods used to collect and assess data. Moreover, it includes the discussion of the results and its application in the real world. In the research, the focus was based on the UK and China, offering a comparative analysis to determine which country was the best for the company to invest in. As such, the paper carried out qualitative research in the form of questionnaire surveys.

2.2 Research Design

The current study aimed at researching the investment opportunities for the supply of Li-ion Batteries to the electric vehicle market in China and the United Kingdom. Therefore, the study applied the use of qualitative methods in collecting crucial data. Mohajan (2018) states that qualitative research enables a researcher to study and interpret the information based on the studied population. Therefore, this method of data collection allowed the report to be feasible and aimed to provide the company's stakeholders with the crucial information needed to advance to the next investment step.

2.3 Ethical Considerations in the research

The participants who were willing to be included in the feasibility study were informed that the study's purpose was required to sign a consent form before the study commenced further. The consent forms were both distributed in person or sent via emails and Skype, and the active participants were required to verify their consent through a clicking option (Kosinski 2015). However, due to the strict cybersecurity laws that are characteristic of China, the questionnaire procedure took a bit longer than usual due to the unwillingness of the electric car consumers and other stakeholders in the vehicle fleets' electrification to share information by participating in the study. Moreover, it was a requirement by the participants to go through and understand the questionnaires before answering them carefully. During the questionnaire procedure, the participants expressed their opinions freely and therefore were not subject to bias.

2.4 Research Strategy

In the survey, the research participants included urban residents residing in Shenzhen and London, as these areas are essential due to factors such as; their political, social, and economic climate. Other electrification stakeholders also included the managers and employees in the two countries' public and private automotive sectors. Moreover, the urban centres are densely populated and enjoy strong economies and access to innovative technologies such as electric commercial buses, electric two/three-wheelers, and private electric vehicles (Wu 2018). Additionally, the emission of greenhouse gases by the cars found in the cities contribute significantly to global warming. Therefore, it is evident that these cities, to go green, have large business resources concentration at their disposal. As a result, it was significant to use these two cities to guide how the residents and other influential stakeholders in the electric vehicles industry could embrace the purchase of Lithium-ion batteries for use in the mentioned countries.

2.5 Data Collection

The study applied the use of the grounded and planned framework to facilitate qualitative research. The technique was identified as suitable because it can determine and design an open market through which the consumers' willingness to pay for the Lithium-ion Batteries would be substantially ascertained. The research made assumptions that the social norms, subjective norms, values, and financial stability impact the willingness to pay for electric car attributes such as the Lithium-ion Battery. Moreover, the preferred method was applied to compare and differentiate the buyers' willingness to pay for electric vehicle attributes in both cities (Attri and Grover 2015). Lastly, the educational background, which has been identified by previous research as a factor that impacts buyers' willingness to pay, was also included.

2.6 Questionnaire design and survey

The distributed questionnaire was divided into three parts and involved 46 questions. The first part of the questionnaire primarily focused on the social demographic factors in the two cities, such as age, gender, and the residents' financial stability (McGuirk and O'Neill 2016). The second part was broader and included questions aimed at the electric vehicle company managers and other stakeholders involved in vehicles' electrification. Moreover, it had external business factors, such as the ease and requirements of conducting an international business, including the logistics, taxes, and other operational costs as they contribute to the company's product's success and are considered factors of risk. The last part studied the electric vehicle companies' and residents' WTP for EVs, including their attributes (Lithium-ion batteries) and

their purpose for purchasing and using them. The questionnaires were then distributed through online channels and physical presentations via interviews and meetings, especially with the managers and stakeholders in the electrification process. Rewards were provided at the end of the questionnaire process to encourage full participatory. To select participants, the research used random and straightforward sampling techniques to choose the participants from the general population (Collins 2010). The entire survey procedure was conducted from September 2019 and completed in January 2020. Out of the 40,000 questionnaires distributed in both cities, the recovered questionnaires amounted to 31,000 copies. Tampered questionnaires or those not answered but delivered narrowed down the questionnaires to 28,000 copies (90.3% feedback).

2.7 Validity and Reliability analysis

The validity of the research was ensured through recorded interviews and well-structured questions while relying on the research's objectives. Moreover, a detailed review of the available literature and feasibility tests on Lithium-ion battery demand in both cities was conducted. To ensure and guarantee reliability in the research process, the report acknowledges bias in the sampling methods applied in the data collection process and the factors put in place to mitigate the bias. The study also ensured that the data collected was transparent, consistent, and accurate by comparing the findings with previous works of other scholars to determine and compare both cities' investment advantages. The feasibility research report is, therefore, valid and reliable.

Chapter 3: Presentation of Data and Analysis

The investments in the production of electric cars and the gradual increase in purchasing power are directly proportional to the growth and demand of Lithium-Ion Batteries and the decrease in motor vehicle pollutants' emissions. However, the Paris agreement goal on climate change states that the emissions from fuel-dependent engines are set to double by 2050, adding that the automotive industry's investments need to be substantial and innovative (Höhne et al. 2017). To ensure that the three governments' goals are a success in reducing these emissions, there is a need for a different approach. At both the domestic and international level, persuasive agreements about climatic actions and its economic benefits changed preferences regarding commitments to policies and regulations by governments (Dimitrov 2016). Therefore, it can be determined that even though climate change has had detrimental effects on the environment, it has brought opportunities through international and domestic initiatives that promote the use of green energy.

