Price Vs. Value, Tesla - a Trillion-Dollar Company

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Abstract

Tesla's share price has experienced significant growth in recent years, outperforming competitors and creating debates regarding the value of the firm. The scope of the thesis is to value Tesla as of February 4th, 2022, and subsequently, investigate the impact of Elon Musk's announcements and future expectations on the value of the firm. This is done through a Discounted cash flow analysis of the firm with a 10-year forecasting period. The researchers create a two-part analysis of Tesla and the industries it operates in, to estimate future revenue from the company's operations. The strategic analysis follows the structure of Porter's Five Forces framework and has a special focus on Tesla's supply chain management, given the importance of this for the firm. The analysis finds that both the BEV market and energy storage industry will see high growth in the future. It also finds that the company is facing several challenges for critical components and supplies. Tesla's ability to secure its supply chain through strategic acquisitions, insourcing, and exclusive supplier deals is key to withstand supply chain disruptions. Furthermore, Tesla's ability to utilize lean manufacturing and elements of Industry 4.0 is important for future production and securing competitive advantage. The financial analysis seeks to analyze the financial performance of Tesla and its competitors and find the current stage of the company's business life cycle, in order to estimate future performance.

The valuation estimates Tesla's share price to be $498.91 and estimates that Tesla will produce 4.7 million vehicles in 2031, with a 4.3% market share in 2030 of global light vehicles and 16.8% of the BEV market. The demand for batteries is estimated to be 472 GWh in 2031. Additionally, the researchers create a second valuation case based on Elon Musk's announcements and find the share price to be $3,061.15. The forecast would require significant scaling of production and increase in efficiency to reach Elon Musk's expected capacity of 20 million vehicles in early 2030's. The objective of this report is to highlight the impact of future expectations on the share price. The two values differ significantly compared to the market price of $923.32. This indicates that influence from aforementioned expectations set by Elon Musk and Tesla, could be contributing to the excess price.

Contents

1.0 Introduction

The introduction section aims to give the reader an introduction to the thesis and its structure, as well as the underlying motivation for the paper.

1.1 Background and motivation

Tesla has seen large growth in market capitalization over recent years, increasing more than a 1000% in two years from January 2020 to January 2022, from a share price just under $100 to surpassing $1000 per share (Yahoo finance, 2022). Despite the COVID-19 crisis when many stocks saw a fall in share price, Tesla's share price has increased significantly over the period (Yahoo, 2022). The financial news media has covered the rise of Tesla's stock extensively, commenting on the surge of the stock both in admiration and disbelief (Stankiewiez, 2021; Thomas, 2021). Despite the continuous rise in share price, Tesla was one of the most shorted stocks on Wall Street in 2021 (Krauskopf, 2021). Some investors believe in the potential of the firm and its continuous domination in the EV market, while bearish investors believe the stock is overvalued and detached from fundamentals (Stankiewiez, 2021).

In the fall of 2021, Tesla surpassed a $1 trillion valuation following a deal to sell 100 thousand vehicles to Hertz. This was the fifth company ever after Apple, Microsoft, Amazon, and Alphabet to achieve a trillion-dollar valuation (Thomas, 2021). Despite the market's development, many analysts and financial commentators continue to be skeptical of the valuation. JP Morgan analysts increased their price target in January 2022 to $325 from $295 in December 2021, which is still significantly below the share price of $937 as of January 26, 2022 (Brinkman, 2022). Similarly, Barclays and Citigroup analyst's set similar low price targets for the stock at $325 and $313, respectively (Johnson, 2022; Michaeli, 2022). Financial commentators point to the fact that investors treat and value the Tesla stock more as a tech firm than an automotive company. Despite making up less than 1% of global car sales, Tesla has the same market cap as the nine biggest automakers combined (Thomas, 2021). Figure 1 below shows the comparison between the nine biggest automakers by market cap in comparison to Tesla, as of February 23rd, 2022.

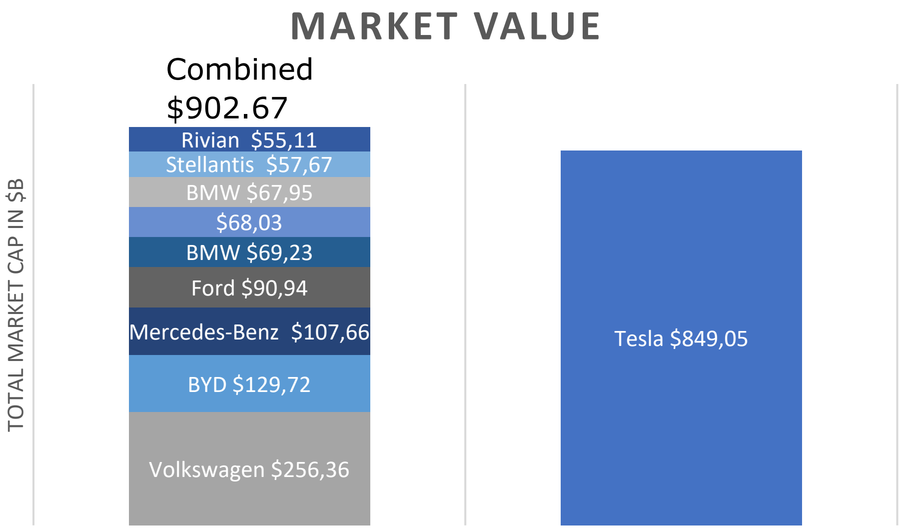

Figure 1 Market value of top 10 car manufactures in the world per 23-Feb-22. Own creation, data retrieved from (Companiesmarketcap.com, 2022)

Financial commentators also comment on Tesla's yearly revenue being significantly less than other $1 trillion companies, with Tesla's revenue being 25% of Microsoft's annual revenue in 2021 and 10% of Amazons (Tully, 2021). CNBC's financial commentator Jam Cramer has famously called the stock a phenomenon that "*go up endlessly on nothing*" (Stankiewiez, 2021). Elon Musk himself has also commented on the rise of the share price on multiple occasions on social media. Elon Musk tweeted "*Wow"* as a response to a spike in the share price in July of 2020. In a controversial case from May of that year, Elon Musk tweeted that the share price was too high in his opinion, causing a 12% decrease in the share price (Waters, Fox, & Hodgeson, 2020). The power of Elon Musk's announcements on Twitter can be seen in the lawsuit from 2018 made against Elon Musk by the SEC. According to SEC, Elon Musk violated security laws by tweeting that he wanted to take Tesla private. The settlement required Elon Musk to not make any public announcements with information about Tesla without the approval of the firm. A requirement which Elon Musk has violated on several occasions since according to SEC (Duffy, 2021).

Tesla has made several ambitious announcements in recent years, with the launch of future projects including Semi Truck and Cybertruck. These projects have been pushed back a number of times, with Elon Musk admitting both development- and supply chain issues having an impact on the development (Kolodny, 2021). As seen in earnings calls and announcements by Elon Musk, he believes that the company has significant potential to grow both its vehicles and energy solutions in the future (Musk, 2020; Tesla, 2020b). Current literature shows how the management of the supply chain plays a significant role, especially for production companies (Filbeck, Kumar, Liu, & Zhao, 2016; Hendricks & Singhal, 2003; Zsidisin, Petkova, & Dam, 2016). Tesla has made several moves in recent years to make its supply chain more resilient to disruptions, in some cases taking unconventional steps (Hull & Stringer, 2022; Sage, 2017). The important role of managing the supply chain has led the researchers to focus on elements in Tesla's supply chain, to determine the future cash flow of the firm.

As stated by Damodaran (2006) "*A postulate of sound investing is that an investor does not pay more for an asset than it is worth*." (Damodaran, 2006). Following this notion however can be difficult in the case of Tesla since many experts and analysts disagree on the valuation of the firm. Considering the expectations from Elon Musk on Tesla's future adds another factor to consider for investors. Previous literature on the evolution of Tesla's share price have also shown that investor behavior, when it comes to future cash flow, is not necessarily driven by fundamentals, but rather on investor sentiment (Cornell & Damodaran, 2014; Lim & Tan, 2021; Strauss & Smith, 2019).

The motivation for the thesis is based on these differences seen between the evolution in market value and the opinions from analysts, financial commentators, and Elon Musk himself regarding Tesla's value. The overall purpose of the thesis is to estimate the share price of Tesla, based on what the researchers consider realistic assumptions.

1.2 Problem statement

Based on the background and motivations for the research, the following research question has been formulated:

"What is the estimated value of Tesla Inc. as of February 4th, 2022?"

The initial valuation made will be referred to as the *Researchers' Case.* Due to the many uncertainties regarding the valuation of Tesla's stock from financial analyst, as well as the big announcements made by Elon Musk regarding Tesla's future potential, the researchers seek to subsequently build a valuation case on Elon Musk's announcements. This case will be referred to as the *Elon Musk Case.* To support the research question, the following the sub-question has been created:

"*How does Elon Musk's expectations for Tesla's future affect the share price of Tesla Inc. as of February 4th, 2022?"*

The *Elon Musk Case* is an effort to uncover some of the elements which certain experts and analysts call "unrealistic expectations" and put them into context. The intention is to use the findings in the sub-question and compare it to the value found in the *Researchers' Case,* as well as to the market value of the stock. The comparison between the cases seek to highlight the impact of Elon Musk's expectations of future growth and discuss if this can explain the potential difference in price and value. As stated by Damodaran (2006), sound investments do not pay more for an asset than it is worth.

The researchers aim to build the *Researchers' Case* on fundamentals regarding Tesla and the future market. The term *fundamentals* is defined by the researchers as the facts at hand regarding the company's future cash flow and growth perspective. This consists of the most accurate estimates of the future market and Tesla's performance in the mind of the researchers, based on the analysis of Tesla and the present industries they operate in. The subsequent *Elon Musk Case* is the researchers aim to build a case based on investor sentiment. The term *investor sentiment* is defined as the expectations of the company's future financial performance, based on announcements made by Elon Musk and Tesla regarding future production and the potential of the firm.

A strategic analysis of Tesla and the automotive industry is made, which creates an overview of current and future development. The strategic analysis makes a thorough analysis of the automotive industry and Tesla's role in it, while also looking at other industries Tesla is involved in. Based on the literature review, it is determined that it is important for Tesla to manage its supply chain. The strategic analysis will therefore have a special focus on how Tesla manages its supply chain. The second part of the analysis consists of a financial analysis, looking at the financial performance of Tesla and its competitors. The findings in the analysis regarding the current and future of the company and industries, are used in the valuation. A DCF-valuation method will be used, considering elements influencing its future cash flow, to ultimately estimate the value of the firm and the share price in the *Researchers' Case*. Subsequently, the researchers aim to build the *Elon Musk Case* based on investor sentiments. By comparing the estimates from the two cases and the market price per share, the researchers aim to answer the research question and the adjoining sub-question.

1.3 Structure

The structure of the thesis follows the approach presented by Saunders et. al. (2021) (Saunders, Lewis, & Thornhill, 2021). The paper consists of several different stages, as illustrated in Figure 2 below. Beginning with an abstract summarizing the findings in the paper to give the reader an overview of the paper. The introduction provides an initial presentation of the paper's content, its background, and the research question. The following literature review highlights the current knowledge on the subject. *Current and future automotive production* aims to give the reader an introduction to the automotive industry and explain the development in the industry. A two-part analysis is made, one for Tesla and the automotive industry following the structure of Porter's Five Forces framework, with additional insights into Tesla's other businesses. The second part of the analysis consists of a financial analysis of the firm and its competitors. A SWOT framework is presented after the analysis to summarize the findings. Based on the analysis, a valuation is made consisting of a revenue forecast, cash flow forecast, the WACC, enterprise value, and a sensitivity analysis. Finally, the *Elon Musk Case* is presented. A discussion is made to evaluate the findings of the paper and finally a conclusion, summarizing the findings and discussing potential future research.

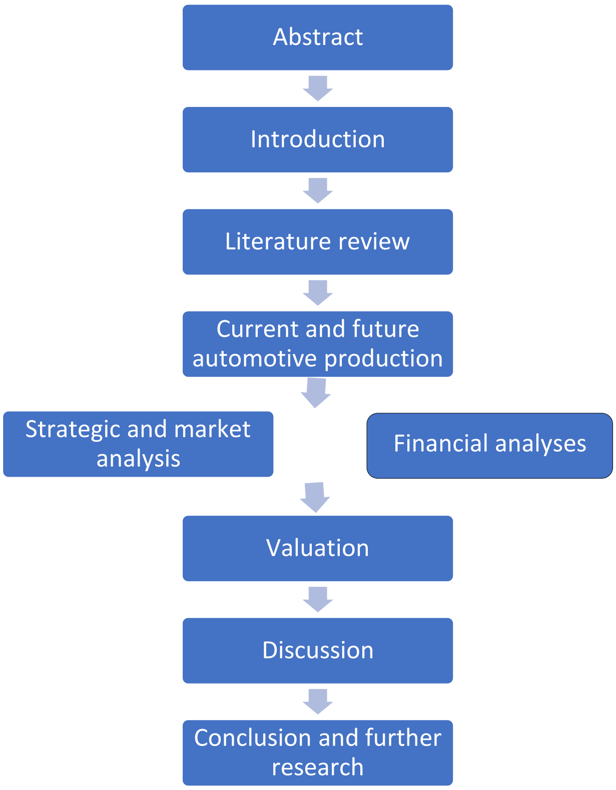

Figure 2 Illustration of the structure of the paper, Source: Own creation

1.4 Methodology

Following the presentation of the problem statement and the structure of the paper, the methodology section outlines the methodological approach that the researchers base the paper on.

1.4.1 Research approach

The research approach to the paper determines the overall structure for conducting the research. Saunders et. al. (2021) differs between two types of research approach. A deductive approach aims to develop a theory or hypothesis and design a research approach to test these assumptions. The tested hypothesis can be modified if necessary. A deductive approach seeks to explain the relationship between different variables. This is the typical approach in scientific research and natural science, where certain basic laws allow researchers to anticipate the outcome. The deductive approach can be critiqued for not allowing alternative outcomes due to being structured around a theory or hypothesis. The inductive approach to research takes the stance of collecting data and insights and develops a theory on the basis of the findings. Inductive research approach usually results in research designs and outcomes that can be used for generalization. This differs from the deductive approach by following the data rather than a preconceived notion (Saunders et al., 2021).

In practice it can be difficult to differentiate between the two research approaches. The purpose of the paper is to estimate the impact of Elon Musk's announcements on the value of Tesla, using existing financial theories and models. The approach in this paper is predominantly deductive since the researchers base the paper on a theoretical subject with a specific purpose in mind. The research is also based on information gathered on the subject prior to the research. On the other hand, is the valuation method applicable to similar cases, from which general insights could be drawn. The research is therefore considered to have elements of both research approaches.

1.4.2 Sources

The paper is written from the perspective of the investor. The information used for the analysis and valuation in the paper consists of publicly available information, which is all secondary sources. The researchers use a combination of qualitative and quantitative data for the analysis and subsequent valuation. The qualitative data consists of news stories, books, articles, and announcements from Tesla and Elon Musk regarding the current and future operations of both Tesla and the industry. The information is collected primarily using online search engines, several financial news media, Tesla's website, CBS library online search tool, as well as the library itself. Sources include Tesla's own website and reports, Financial Times, CNBC, Bloomberg, Insideevs, Forbes, and Reuters. The quantitative data used in the analysis consists of insights on finances and production numbers for both Tesla and industries. The quantitative data is collected from market reports from leading investment banks, MarketLine, BloombergNEF, KPMG, as well as market intelligence platforms such as S&P Capital IQ and Bloomberg terminal. The qualitative data is also found in reports from both Tesla and its competitors. The sources are primarily found through statistical databases such as MarketLine and Statista, or through financial databases such as Yahoo Finance, S&P Capital IQ, and Bloomberg.

1.4.3 Validity

The researchers have ensured the reliability and validity of the sources by taking a critical approach to data collection. Qualitative data on Tesla and the industry is collected using peer-reviewed literature from recognized sources, collected primarily through CBS library. The researchers also ensure the validity of online sources by using credible sources from globally recognized financial news media, as well as recognized media dedicated to covering the EV- and automotive industry. To ensure further validity, the researchers triangulate the data with quantitative data from industry reports and the company's own reports. The quantitative data is also collected through recognized sources, such as the company's own reports, state and regional authorities, and established market intelligence platforms.