3.1 Lithium-Ion Batteries and Electric vehicles

To understand and understand how the company can benefit from the production and supply of Lithium-Ion Batteries, it is essential to define and understand what Lithium-Ion Batteries are, how they work, and their relation to the production and consumption of electric vehicles. A Li-ion battery is a complex innovation that applies Li-ions as the significant chemical property of its electrochemistry (Pistoia 2013). The Li-atoms present in the anode are ionized and split during the discharge cycle. The Li-ions leave the anode, through the electrolyte and lastly reach the cathode, recombining with their electrons and electrically neutralizing (Manthiram and Wang 2017). Due to lithium's small size, they can achieve too high voltages and charge storage per unit mass and volume. Compared to other high-quality rechargeable battery innovations, Lithium-ion batteries possess some advantages that the others might not have. For instance, the battery has one of the highest energy densities ever recorded in the current battery technology industry (250-670 Wh/L).

Moreover, they can produce up to 3.6 volts, which triples battery technologies such as Ni-MH. This is the most important trait as it can create larger electrical currents for high-power applications, such as in the electric car engine. Additionally, the Lithium batteries also require low-cost maintenance, which is suitable in the electric automotive industry as they do not need scheduled cycling to conserve their battery life. Lithium-ion batteries also do not have a memory effect. Lastly, the batteries possess low self-discharge rates (1.5-2%) and are environmentally friendly as they are not made of toxic cadmium, making it easier to dispose of them (Zubi et al. 2017). The batteries can also retain a lot of energy for their weight, which is significant for electric vehicles as a reduced weight will make the car travel longer distances on a single charge (Scrosati, Hassoun and Sun 2011). Therefore as observed, Lithium-ion technology can be applied in battery-powered vehicles found in the HEVs, PHEVs, and EVs categories.

3.2 The demand for electric vehicles and their infrastructure in China, the UK and the US

The purchase of electric cars globally as of 2019 surpassed the two million mark compared to the previous year's low numbers, bringing the number of active electric vehicles being used to more than seven million. The EVs also had a market share of 2.6% in the global car sales in 2019, registering an annual increase of 40% from the previous year (Rietmann, Hügler, and Lieven 2020). The gradual increase in electric vehicles' sales has been a result of the electrification of two and three-wheelers, buses, and trucks. In the last decade, policies in the

three countries have been crucial in facilitating electric vehicles' production. For example, the automotive industry has experienced a shift from subsidies deemed direct to regulatory approaches that depend almost entirely on structural and policy reforms, including mandates such as the zero-emission vehicles (ZEV) and fuel economy standards (FE). As such, clear directions have been set at both the international and local levels that promote an economically sustainable transition for countries participating in the process. Of the 7 million electric cars currently on the road today, 47% are found in China (Ling, Cherry, and Yang 2019). In today's market, the purchasing of electric vehicles has seen a change in the consumer profile, which has evolved from technophile buyers to being adopted by many people. Moreover, in the three countries, crucial developments and improvements on the technologies and a wide variety of electric car models to choose from have impacted consumer purchase decisions. The automakers have also announced plans to produce and release more than two hundred new electric car models. However, China continues to lead in electric vehicle attributes such as publicly accessible chargers, which are suitable for its densely populated urban areas. Electric micro-mobility options have also increased in the three countries and include; electric scooters, electric mopeds, electric-assistance bikes, and commercial electric vehicles. China again has heavily invested in these options, with the majority of the market share being experienced in the country (25% of the 350 million electric two and three-wheelers found worldwide). Moreover, China is estimated to be having more than half a million active electric buses, the largest number in comparison to the other two countries (Milovanoff, Posen and MacLean 2020). It is also important to note that the production of Lithium-Ion Batteries by the company will focus on commercial vehicles and regular cars and include two/three-wheeled cars. This is because the category will continue to have the largest market share in the total electric vehicles fleet as it is more inclined towards the rapid transition to electric drive. Moreover, intercity buses are projected to be primarily used by 2030.

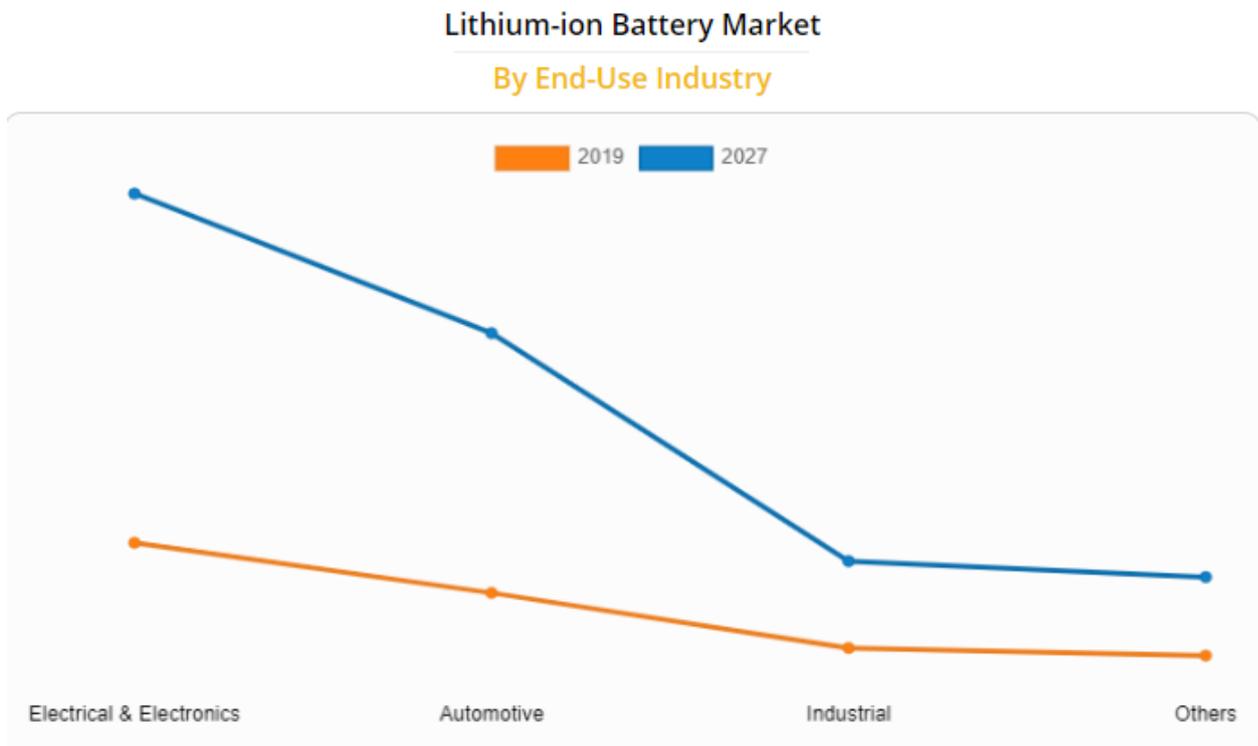
3.3 factors that influence and affect the production of Lithium-Ion Batteries

Lithium-ion Battery Market Outlook

In 2019, the global Li-ion battery market was estimated at \$36.7 billion. It is estimated to reach \$129.3 billion in 2027 (Mohammadi, 2019). The increase in smartphone usage, laptops, and other electronic devices will further propel its market growth. Moreover, an increase in electric vehicles' production has significantly driven the development of its market share. The rise in government legislations and policies are influences that are expected to augment the product's

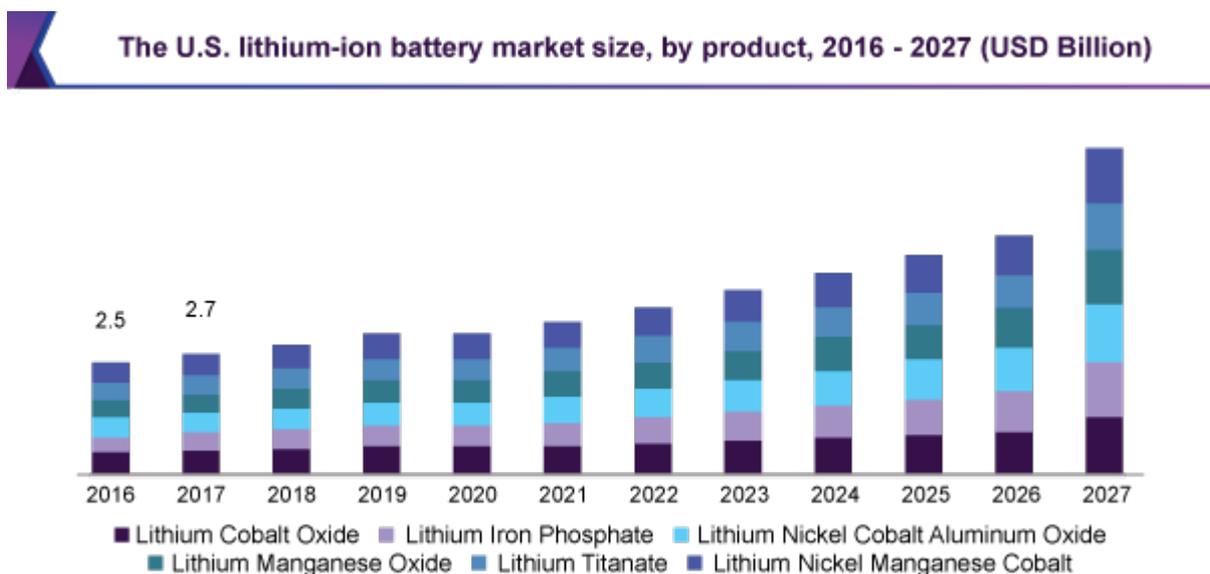
market growth. However, the market growth might be restrained by the increase in the prices of Lithium-ion Batteries.