1.5 Theory

1.5.1 Discounted cash flow valuation

The discounted cash flow (DCF) valuation model is a central part of the report and is used to find the share price in both valuation cases. The DCF model estimates the value of a firm by projecting the future cash flows and then discounting that cash flow back using a rate which reflects the riskiness of that cash flow (Damodaran, 2006). If similar to Warren Buffet, you believe in the assumption that you are buying the underlying business and not the stock, then the DCF valuation is a great approach since the model looks at fundamental value-drivers rather than market perceptions (Hagstrom, 2014). Therefore, the method is considered the most theoretically accurate valuation method available. Furthermore, it is one of the most widely used valuation methods (Damodaran, 2006). According to a 2021 report by Morgan Stanley the DCF model is the second most used valuation method amongst professional equity analysts. However, there are limitations to the model. A risk of using the DCF model when valuing a company is that you might end up estimating that every stock is overvalued. This can happen if market perceptions have outrun fundamentals and can be an issue for investors looking to buy in overvalued markets. Additionally, the 2021 Morgan Stanley report found that the most used valuation approach is an enterprise value-to-EBITDA multiple to estimate the continuous period or the terminal value in a DCF model. The terminal in a DCF model often has a huge impact on the valuation of the firm, therefore it can be argued that a DCF valuation is driven by a multiple and could be a better approach to valuation. Therefore, using the DCF valuation approach requires substantially more information to value a company (Mauboussin & Callahan, 2021).

1.5.2 Porter's Five Forces

Porter's Five Forces model is an analysis tool used to explain the competitive environment of an industry, by diving into five different drivers. The *threat of new entrants* mainly depends on the entry barriers of the industry. The framework also highlights *the power of both suppliers and buyers.* This determined the nature of suppliers in the industry and how dependent buyers are on these firms. The same goes for buyers, with powerful customers having an impact on prices and quality of products and controlling much of the industry. *The threat of substitutes* is depending on the price-performance trade-off of other products and the switching cost to these substitutive offers. The fifth driver is *rivalry among competitors* and maps the other actors within the space and their offerings. The rivalry depends on factors like the number of competitors, industry growth, exit and entry barriers, and price competition. (Porter, 2008). The model gives a good overview of an industry, but some scholars argue that it is too static, only assessing the competition and the industry in its current stage and encouraging the mindset of industry boundaries. It is also argued that the framework oversimplifies the categories and does not segment each one further. The analysis also does not link directly to any possible actions that could be taken (Grundy, 2006).

1.5.3 SWOT framework

The SWOT framework is designed to analyze a firm's strategic position based on four parameters. The internal factors analyzed are strengths and weaknesses, while the external are threats and opportunities. Strengths are the internal elements that make up the firm's competitive advantage, such as the technology or brand. Weaknesses are elements that can work against these strengths and hinder the firm's performance. Opportunities are external factors that could play to the firm's advantage, such as a development in the market or favorable legislation. Threats are external factors that could have a negative impact on the firm, such as increased competition or unfavorable tariffs. The analysis is designed to give a realistic and fact-based overview of the company's performance and potential. The framework is visualized as four quadrants, giving a quick overview of the situation the company is in (Hill & Westbrook, 1997). The SWOT framework is a very popular tool in business analysis because it is very straightforward and gives a good overview of a company's current situation. However, Hill & Westbrook (1997) highlight a number of critique points regarding the framework, mainly when it comes to using it as an analysis. Especially for large firms, using the SWOT analysis as the only tool to analyze the firm does not give enough insight and oversimplifies the outcome. The SWOT approach only highlights issues and does not provide solutions that could be used in strategic development (Hill & Westbrook, 1997).

1.6 Delimitation

Due to the limited time frame of the research, as well as the limited size of the paper, a number of delimitations are imposed to limit the scope of the research. The primary approach for the paper is that the research is conducted from the perspective of an external investor. The researchers only consider public available information for the paper. Only information published up until April 2022 is considered for the paper. All information used is secondary data since the valuation is made from an investor's perspective. While current literature suggests that investor sentiment regarding Tesla's stock could be driven by several factors, the researchers choose to focus specifically on the effect of Elon Musk's expectations and announcements on the future of the company. The researchers do not consider other elements such as herding behavior, fear of missing out, or other social moods of the market and investors. The valuation of the share price of Tesla is made on the chosen data of February 4th, 2022. Based on the analysis, the researchers estimate the future revenue of the company. This is limited to the existing industries the company operates in. It does not consider any future revenue in other industries. The researcher excludes from estimating revenues from potential future mergers and acquisitions. A 10-year forecasting period is chosen by the researchers for the forecast. Revenue from licensing self-driving technology is not included in the forecast since this will reduce Tesla's competitive advantage. Additionally, operating margin is estimated across all of Tesla's businesses and products. Consequently, the attributes in changes of a single unit sold does not affect operating margins. For the *Elon Musk Case* the increase in revenue from Tesla's energy generating and storage business is not accounted for in the computation of the company's weighted average cost of capital.

2.0 Literature review

The following literature review seeks to present the current literature and knowledge on what factors influence the share price of firms and Tesla in specific.

2.1 Supply chain disruptions impact on shareholder wealth

Several scholars have investigated the impact of supply chain disruptions on shareholder wealth. Focusing on Tesla's supply chain and the management of it, is significant for a number of reasons. Tesla is a production company with global production and has a vast network of suppliers where the impact of supply chain disruptions (Valentin, 2018). In modern supply chains, firms do not operate in a vacuum and are influenced by the many different actors and factors that affect their supply chain. As company's supply chains and the stakeholders within become increasingly intertwined, the effect of potential disruptions does as well (Hsuan, Skjøtt-Larsen, Kinra, & Kotzab, 2015). The importance of supply chain management is especially important in the case of Tesla and virtually all parts of its business. The company is dependent on suppliers of critical parts like semiconductors or raw materials for battery production, on controlling and scaling its production, and delivering vehicles and energy products to customers. Furthermore, the automotive industry in general is facing a number of current- and future supply chain challenges which have also impacted current and future production for Tesla, as well as other firms in the industry, significantly (Trivedi, 2021).

Disruptions in the supply chain can arise from both internal and external factors. External risks include unforeseen elements like natural disasters, war, or pandemics like Covid-19, but it can also be legal initiatives by governments. New legislations can have a negative impact on a business if they cause restrictions but also create new opportunities as sanctions are eased or imposed on competitors. Internal disruptions refer to the operations within the firms' supply chain that can cause both operational and financial impact. These are the factors that can be controlled by the firms' strategy and supply chain management (Christopher, 2016). Disruptions can impact several areas of a firm's financial performance such as cash flow, earnings, ROA and credit ratings (Filbeck & Zhao, 2020).

Several studies and scholars have investigated the financial impact of supply chain disruptions on firms. Hendricks & Singhal (2003) studied how the announcements of supply chain glitches impacted the share price of those firms. The study used a sample of 519 glitches announcements made between 1989 and 2000 and the scope is on glitches causing production or shipment delays. These glitches can be caused by forecasting errors, shortages, lack in quality, breakdowns, capacity issues or operational constraints. The study suggests that the value of a firm's supply chain resilience can be difficult to estimate based on data, however measuring the value lost from unreliable or unresponsive supply chains can help determine the stage of supply chain resilience. The loss in shareholder value due to a disruption can help determine the value of a more reliable supply chain. Ultimately, the researchers use this notion to argue why analyzing a firms' supply chain is important in determining its value. The research shows that the announcements have a clear negative impact on stock price by conducting an event study with a two-day event period with a cumulative abnormal return (CAR) of -10.28%. Based on the study they conclude that two of four variables tested had an effect on the share price's reaction to supply chain glitches. Firms with a high growth prospect are hit more severely by supply chain glitches than low growth prospect firms. The size of the firm also impacts the reaction, having a greater impact on smaller firms. Dept-to-equity ratio of the firm and the timing of the supply chain glitch were not found to have a significant impact on the market reaction (Hendricks & Singhal, 2003).

Zsidisin et al (2016) suggest that the research by Hendricks & Singhal (2003) does not consider the reason for the disruption itself. They argue that some disruptions have a greater impact, are more difficult to manage, or are perceived as more severe by stakeholders. Their paper divides supply chain glitches into four different reasons; supply-side, regulatory, catastrophic, and infrastructural. With this addition the researchers found a mean CAR of -1.94% on the event day. There is a big difference on the impact depending on the type of disruption. Regulatory (-5.0%), catastrophic (-2.6%), and infrastructural disruptions (-1.7%) have a bigger impact on share price than supply-side disruptions. CARs do not differ across industries, expect for what is categorized as "industry 4", transportation equipment, which include car manufacturers. Here announcements of glitches have a average CAR of -3.8% on average, which is a significantly harder impact than in other industries (Zsidisin et al., 2016). Considering the four variables tested by Hendricks & Singhal (2003), the study did not find that the growth prospect of a firm significantly impacts the markets' reaction to supply chain glitches, but rather it is the dept-equity ratio of the firm which has a significant impact. The share price of firms with a high debt-equity ratio are impacted more severely than firms with a low debt-equity ratio (Zsidisin et al., 2016).