Figure 1: Lithium-Ion Battery Market overview



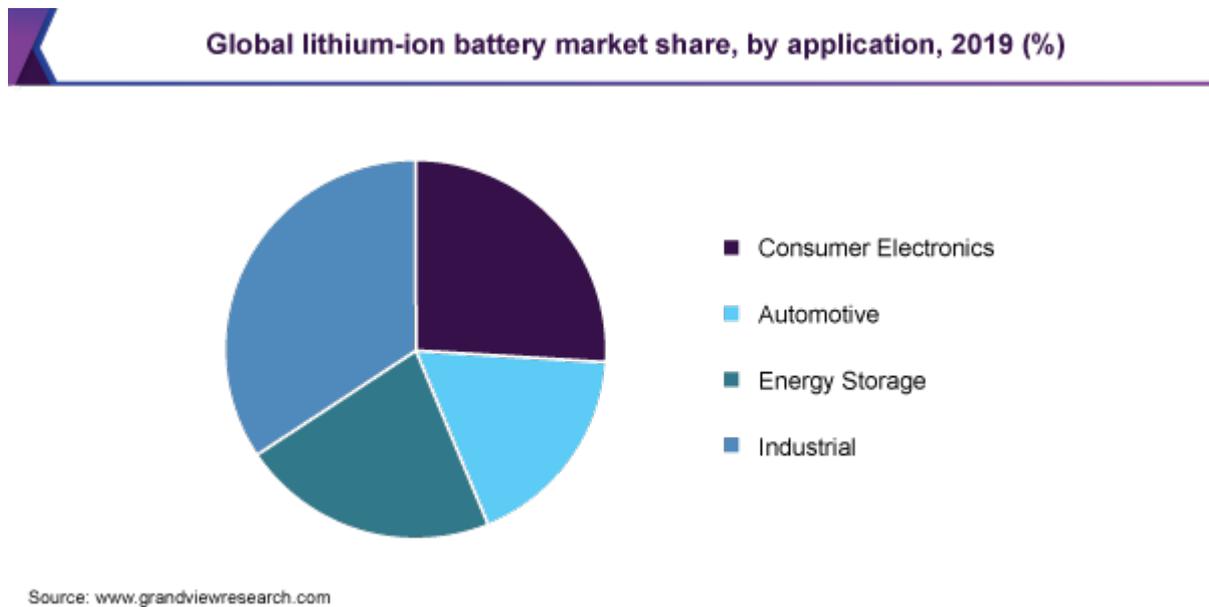
It can be observed in the figure above that the automotive industry is projected as the most lucrative category.

Figure 2: The U.S Lithium-Battery Market Size



Source: www.grandviewresearch.com

Figure 3: Global Lithium-Ion Battery Market Share



To identify the factors that affect the production and supply of lithium-ion batteries, a PEST Analysis was conducted, which compares the influence of the political, economic, social, and technological factors on the product (Leyva, Hechavarria, Batista, Alarcon and Gomez 2018.).

The Political and Legal Factors

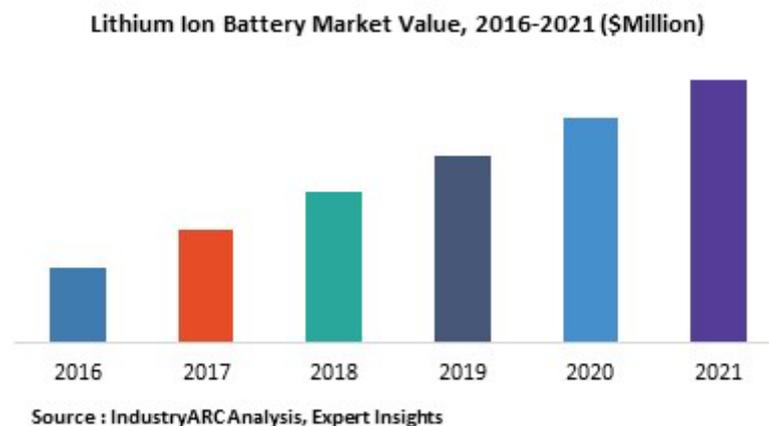
The European Union's Battery directive states that the Lithium-Ion Batteries produced and supplied by the company should recycle by 50% its average weight. Moreover, in the three countries, the competition of policies, especially on competition rules, might, directly and indirectly, affect the product's production and supply. The procedures and requirements, such as the eco-design requirements found in each country, will also influence the demand for the Lithium-ion battery as it will mean an increased number of EVs fleet. Moreover, China and the UK have introduced free parking for EVs and have also allowed bus-lane driving in urban areas. From a business perspective, the laws for conducting businesses in the country are strict and might negatively affect the company. This is because related government procedures for the supply of the product are not transparent enough.