Risk assessment in firms often has a focus on financial or regulatory risk rather than the broader supply chain vulnerabilities (Christopher, 2016). The impacts of the disruptions caused by the COVID-19 pandemic has shown the need for a new approach to supply chain resilience, with a longer-term perspective. Disruptions may unfold faster, and come in various different shapes such as technological revolutions, climate change, and geopolitical uncertainties (Nauck, Pancaldi, Poppensieker, & White, 2021). Due to the increasingly integrated nature of supply chains, the damage caused by disruptions are not limited to the firm itself but have the potential to affect all actors along the supply chain, as well as competitors. The impacted firm’s share price reacts most negatively to demand and supply disruptions, production planning events, and quality issues. Competitors are impacted mostly by disruption events, followed by capacity, and production planning disruptions (Filbeck & Zhao, 2020). From a market perspective, disruptions can cause opportunities for competitors, however from a supply chain perspective, disruptions can also impact competitors negatively. Competitors in many industries share suppliers or customers (Filbeck et al., 2016). Similarly, to Hendricks & Singhal (2003), Filbeck & Zhao (2020) find that firms with a high growth prospect and higher leverage ratios are more negatively impacted by disruptions. The same is the case in industries with a high concentration of firms. Customers and suppliers are less affected by the disruptions, mainly because they are often in a different industry not affected by the disruption. Customers in industries with low competition, lower sales, and high risk are however more negatively impacted by announcements from a supplier (Filbeck & Zhao, 2020).

Specifically for the automotive industry, Filbeck et al. (2016) makes a study of disruptions in 5 car companies and the impact on their CARs over a period of 5 days before and after the announcement from 1990-2010. The study found a negative CARs of -0.99% over the period for both American and Japanese automakers. However, market cycles are more significant for American firms with a negative CARs of -6.72% during bear market periods, compared to -2.12% for Japanese firms. During bull markets there is no significant announcement effect on American stocks, with a negative impact of -1.22% for Japanese stocks. Bull markets do react negatively to disruption announcements immediately after an announcement, but market dynamics and trends cause the negative effect to dissipate quicker in bull markets. The difference in the number of disruptions reported is credited to the Japanese automakers long-term focus on supply chain management and resilience. Japanese companies have fewer recalls of vehicles and fewer disruptions reported than American manufacturers. The researchers suggest that American companies are also more affected by media bias and scrutiny of American car manufacturers, which could have an impact on investors' perceptions (Filbeck et al., 2016).

These studies suggest that the impact of the disruption on a firm's share price is dependent on the nature of the disruption and its impact on the industry as a whole. In general, there is clear evidence for a negative impact of disruptions in a firm's supply chain. It does not only affect the firms itself, but also other actors in the supply chain such as competitors, customers, and suppliers. The significance of a disruption is based on both the nature of the disruption, the industry, the firm, and the stock market's conditions.

The studies highlighted above have dealt with the market reaction to supply chain glitches across firms and industries. There have also been several scholars investigating what drives investor's decisions when it comes to Tesla's stock specifically. Cornell & Damodaran (2014) have tried to explain investor sentiment when it comes to Tesla's stock. They have made a detailed anatomy of the stock's run-up between March 22 2013 and February 25 2014, where the price increased seven times the original value (Cornell & Damodaran, 2014). This is compared to the S&P 500 index increasing 20.4% over the period, and other major automotive manufacturers 16.2%, suggesting that Tesla's increase was not only market or industry related. The paper follows the notion from DeLong, Shleifer, Summers and Waldman (1990), defining investor sentiment as the belief about future cash flow and investment risk that cannot be justified by facts. Making a DCF model to value Tesla before, during, and after the run-up, suggested that the market price in all three occasions was much higher than the estimated value. At the end of the run-up, Tesla stock was overvalued by 150% according to the researchers' estimates of $100.35 per share, compared to the stock price of $250. An event study for the period determined that no significant positive news on either new innovations or earnings and revenue was reported during the period that could justify the massive increase in share price. The research conclusion that the run-up could not be supported purely by fundamentals but must also be influenced by investor sentiment. The conclusion about investor sentiment also suggests that share price should eventually reflect actual value over time, as the cash flow generating characteristics become clearer (Cornell & Damodaran, 2014).

Other scholars have investigated the elements that could explain the investor sentiment for Tesla, as explained by Cornell & Damodaran (2014). The paper by Strauss & Smith (2019) suggests that announcement and speculations could have a significant influence on the evolution of Tesla's share price. The researchers investigates the impact of company announcements and financial news coverage on Tesla's share price over time (Strauss & Smith, 2019). They use the case of a tweet made by Elon Musk on the morning of August 23rd, 2016, announcing a Tesla product introduction later that day. They anchor the analysis in the issue-attention cycle by Downs (1972), explaining the different stages of how financial news flows and is being reflected in the share price of a company. The cycle consists of five stages: the pre-problem stage, alarmed discovery, and euphoric enthusiasm, realizing the cost of significant progress, gradual decline of public interest, and finally the post-problem stage. An event study follows the development of the share price as information spreads during the day. Tesla's stock rose immediately after the tweet was posted. According to the issue-attention cycle, the tweet by Elon Musk grabbed the attention of people and they were optimistic that the issue could be solved, despite little information available regarding the actual product introduction. Many speculated that the announcement could mean significant news from Tesla, like a new vehicle launch. The third stage of the cycle is the realization of what the news entails. The product introduction turned out to be a new battery. News outlets reported extensively on the new battery and its implications but determined that it was only an incremental improvement. The introduction did not meet the expectations of the market and the share price fell thereafter. The final two stages of a gradual decline in interest and the post-problem stage are seen in the three days after August 23rd as financial news about the announcement decreased. The share price did not respond to the additional analysis from financial news outlets, and the share price returned to the level prior to the announcement. Based on the analysis, the researchers argue that financial news plays a limited role for Tesla's share price. The price is strongly influenced by the announcement made by Elon Musk in his tweet and the subsequent speculations regarding the announcement. Rather than waiting for the introduction and basing the investment of facts, some investors seem to base their decisions on herding behavior and the fear of missing out on a potential big upside if rumors were true. The study also suggests that Tesla's stock is subject to day trading speculations. Investors can successfully trade on rumors due to the belief that the majority of traders will react to rumors in a certain way, which is the case for Tesla's stock (Strauss & Smith, 2019).

Research by Lim & Tan (2021) suggests that the market does not always follow rational fundamentals but is also impacted by the sentiment of the social mood. The study analyzes the impact of protests in China in April 2021 on Tesla and the Chinese EV company Nio. The event analyzed was an incident where a woman in Shanghai climbed on top of a Tesla at an auto show in a T-shirt protesting the recent Tesla vehicle accidents. The video of the incident went viral, causing a series of negative news about Tesla's quality issues and the handling of the incident. The event study showed that the event significantly impacted Tesla's share price negatively in the following period. The findings further validate that the notion that the social mood influences the development of the share price. The researchers chose to include Nio in the comparison to uncover how the event involving one company influenced its competitors. Nio's share price rose as a consequence of the bad news for Tesla (Lim & Tan, 2021).

The three studies on Tesla suggest that the company's share price could be driven investor sentiment rather than fundamentals. Due to the studies on Tesla presented above, the researchers also aim to test the significance of announcements and expectations from Elon Musk regarding the future of Tesla. Studies across firms and industries, as well as studies specifically on the automotive industry, all suggest that supply chain glitches can have a significant impact on the share price a firm. By analyzing Tesla with a specific focus on its supply chain, the researchers aim to estimate the value of the firm based on fundamentals. The fundamentals consist of company and industry data of both Tesla's finances and data on the current and future potential of its supply chain operations. Using the insights from the analysis in a DCF valuation of the firm, the researchers seek to investigate how these announcements have an impact on the share price of the firm and how this compares to the *Researchers' Case* and the market price per share.

3.0 Current and future automotive production

The second industrial revolution gave birth of *Fordism* and since then, supply chain management has been an integrated part of creating value and effective processes for mass production. With the introduction of lean production, first pioneered by Toyota in the 1980's as the Toyota Production System (TPS), controlling the supply chain became even more important (Hsuan et al., 2015). Lean production is a continuation of the *just-in-time* (JIT) production approach. The solution to disruptions in production was traditionally to hold buffer inventory, to combat the fluctuation in supplier delivery. The basic idea of JIT is to produce items as they are required and in quantities needed to satisfy immediate demand (Paton, Clegg, Hsuan, & Pilkington, 2011). JIT has several advantages such as, reduced inventory, reduced factory space needed, reduced material handling, and better quality-control due to the small quantities for each lot. Simultaneously, inventory cost is shifted from producer to supplier and production becomes more flexible as it can be adapted to demand (Paton et al., 2011).