Moreover, the country which practices communism has a weak and judicial and regulatory institutional environment. Therefore, simple tasks such as obtaining business permits and product approvals may take longer than usual. China also favours and supports domestic firms at the expense of international companies through the predatory “Manufacturing 2025” policy that affects electric vehicles and battery power. The United States also strengthened its foreign policies after its trade wars with China earlier this year, impacting how the business might be conducted, mainly since it is located in the country.

Economic Factors

The market price of materials meant to design and create the Lithium-ion Battery is a crucial factor that the company needs to consider. The cost of material is projected to be more than 60% of the battery’s total price, including other operational costs. Moreover, there is a significant cost of handling and transporting the production facility’s batteries to the consumer’s ends. Additionally, the oil price is also a determining factor as a drop in the prices of oil worldwide will mean that the fuel for internal combustion engines will be available and cheap for the consumers, reducing the demand and need for electric vehicles. Moreover, the secondary economic factors, such as the rise in the number of EVs sold, the price of electricity, importation, exportation taxes, and fee deductions, will also impact its operations.

Figure 4: Lithium-Ion Battery Market Value



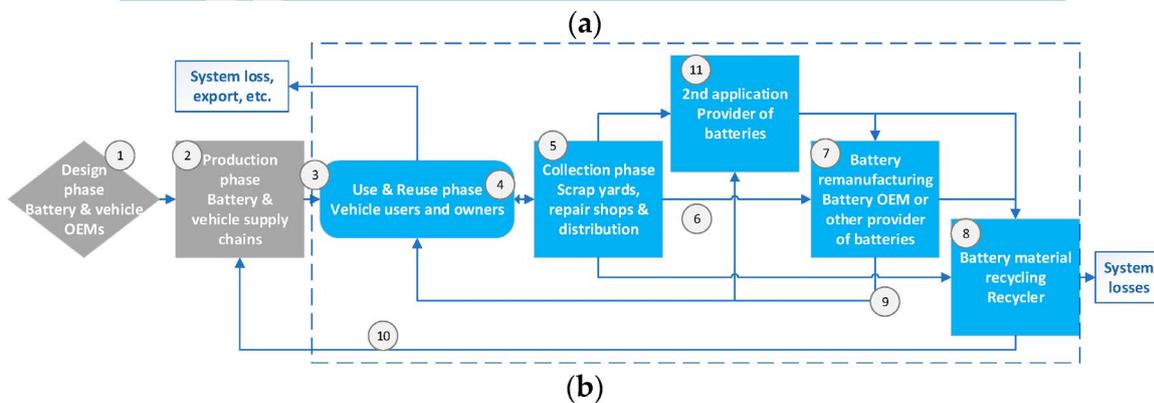
Social Factors

Sustainable business plans are essential accelerators of growth for a sustainable Lithium-ion Battery and its design and development phases. Therefore, the company should put its efforts into the R&D of advanced Li-Ion Batteries through the sharing of information with other critical stakeholders in the EV industry. Moreover, end-user behaviours also play a crucial role in purchasing EVs attributes such as the battery and their satisfaction after testing it. Lastly, the customer demands for the certification of ethical and conflict-free products may also impact the company's Lithium-Ion batteries' market.

Technology and Development Factors

The developments of innovations and technologies will significantly influence the production and distribution of Lithium-Ion Batteries by the company. The battery system's material effectiveness will be affected by the metals and chemicals used in the developments. Therefore, the company should be prepared to invest in the research and development of an advanced Lithium-battery with limited use of critical elements. Additionally, the battery pack design is essential for safe service and customer satisfaction. Lastly, the energy storage innovative developments may also impact the market for Lithium-ion Batteries.

Figure 5: A summary of the PEST Analysis



A SWOT analysis was also conducted to ascertain the feasibility of the international venture as shown below (Vlados and Chatzinikolaou 2019);

Figure 6: A SWOT Analysis of the Lithium-Ion Battery

| | |
|--|--|
| <p><u>Strengths</u></p> <ul style="list-style-type: none">• Product Features: The lithium-ion battery has advanced capabilities and is also in demand which is a strength for the company.• Innovative technologies ensure the recycling and reuse of the battery packs.• The distribution channel that for this new venture is a strong one. The product distribution channel will ensure the supply of the batteries to a diverse and broad market. | <p><u>Weaknesses</u></p> <ul style="list-style-type: none">• The cost of using this technology is significantly high. This is because the company's plan to invest in the R&D of the product may affect its overall pricing, making the batteries more expensive than other similar products in the market. This can be detrimental to the company.• Technology is a continuous and dynamic process and is continually changing. Cheng (2016) states that the market for power systems is very unpredictable. As such, these developments require newer technologies, meaning that the company must always invest in its research and development department to keep up with these changes. A lot of time and money is needed, and the company cannot risk investing a lot of money in the new venture.• People residing in rural areas do not know rechargeable battery technologies, and therefore, the company will have a problem penetrating this target market. This might turn out to be a significant weakness for the company. |
| <p><u>Opportunities</u></p> <ul style="list-style-type: none">• Increase in demand for the Lithium-ion batteries as a result of the growth in the production of an electric vehicle. | <p><u>Threats</u></p> <ul style="list-style-type: none">• The rechargeable battery market already has some big players who are already established—as such, making the business successful while competing with these |

| | |
|---|---|
| <ul style="list-style-type: none">• After-sales services will be a turning point for the business and an opportunity for growth through the extension of warranties and the provision of quality services.• Advancements in new and innovative technologies, for example, the automotive vehicles and electric vehicles need lithium-ion technologies and is an opportunity for the business to take advantage of. | <p>brands will remain a significant threat to the company.</p> <ul style="list-style-type: none">• Easy entry into the market and the demand for rechargeable batteries makes it easier for businesses of all sizes and types to have a market share. |
|---|---|

3.4 Standards, codes, legislation, and policies that promote the production of electric vehicles in China, the UK and the US

To reduce pollution, electric cars are the key to densely populated regions as they will contribute to energy diversification. Electric cars' advantages include; increased efficiency than in fuel engines, zero tailpipe emissions, and reduction in emission of greenhouse gases. To promote electric car production and usage in China, the government cut electric car purchase subsidies by about half in 2019, which was crucial in phasing out the country's direct incentives in 2016. However, In the United States, the federal tax credit program reduced the number of electric vehicles sold as it only applies to automakers who have a 200,000 sales cap (Sherlock 2019). This move affected electric automaker companies such as Tesla and General Motors. A variety of support policies that encourage the convenience and cost-effectiveness of private and public charging services such as equipment purchase incentives, preferential rates, and rebates have played a crucial role in facilitating the growth of electric vehicles' infrastructure. Moreover, China has banned the use of two-wheelers with internal combustion engines (Bakker 2018). The three countries have also formulated policies, with the latest being a joint announcement of 100% zero-emission targets and phase-out of fuel-dependent engines by 2050. However, these policy actions rely heavily on the electric car market and the technologies in use. In the sales of electric cars, each country has implemented its legislation. China has the New Energy Vehicle mandate, while the United Kingdom applies the European Union's CO₂ emissions standard (Zhang and Qin 2018). The United States, on the other hand, makes use of the zero-emissions vehicle mandate. The European Union also offers bonuses to

heavy electric vehicles in the new fuel economy standard. In the United States, the Safer Affordable Fuel-Efficient (SAFE) vehicles regulation implemented in March 2020 has also improved fuel economy standards. Overall, these laws, bars, and rules imposed by the governments will ensure a window of opportunity for the Lithium-Ion Batteries.

3.5 Future Development Trends in Lithium-Ion Battery applications

The current trend is in the increase in the size of the battery and the capacity to increase its range. Moreover, the battery market is projected to reach \$90 billion by 2025 (Zubi, 2018). Pioneer industries such as Tesla, Daimler, and Dyson have heavily invested in the industry. However, Lithium-ion batteries also have had their disadvantages concerning the environment as their recycling rates are lower. There is also a limited amount of lithium available while it's mining having environmental and human costs. Other advancements of the battery have come in the form of their structure and design. For example, Lithium-ion Phosphate is cheaper, denser, and has a longer lifecycle. Other scientists have stated that replacing lithium-ion with lithium-sulfur in batteries will amount to lighter and more energy-dense batteries. Lastly, Zinc-air batteries have also been developed and used in electric vehicle technologies as zinc is cheap and abundant and economic and user-friendly.

Chapter 4: Implications for Cost and Pricing Analysis

This section outlines the costing structure related to the business plan. Capital requirements and cash flow projections are assessed and analyzed to ensure all stakeholders in the company properly understand proper financial requirements for the entire business.

Figure 7: Projected Cash Flow

| Cash Flow Projections | Amount in \$ (Y1) | Amount in \$ (Y2) | Amount in \$ (Y3) |
|-----------------------|-------------------|-------------------|-------------------|
| | | | |

| | | | |
|---------------------------------|-----------|-----------|-----------|
| Opening Cash Balance | Nil | 500,300 | 1,800,400 |
| Money From Operating Activities | | | |
| Net Income | 1,200,000 | 1,800,000 | 2,600,000 |
| Depreciation and Amortization | 130,000 | 170,000 | 200,000 |
| Money from investing activities | | | |
| Equipment investments | 1,500,000 | 1,000,000 | 800,000 |
| Cash from Financing activities | | | |
| Reserves conserved | 230,400 | 340,000 | 550,000 |
| Company's Closing Cash Balance | 500,400 | 1,800,600 | 3,200,000 |

The projected cash flow chart above highlights that the company will experience the right cash balance to operate the business while maintaining the required liquidity.

Figure 8: Projected Capital Requirements

| Capital requirement | Amount in \$ (Y1) | Amount in \$ (Y2) | Amount in \$ (Y3) |
|---------------------------------|-------------------|-------------------|-------------------|
| Startup Capital | 10,000,000 | 10,000,000 | 10,000,000 |
| Cash used from the profits made | Nil | 1,200,000 | 1,800,000 |
| Sales and Purchases | 15,000,000 | 17,000,000 | 21,000,000 |
| Profits made | 5,000,000 | 7,000,000 | 11,000,000 |

The capital requirements are essential as they make sure that the breakeven will be achieved by the business as well as significant profits that can be of use for the sustainability of the company.