JIT further developed in what is today known as *lean production.* The concept is based on reducing or eliminating waste in production and creating more efficient production processes to reduce cycle time and in the end reduce lead time. Another key aspect is putting the end user at the heart of the internal practices when it comes to value creation (Russell & Taylor, 2017).

As described earlier, smaller lot sizes are a central part of reducing waste in lean production. Decreased inventory levels simultaneously make processes more dependent on each other to perform as there is little or no safety stock, and errors and bottlenecks become apparent (Russell & Taylor, 2017). Another approach to reduce waste is reducing the setup time. Automotive production involved many heavy machines with a long setup time, which would normally defy producing small lot sizes as lean suggests. However, Toyota was able to reduce the setup time from 6 hours to 3 minutes at its factories (Paton et al., 2011)(Russell & Taylor, 2017).

Thirdly, managing the production flow through mixed production schedules allows for uniform production levels, which is an integrated part of lean production (Russell & Taylor, 2017) (Paton et al., 2011).

Due to the focus on limiting waste and the low safety stock, the focus on quality is important. (Russell & Taylor, 2017). Firms can use mistake proofing, designing production processes so they can only be performed in one way to decrease mistakes (Paton et al., 2011). A close collaboration with suppliers is critical to generate additional product value. Long-term contracts and close relationship allow for synchronized production, where suppliers act as an extension of the firm’s production line and value chain. Close partners like this go through various checks and certifications to ensure compliance is met. (Russell & Taylor, 2017). Lean production allows for *make to order* production where individual products can be customized to fit the requests of the customer based on the standard product. This is something which is seen in many parts of the automotive industry (Hsuan et al., 2015).

3.1 Industry 4.0 and Teslism

"The fourth industrial revolution", also known as Industry 4.0, was a term popularized by the Founder and Executive Chairman of the World Economic Forum, Klaus Schwab, in 2015. He argued that the development of technologies such as artificial intelligence, internet of things, and advanced robotics, are not only technological advances, but will dramatically alter existing industries (Schwab, 2017). There are four main challenges for industries in this new era. Hyper connectivity between machines, products, and humans is the first challenge. Access to information should no longer be limited to a few people and consumers demand real-time responsiveness from companies. Utilizing technologies like atomization to build more agility in production and exponentially progress efficiency. The third challenge is the hyper-concentration of industries, where a few big firms and their digital ecosystems become dominant. The fourth challenge is the perception of value, going from the consumption of products to the use of products as services. There is also increased focus on digital platform business models (Valentin, 2018).

Valentin (2018) argues that Tesla's business model, referred to as Teslism, can be used as an organizational model for Industry 4.0, like Toyotism was for the third industrial revolution. Valentin (2018) presents seven main principles of Teslism in which Industry 4.0 is structured (Valentin, 2018).

Hypermanufacturing builds on the principles of lean manufacturing but updated using new technology like robotics and digital solutions in generating collaborative value. It uses frugal manufacturing, the act of creating zero waste innovation, throughout the supply chain as an added value to consumers. The zero-waste approach still requires firms to perform mass customization of products, created through coordination and data utilization (Valentin, 2018).

Cross integration uses four levels of vertical, horizontal, transversal, and peripheral integrations to add value for consumers. Peripheral integration is the social, societal and environmental integration of factories, reducing emissions and collaborating with neighborhoods and authorities to build an ecosystem (Valentin, 2018).

Software hybridization is utilizing software solutions to create both better production processes and creating connections to customers. Software can create better design and lower R&D costs, optimize manufacturing, and improve quality through single order tracking. Software is also upgrading physical products with additional services to create value and for the firms to better understand customers (Valentin, 2018).

Industry 4.0 creates a network of value around the product or service which can be a closed ecosystem across products, much like Apple's IOS (Valentin, 2018).

Storytelling is another element of Teslism, focusing more a greater vision of the firm with leaders at the front of the firm. The vision impact investors as well as employees, attracting visionary minds to the company. The firm maintains a star-up leadership approach (Valentin, 2018).

The last principle is mixing human and machine learning, to create a culture of testing and learning using short loops to quickly determine viability. With the large amounts of data generated, using this efficiently to innovate is key for R&D (Valentin, 2018).

While Tesla's business model and approach to manufacturing is among the most disruptive in the automotive industry, principles described are not unique to Tesla. Many companies in other industries have adapted to Industry 4.0 and created disruptive strategies based on it. Companies cannot anticipate their future in Industry 4.0 since it is already happening (Valentin, 2018).

4.0 Strategic and market analysis

To estimate Tesla's future business, an in-depth analysis of the current operations is needed. Throughout this analysis, Tesla's current market position amongst its competitors is analyzed for its core business as well as non-core businesses. First, it is important to understand what products Tesla is selling. Tesla's core business is its automotive business, which currently consists of four different vehicle models; two sedans called the Model S and the Model 3, and two SUVs called the Model Y and the Model X, details on these vehicles can be found in Appendix 1. Tesla's non-core businesses relate to its production of vehicle charging stations, known as Superchargers, which are essential to its automotive sales. Furthermore, Tesla has a range of products related to its energy and storage business, included the "Powerwall" a battery system which stores energy in case of a power outage, "Tesla Solar Roof" roof tiles with build-in solar panels, standard solar panels, as well as the "Tesla Megapack" a large energy storage system for utility-scale installation (Tesla, 2022c).

Based on the findings in current literature on supply chain disruption's impact on shareholder wealth, it can be seen how managing the supply chain is of significant importance for automotive firms. The literature also shows how this is the case for Tesla. The following section will therefore have a special focus on the elements of Tesla's supply chain.

4.1 Automotive industry analysis

Tesla's core business is the manufacturing and sale of electric vehicles. In 2021, 95% of its revenue came from its automotive business (Tesla, 2022a). This includes the manufacturing and sales of vehicles, as well as services such as leasing and repairs. The rest of its revenue comes from its energy generation and storage business (Tesla, 2022a). The company has so far produced a number of passenger vehicles and have announced their first semi-truck, which is slowly starting production but not expected to start full-scale production until 2023 (Hetzner, 2021) (Tesla, 2022e). Apart from the manufacturing of vehicles, Tesla is also responsible for the sale and leasing of its cars through its website and dealerships. Tesla earns tradeable regulatory credits from various regulations related to its production of zero-emission vehicles. The sale of these credits to other automotive manufacturers is also part of the revenue from their automotive business. Finally, services and others cover after-market sale, retail merchandise, sales by acquired subsidiaries to third party customers and vehicle insurance (Tesla, 2022a).

When analyzing electric cars, it is important to differentiate between purely battery driven vehicles and plug-in hybrid vehicles. PEV (plug-in electric vehicle) is a definition that is used for all vehicle rechargeable batteries that can be charged with electricity from an external source. Within this category there are battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs). BEVs are purely electric while PHEVs consist of a traditional combustion engine with an additional electric battery to drive the car (Graham, 2021).

Tesla has several subsidiaries related to their primary business. DeepScale is a company bought by Tesla in 2019 which develops software and computer vision of automated cars (Kolodny, 2019). Tesla Grohmann Automation, a German engineering company acquired in 2016, producing and supplying automated production equipment for car and battery pack manufacturing (McGee & Campbell, 2016). As the automotive part of Tesla's business accounts for the majority of its revenue (95%), the researchers will focus mostly on this segment in order to make an in-depth analysis of the firm (Tesla, 2022a).

The analysis of Tesla starts with an overview of the automotive industry following the structure of the Porter's Five Forces framework. The analysis considers the BEV market a part of the automotive industry, and thereby Tesla as a competitor to established automotive manufacturers. This is due to BEVs growing share of total vehicle sales and the projected replacement of internal combustion engine vehicles (ICEVs) in the future global vehicle fleet (Macquarie Research, Hong, Park, et al., 2021). Using the structure of Porter's Five Forces framework helps to determine how the economic value in the industry is divided among the actors and helps understand the different aspects of the industry. Furthermore, the aim of the analysis is to observe the future profit related to Tesla's core business.

4.1.1 Threat of new entrants

Automotive industry is dominated by established firms due to high entry barriers in the industry. Established firms producing BEVs is not seen as a new entry into the industry, as the EV market is considered a part of the automotive industry. Entering the automotive industry requires significant investments into production, as established firms are dependent on economics of scale and scope to deliver competitive products to customers both when it comes to quality and price. It also requires significant investments into R&D and engineering, and several years of development to finish a new car design with safety standards and regulations (Wong, 2018).

There have been examples of later entries into the automotive market with the ability to gain a substantial market share. Tata Motors entered the market producing their first car in 1988, acquiring Jaguar Land Rover from Ford in 2008, resulting in significant growth. Chinese company Geely Automobile had a similar approach, acquiring the rights to Volvo and moving production to China in 2010. One of the main elements of automotive manufacturers is the brand strength and reputation. Horizontal acquisitions of established brands help new players establish credibility in the industry, and get access to know-how and production facilities more easily (Wong, 2018).

In recent years there has been an expansion of the BEV market with newcomers such as the 2009 Rivian, the 2007 Lucid Motors, the 2010 Polestar and the 2014 XPeng (Graham, 2021). Tesla used the term first described in Diffusion of Innovations (1962) "early adopters", targeting early adopters willing to pay a premium for the new technology (Rogers, 2003). Tesla was established in 2003, launching their first car, the Tesla Roadster, in 2008. The strategy of Tesla was to first produce a high-end low volume car and use the capital, knowledge and brand recognition gained to launch mass-market models. This way Tesla scaled up production capacity slowly, while decreasing production cost (Graham, 2021). In 2010, Tesla was the first US automaker to go public since Ford in 1956 (Gupta, 2010). This shows how difficult new entrants have had it developing themselves into companies capable of mass-producing vehicles. They are often acquisition targets of bigger and more established firms, or they never reach the scale necessary for mass-production (Wong, 2018). Another latecomer to the game is Lucid Motors, who currently have the longest-range models on the US market. Established in 2007 as an EV battery and powertrain producer, the company started producing cars in 2016. The company has a premium price point for their models and currently delivered just over 300 vehicles (Kane, 2022a). It must therefore be considered to be in its early stages of its existence, expecting to produce 12,000 to 14,000 vehicles in 2022. With its production plant in Arizona and a newly announced one in Saudi Arabia, they are expected to exceed 500,000 vehicles per year in the future (Lucid Motors, 2022).

BEV exclusive companies such as Tesla entering the automotive market, having to compete with established firms. One of the points of differentiation besides the electric engine, was the focus on technological solutions. Tesla excelled in the development of autopilot features, continuously updating the software to make their car more autonomous. Other technological features like being able to summon the car, over-air-updates and the big central touch screen, have all been used as unique selling points. A Tesla car is portrait as not only a vehicle, but as technology on wheel (Graham, 2021). Elon Musk also emphasized this himself, saying that Tesla is more closely related to Google or Apple than traditional car manufacturers (Gupta, 2010). Tesla has also added a number of attention-grabbing gimmicks to their car over the years, including dog sitting mode, falcon-wing doors on Model X, ability to play games on the center screen, just to name a few. New models are announced in an Apple-like fashion at big events, and the CEO Elon Musk has become the front person of the company, appearing on TV shows, and using Twitter actively to promote the company and create awareness about his persona. Tesla has used these various attention-grabbers to differentiate themselves from established firms in the mind of the consumer (Valentin, 2018).

The future development of the BEV market also has rumored entrants from other industries. The high industry focus on technology has opened the market to tech firms, with electronics companies like Apple and Alphabet seeing their possibilities in the growing market. Apple is allegedly close to finalizing a deal with Hyundai-Kia to build Apple branded cars at their US plant in Georgia and could be ready to begin production in 2024. The focus here is on fully autonomous driving, something Apple have been researching and developing for years, hiring several former Tesla employees in the process (LeBeau, 2022). Fully autonomous driving technology is the current focus of Alphabet company Waymo, developing fully autonomous cars together with Geely. The company has also developed Waymo Via, a fully autonomous semi-truck together with Mercedes. The future could see more tech companies with technological know-how, entering the space in joint ventures with established automotive manufacturers due to the high entry barriers of mass production (Feiner, 2021). A lot of money has been invested into EV stocks in recent years, with some analysts calling the industry a bubble. Several EV companies' trading prices are far above analyst's price targets, while many companies besides Tesla are still unprofitable. In an industry in growth with a bright future, investors are looking for the next big thing (Adinarayan & Lewis, 2021).

4.1.2 Substitutive products

The car as a mode of transport has many advantages and is difficult to beat when it comes to flexibility. Car ownership is also characterized by other physiological factors like freedom and the status of owning one (Wong, 2018).

Substantial investments have gone into public transport initiatives, especially in developed countries. In urban areas there are more alternative modes of transport, with the build-out of public transport options, and possibilities for personal transport such as bikes, walking, and electric scooters. Many cities see continuous scrutiny of car ownership, limiting parking options and imposing taxes on owning and operating vehicles (Peters, 2020). Rail is seen as an alternative to long-distance travel. Europe has seen upgrades and expansions of existing networks, with new high-speed rail lines for trans-European travel (European Commission, 2021). China has the world's longest high-speed rail networks, building more than 37,900 kilometers since 2008. The construction was actively used by the government to accelerate the economy after the financial crisis (Jones, 2022).

Despite these investments, many countries and regions remain reliant on cars as their main mode of transport. Cars are in many cases more efficient and flexible, both for private use and last mile delivery for companies. A number of alternatives to traditional car ownership have seen the light of day in the last century. Uber and Lyft have made it more affordable and convenient to use cab services. Ride sharing services are another cheaper alternative to traditional car ownership, for the occasions where a car is still a necessary mode of transport. Established automotive companies like BMW and Mercedes have invested $1.1 billion in the joint venture Share Now, a peer-to-peer service where customers can rent cars and pay by the minute (Kiley, 2019). The global ridesharing market is expected to have a CAGR of 17.3% during the period 2021-2026 to a $61 billion market value (Mordor Intelligence, 2021). Other services like robotaxis are alternatives to car ownership in the future. Autonomous driving company Cruise, backed by GM, got permission in the beginning of 2022 to test and operate 5 autonomous vehicles on the streets of San Francisco. Ford & Lyft, Waymo, and Intel are also looking to operate robotaxis in cities in the US and Europe (Hetzner, 2022). The services can also work in tandem with ownership. Elon Musk has proposed Tesla vehicles being used for robotaxi services. He suggested that 1 million Tesla's could operate as robotaxis by the end of 2020, but the project has been delayed since the idea was announced in 2019. Autonomous vehicles are still in the early stages of roll out, but with big companies investing in the technologies, it could be viable in the future (Ford, 2021). Traditional car ownership is set to change with the growth of peer-to-peer lending and ridesharing services. Even with the many alternatives, the global light vehicle sale is expected to grow from 85 million units in 2021 to 110 million units in 2030. The growth in the automotive industry is driven mainly by a growth in BEVs, PHEVs and HEVs, with the sale of internal ICEVs declining to less than 50% of sales in 2030 (Macquarie Research, Hong, Park, et al., 2021).

4.1.3 Suppliers

The power of a supplier depends both on the dynamics of the industry they are supplying, as well as the specifications of products they are supplying. If suppliers are few in number and serving a market with many buyers, they are powerful because there are fewer alternatives to them. Suppliers serving more than one market are not as dependent on the buyers within one industry and therefore have more bargaining power. Another aspect is suppliers with access to exclusive resources or technology that buyers are dependent on or does not have the expertise or resources the produce themselves. The cost of switching from one supplier to another also increases the power of suppliers. This is often dependent on the assist-specific investments made by the buyer into the relationship, like common production facilities. Finally, there is the threat of forward integration by the supplier into the industry of the buyers, in case the relationship outcome is not considered fair by the supplier (Porter, 2008).

Firms usually have different tiers of suppliers, with their primary suppliers of key components and secondary suppliers for sensitive components. Tier one suppliers are often locked into multi-year contracts and are mutually dependent on the relationship. Integrated relationships with suppliers are also characterized by information sharing or even R&D partnership in developing products (Hsuan et al., 2015; Kraljic, 1983). In the automotive industry we see different examples of tier suppliers and close collaborations. Toyota's production philosophy builds on a close collaboration with suppliers being considered reliable suppliers. Toyota sends personnel to suppliers to ensure the transfer of knowledge to the supplier. Toyota uses this network of close supplier relationships to create competitive advantage (Dyer & Singh, 1998). When supply chain disruptions occur, Toyota has priority on getting parts from the suppliers, which is key for just-in-time production and to secure quality (Dyer & Nobeoka, 2000).