Figure 9: Projected Profit and Loss statement

| | FY 1 | FY 2 | FY 3 |
|--|------|------|------|
| | | | |

| | | | |
|---|------------|------------|------------|
| Sales | 15,000,000 | 17,000,000 | 21,000,000 |
| Expenses | | | |
| Rental | 200,000 | 200,000 | 200,000 |
| Electrification along with other operational costs | 130,000 | 143,000 | 150,000 |
| Workers' wages | 700,000 | 780,000 | 800,000 |
| Cost of Raw Materials | 2,000,000 | 2,230,000 | 2,640,000 |
| Cost of Equipment | 500,000 | 300,000 | 200,000 |
| Salaries for company executives and other administrative officers | 700,000 | 900,000 | 1,200,000 |
| Marketing expenditure | 500,000 | 700,000 | 800,000 |
| Net Profit | 10,300,000 | 13,000,000 | 15,000,000 |
| Net profit /total sales in % | 68.7% | 76.4% | 71.4% |

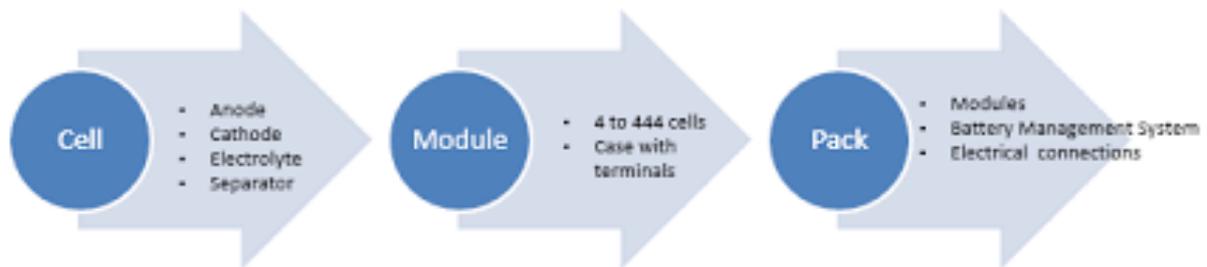
The net profit is expected to gradually rise in the first year and be even higher than the previous year due to the increase in the number of sales made.

Chapter 5: Implications for Risk Analysis and Development of Mitigation Strategies

The research confirms that investment opportunities in China surpassed that of the United Kingdom. The population factor, monthly income, and knowledge of electric vehicles and their Shenzhen residents' attributes highlight a dominant gap. It can be observed, and hypothetically stated that China's investment opportunity is higher than that in Europe. Even though China's laws are a bit dynamic, the country offers international companies with 100% ownership in manufacturing operations. Using the data collected in the previous chapter and secondary research, the development and distribution of the lithium-ion battery are observed to involve several crucial manufacturing supply chain steps; manufacturing of the cells, module processing, and pack assembly. The company can either have all the three processes being conducted in the same facility or be separately done. It is recommended that the company

produces the battery cells and modules in Nevada and have and assemble packs in the same location. Moreover, due to the weight of the battery packs, it is advised that the company identifies a warehouse that is close to the vehicle assembly plants in China. The figure below briefly highlights the stages associated with battery production;

Figure 10: Steps in the production of EV Batteries



Lithium-Ion Battery manufacturing

On average, the cells make up 75% of the total cost of a battery pack (Egbue and Long 2012). To reduce production costs, the company can agree with Panasonic to use its cylindrical small-format Panasonic 18650 and 2170 battery cells to decrease the manufacturing costs. Moreover, the company can also work with other electric vehicle manufacturers to produce and design more giant prismatic battery cells that will ensure a reduction in the complexities and observe an increase in reliability. Based on the recently announced production expansions in China and the United States, It is estimated that even though South Korea and Japan currently have the largest market share in the production of EV Batteries, a significant percentage of Lithium-ion battery production (84%) will be in China and the United States.

Battery Modules

The number of cells per module is of importance in the manufacturing process. The company is recommended to use twelve sections in the modules it produces (Wang, Tseng, Zhao, and Wei 2014). The module stage of production also accounts for eleven percent of a complete Lithium-ion Battery cost. Since the modules can be applied in battery packs in different vehicles, it will benefit the company as it will deal with other electric vehicle manufacturers.

Battery Packs

The battery packs signify the last step in the battery manufacturing process. The battery packs' components include; cooling equipment, electrical connections, and the modules discussed above. The company can assemble them through automated equipment or opt for human

resources when the need arises. The packing step of production also accounts for 14% of the total amount of a complete Li-ion battery pack (Andrea 2010).