In general, the automotive industry has a diverse number of parts coming from parts manufacturers. Original Equipment Manufacturers (OEM) have subcontracted anything from airbags, windscreen wipers, brakes, and tires to these manufacturers. Bosch is the biggest of these producers with a revenue of $46.5 billion in 2020, followed by Japanese Denso ($41 billion) and German ZF Friedrichshafen ($33.4 billion) (Tenneco, 2021). In most cases, labor intensive production like car seats or very specialized components like electronics are outsourced. Parts like brakes and tires where quality assurance plays a big part, are also often outsourced to companies such as Brembo or Bridgestone, using supplier's reputation actively as a selling point that signals quality. Suppliers can also cause big issues for automotive manufacturers, with examples of widespread recalls of cars due to parts failures. The Takata default airbag case caused the recall of 42 million vehicles in the US and forced the company into bankruptcy, simultaneously damaging the reputation of multiple car manufacturers using their airbags (MarketLine, 2022). Companies like Volkswagen Group have taken parts production to new heights with a strategy built on modularization. Breaking the product into modules, and seeking to optimize each one and the way they operate. Volkswagen Group has a range of brands in its portfolio, including Volkswagen, Seat, and Skoda. All three brands have a model built on Volkswagen's New Small Family (NSF) platform. This means that many components like lights, engine, drivetrain, and chassis are the same. Modularization has a number of advantages, ensuring economics of scale, reduced order lead-time, and easier upgrade and replacement of components. It also ensures that Volkswagen Group can create bigger contracts with suppliers, thereby increasing their own bargaining power in the relationship (Hsuan et al., 2015). The concept is also spreading to other companies. Tesla's Model Y shares around 75% of its parts with the Model 3 and is built on the same platform (Tesla, 2019b).

The sourcing strategies of firms often depend on the individual profit impact and the risk of the components sourced. The strategy to outsource or insource production is also dependent on the specifics of the firm. Outsourcing production both entail risk and potential upsides to a firm. Firms can become too decentralized and lose control over their production and expertise. Firms must have a certain global orientation and size to develop a successful outsourcing of production. Keeping more production in-house ensures that organizational knowledge is protected and easier to control and utilize. On the other hand, the firm might miss out on the potential upsides of expertise, more efficient production, and lower production cost that outsourcing can lead to. It is a balancing act for firms to find the right degree of outsourcing depending on their organizational size and set-up. The centralization and decentralization stages of firms are rarely static, and change over time due to factors like economic development in countries and new needs of the firm (Arnold, 1999; Hsuan et al., 2015).

Tesla seeks to insource much of their production and in certain cases do backwards integration. The long-term vision of Elon Musk is for Tesla to also produce its own batteries, halving the cost and securing future competitive advantage according to him (Jin, 2022). Tesla has made moves in that direction, securing deals with nickel suppliers such as Vale SA. This is part of Tesla's long-time effort to tighten its grip on the supply chain and make it more resilient against fluctuating raw material prices and scarcity (Hull & Stringer, 2022). Lithium-ion batteries mainly consist of four materials, lithium, cobalt, manganese, and nickel. Each raw material carries its own concerns, both in terms of availability, price, and extraction (Sun, Hao, Hartmann, Liu, & Zhao, 2019). Cobalt is additionally also one of the most expensive materials in battery production, making up 30% of the cost, a material Tesla is trying to eliminate (Petrova, 2021) (Tesla, 2020c).

In 2020, Elon Musk anticipated that Tesla would be able to produce 100 GWh of their 4680 batteries in 2022, but plans have since been pushed back. Mass production is to start in 2023 due to production issues. Producing batteries efficiently at scale is a difficult task, even for experienced suppliers. Tesla is currently doing test production of their future 4680 battery cells at their own facility in Fremont, California, but only just passed its one millionth cell in January 2022. This is only enough to power an estimated 1200 Model Ys (Jin, 2022). Tesla acquired battery producer Maxwell Technologies in 2019 and integrated it into its business, suggesting more focus on developing batteries themselves (C. Randall, 2020). While Elon Musk's vision is for Tesla to produce its own batteries in the future, the company is still heavily dependent on strategic partners like Panasonic for scaling production and this will most likely not change in the next decade (Bowker & Krisher, 2022).

There are some tensions in Tesla's ongoing collaboration with Panasonic in producing and developing batteries. The two companies have had a close R&D partnership since 2010, delivering batteries exclusively to Tesla and investing in the first Gigafactory together in Nevada in 2014. But there have been issues with order fulfillments, production prices, and cultural differences in the partnership, which have all led to friction in the partnership (Higgins & Mochizuki, 2019). Panasonic is however expected to also produce Tesla's new 4680 batteries at their plant in Japan beginning in March 2024, also building two new factories as part of the agreement (Kelly, 2022). While most of Tesla's battery supplies come from its joint venture with Panasonic, Tesla also relies on suppliers like CATL and LG Energy solution for battery cell supply. Tesla has a big impact on these suppliers, with 90% of Panasonic's BEV batteries being for Tesla vehicles. LG Energy Solutions are the biggest global EV battery producer with 38 GWh in 2020, 20% of which went to Tesla. Tesla also uses CATL for supply of batteries for Model 3 production in China, which makes up 10% of CATL's sales (Kane, 2021a). Panasonic's dependency on Tesla is not sufficient in the long run. While they are investing in new plants for the production of the 4680 batteries for Tesla, the company is also looking to widen its customer portfolio (Mihalascu, 2022a).

The specifics of the supplies are also a deciding factor in the strategy of insourcing or outsourcing production. Tesla started producing its own car seats in 2015 due to the complexity and issues with the previous Model X seat contractor. This is very conventional in the automotive industry, since seat production is both very specialized and labor intensive, usually outsourced to contract suppliers. While Tesla have made investments into its own seat manufacturing, as car production scale it cannot be considered sustainable to keep seat production inhouse (Sage, 2017). On the other hand, having inhouse seat production allows Tesla to control production easier, both in terms of quality and delivery, and they are not dependent on the few number of big seat manufacturers on the market (Shahan, 2019a).

While Tesla insourced its seat production, other aspects of their business are more difficult to insource. There has been a global shortage of semiconductors since late 2020 (Denton, 2021). The global semiconductor industry is made up of a handful of companies and the production is very specialized involving very high-tech manufacturing. In this case, suppliers have a lot of bargaining power since they are sitting on the production capabilities and many industries are dependent on their product (Denton, 2021).

Automotive manufacturers usually focus on their core competences in production such as vehicle assembly, while they outsource complex and labor-intensive tasks to third-party specialists. Ensuring control with the outsourced production is key to ensuring quality and stable delivery. The partnership with suppliers is especially important to combat supply chain disruptions, and buyers are increasingly making efforts to build more resilience. Tesla have made efforts to control more of its supply chain and do more production inhouse but is still dependent on strategic partnerships for more technical production like battery and semiconductors.

4.1.4 Customers

Porter (2008) talks about how buyers can use their bargaining power to have an impact on the price and quality of products produced. There can be different power dynamics depending on the specifics of the industry. When a product is a significant investment to the customer, they are more price sensitive and tend to shop around for the best option (Porter, 2008). This is also evident in the automotive industry where there is a big buyer independence with customers making individual purchasing decisions. Many socio-economic factors influence a car purchase besides income, such as age, family size, and lifestyle. Socio-economic factors outweigh the law of demand for expensive vehicles. This example is also the case for EV's, signaling a more environmentally conscious consumer (Wong, 2018). Car sales generally see seasonality trends with sales ramping up in the spring and peaking around August. The winter months have the lowest sales during the year, with a small spike in December (Nieuwenhuis & Wells, 2015).

An area that is often overseen or underestimated by consumers is the cost of ownership. This is something that the electric vehicle industry has used as a differentiator and selling point compared to ICEVs. EV's have fewer complex mechanics with fewer moving parts and less maintenance cost compared to a combustion engine. Over the first three years of ownership, EV's have a 30% lower service cost on average than combustion engines (Hanley, 2021). There are many factors influencing the cost of ownership. In the US, EV owners still pay more per mileage compared to gasoline cars. EVs are still on average trailing gasoline cars in value for money. Appendix 2 shows the development of cost-efficiency between EVs, Tesla and Gasoline vehicles. The median EV costs $214 per mile in 2021, compared to the median gasoline car at $104 per mile. The same is the case for Tesla, however more efficient than the average EV, still has a cost of $173 per mile (Plante & Howards, 2022a).

A factor that has a significant impact on consumer behavior for the automotive industry is regulations and tax initiatives by lawmakers. These initiatives vary greatly from country to country, and even on a state basis in countries like the US. Norway is among the highest adopters of BEVs and PHEV in the world. The Norwegian government's goal of all new automotive sales being zero-emission vehicles by 2025, is to be achieved not by sales bans but through taxes. Taxing high emission vehicles to support tax breaks for zero-emission vehicles, thereby making it more attractive to choose a zero-emission vehicle for consumers (Norsk elbilforening, 2022) (Deuten, Gómez Vilchez, & Thiel, 2020).