The Sources of Raw Materials

Lithium-ion batteries contain minerals such as cobalt, lithium, and graphite, currently in short supply. The company will enter into contracts with mining companies based in the DRC as the country accounts for three-quarters of worldwide cobalt mining and Chile and Argentina. Moreover, for the Cobalt refining, the company will enter into contracts with Chinese companies as China remains the primary source of Cobalt refining. It is worth noting that the scarcity of Lithium and Cobalt could drive up the prices of battery packs, which is an advantage to the company (Olivetti, Ceder, Gaustad, and Fu 2017).

Manufacturing Competition in the Lithium-Ion Market

There are several EV battery manufacturing companies in the United States, where the company will be located. Panasonic, located in Japan, sells its battery packs to electric vehicle companies worldwide (Curry 2017). Moreover, Tesla has recently started producing batteries for use in its Tesla Vehicles. LG Chem Batteries have also been widely sold in the United States and beyond. Other competitors in the EV battery market include Samsung SDI and AESC.

Challenges in the Lithium-Ion Market

The protection of the circuit during transportation and the maintenance of the voltage and circuit within safe levels remains a challenge in the Lithium-ion Industry (Manthiram 2011). However, the remedy is to improve on the packaging and ensure that there is optimized transportation to mitigate these problems. Another challenge that is being experienced in this market is the efficiency and effectiveness of designing lithium-ion batteries for EVs. This has been due to the lack of quantifiable data due to the few electric cars that are active on the roads today. An increase in the number of EVs will be a viable option to solve this problem.

Marketing Strategy

To effectively market the new product and mitigate the risks, the report recommends the company apply the four P's Marketing Strategy, namely; Product, Price, Place, and Promotion (Resnick 2016).

Price:

The company should focus on retaining more clients and as such, establishing a loyal customer base needs to be a priority for the business to be a success. The company should also ensure that the pricing of Lithium-ion batteries is not higher compared to other manufacturers in the industry. Moreover, a good relationship should be developed with the distribution channel by offering warranties and discounts on select days.

Place:

It is necessary and crucial that the organization establishes a foothold in the rechargeable battery industry and establish the Lithium-ion batteries as a pioneer in the existing market. As such, the report recommends the company distribute the availability of the products evenly and include; mega stores, the company’s websites, and an online presence on social media platforms. The plan is to ensure that the product is diverse and reaches many electric motor companies and consumers.

Promotion:

The company needs to acknowledge that due to the increased demand for rechargeable batteries, the competition will be high. Therefore, to have a slight competitive advantage over other companies, the company should effectively promote the product through a grand promotion as well as innovative advertising, active social media presence, and through the use of creative catalogues.

Product:

The company should ensure that the product design is dynamic and flexible enough to meet consumer requirements. Moreover, it is essential to research similar products in the market and determine how it will make the product unique. Some areas to benchmark from include battery life’s longevity, the consumption of power, and how long the batteries take to charge fully.

Figure 11: The General Business Model to be applied by the company

| | | | | |
|--|--|--|--|---|
| Key Partners <ul style="list-style-type: none"> • OEM alliances • Governments | Key Activities <ul style="list-style-type: none"> • Research and Development • Design | Value Propositions <ul style="list-style-type: none"> • flexibility in long-range properties | Customer Relationships <ul style="list-style-type: none"> • client service | Customer Segments <ul style="list-style-type: none"> • Wealthy people |
|--|--|--|--|---|

| | | | | |
|---|--|---|--|--|
| <ul style="list-style-type: none"> Leasing companies Panasonic Manufacturing and Purchasing Insurance Companies | <ul style="list-style-type: none"> Electric Power technologies Battery Manufacturing Charge Point Infrastructure | <ul style="list-style-type: none"> increased rates of performance EF and ownership cost Charge anywhere | <ul style="list-style-type: none"> client intimacy Direct to clients CRM PA | <ul style="list-style-type: none"> purchasers of Green energy attributes Commercial fleet buyers Corporate executives |
| Cost Structure <ul style="list-style-type: none"> Manufacturing facility and equipment Li-Ion Sales R&D costs Workers Logistics Material costs | Revenue Streams <ul style="list-style-type: none"> Energy generation and storage through the production and selling of the Lithium-ion batteries | Channels <ul style="list-style-type: none"> Retail stores Websites Conferences and Events PR/Media | Key Resources <ul style="list-style-type: none"> Engineering and Design Employee skills and knowledge Battery Production | |

Chapter 6: Conclusions and Recommendations

Overall, the report has provided an insight into the Lithium-ion battery market while also offering a detailed description of how the company should conduct the business. Moreover, the story has also identified factors that affect the industry, both internally and externally. The business operations, manufacturing process, supply chain, and business structure have been discussed in length. SWOT Analysis, a qualitative study, and PEST Analysis have been conducted and examined to make the report more substantial. These tools are essential in assessing the feasibility of the business venture. The marketing techniques to be used by the company have also been discussed. Finally, the report presents a manufacturing plan and provides a detailed account of the costs associated with entry into the Lithium-Ion battery industry. The report recommends that the company improve on the packaging and ensure that there is optimized transportation to mitigate the competition that exists in the Lithium-battery market.

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