Lawmakers also play a central role in the development of charging networks and investments in the electric grid. State and local governments develop many of the initiatives and infrastructure, alongside private companies. The access to charging stations, vehicle range, vehicle price, time of recharging, and the cost of doing so, are the main elements impacting the purchasing decision of consumers and helps combat the "range anxiety" of buyers (Sumantran, Fine, & Gonsalvez, 2017). Looking at the US as an example, based on the Environmental Protection Agency's controlled testing, there is still a performance gap between fully electric passenger cars, Tesla, and gasoline passenger cars.

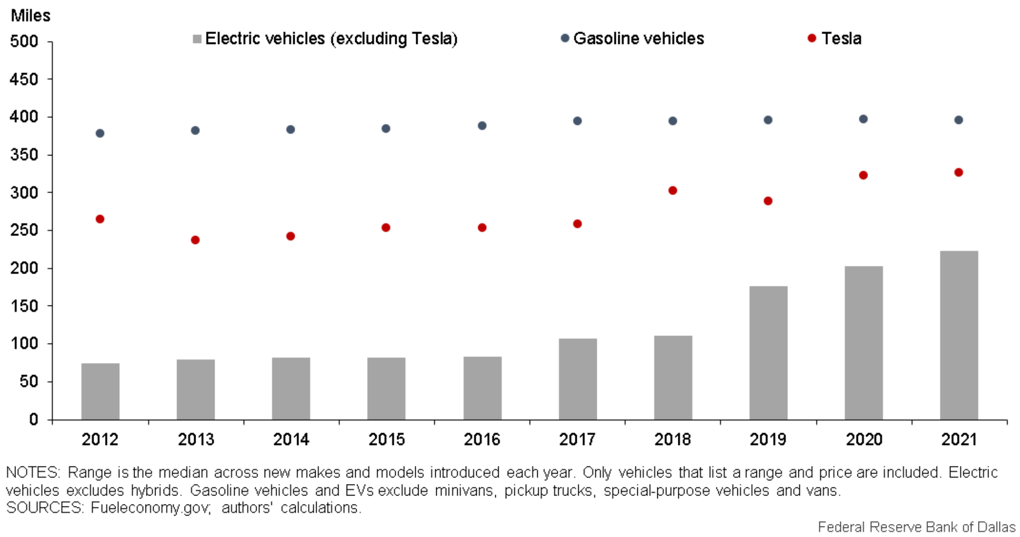

Figure 3 Electric-Vehicle Range Increases Dramatically but Range Gap Persists. Source: (Plante & Howards, 2022)

The above Figure 3 shows that while the range has increased over the last decade, it is still below that of the average gasoline car. The range of BEVs vary depending on conditions and the controlled testing is not always consistent with real life performance (Plante & Howards, 2022b). The longest-range Tesla model is Model S Dual Motor 19” with 405 miles (652 km) according to EPA tests (Tesla, 2022i). According to EPA test results, Lucid has the models with the longest range, with their base model of Air Grand Touring 19” with a range of 516 miles (830 km). Their top performance car, the 2022 Lucid Air Dream Edition Range 19”, has a range of 520 miles (836 km.). This is the longest range of currently available models on the US market. It should also be noticed that Lucid models’ retail price is significantly higher than competing models such as Tesla Model S, Tesla Model 3.

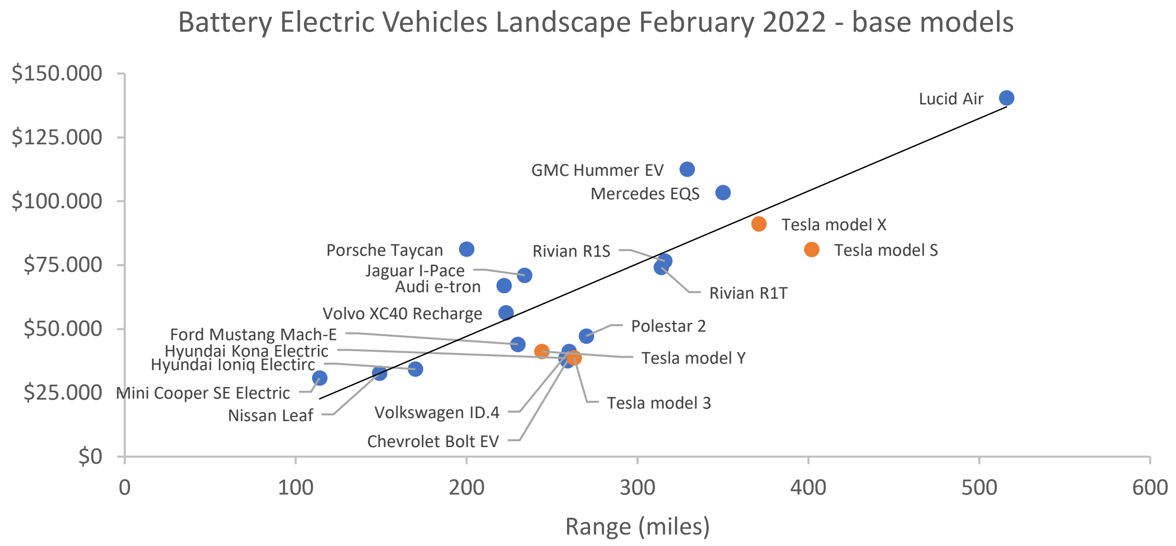

Figure 4 Battery Electric Vehicles Landscape February 2022, Source: (Kane, 2022a)

Figure 4 shows the BEV landscape as of 2022 by comparing the lowest trim level of selected models available on the US market. Comparing models across trim levels, Tesla’s Model 3 Long Range AWD 18” and 19” are the only two models in the top 20 that has a price point below $55.000 (Kane, 2022a). While Tesla’s current models are still at a premium price point, the company’s ultimate goal has long been to produce a more affordable car at $25.000 to rival ICEVs (Morris, 2020). The premium price point of BEVs is also a key consideration in the customer purchasing decision, as it creates higher switching costs for customers going from gas to electric. With the continuous development of BEVs, there are still limited models that can compete with the range of ICEVs (Rosevear, 2022). This limits the bargaining power of customers since their choices are still more limited than with combustion engine vehicles.

The access and need of charging stations also vary depending on location and consumer behavior. Households can have their own charging setup, but people living in apartments and urban areas still rely on commercial charging stations. Commercial charging stations are often situated in urban areas or along interstates in the U.S., and a scarce in rural areas (Plante & Howards, 2022b). The number of publicly available charging stations globally has increased to 385,000 fast chargers (above 22kW) and 922,000 slow chargers (below 22kW) in 2020. This is an exponential growth over the past 10 years, and more than double the number of chargers from 2018-2020. The deployment in is dependent on each country. In the US there are around 100,000 public chargers, most being slow chargers. In Europe there are around 285,000 chargers where the majority are also slow chargers. China has the most public charging stations with just over 800,000 chargers, with 38% percent being fast chargers (International Energy Agency IEA, 2021a). In comparison, Tesla's supercharger network operates 31,498 chargers globally as of 2021 at 3,476 stations, making it the biggest fast charging network (Tesla, 2022j). Tesla's V2 chargers are 150kW, while their fastest V3 superchargers have a 250kW capacity, which are expected to be increased to 324kW in North America later this year (Kane, 2022b). South Korea has the lead in charging locations per 100 kilometers of roads with 75.2, with Netherlands in second with 21.9, and Norway with 13.6. This shows the difference in distribution of charging stations in different countries and the challenges of long-distance BEV travel in countries like the USA and Canada where there are 0.8 charging stations per 100 kilometer (Berger, 2021).

Another consideration for consumers is the charging time of BEV's. While gasoline cars still have the advantage of filling up in minutes, BEV charging time varies greatly. The new version of Tesla's Model S can charge the equivalent of 200 miles (321 km) in 15 minutes using the V3 supercharger (Tesla, 2022j). Fuel efficiency for gasoline cars varies depending on the engine and weight. Similarly, BEV's efficiency also varies greatly depending on battery size, efficiency, and vehicle weight. Another factor is the availability of fast chargers. As mentioned earlier, the majority of chargers available in the US and Europe are below 22kWh. The charging time is also dependent on continuous development of fast chargers, both residential and public, to decrease the charging time. Faster charging technologies are being developed, putting older or cheaper models at a disadvantage by not being able to use them (Sumantran et al., 2017).

Generally, residential charging costs are lower than commercial charging stations (Plante & Howards, 2022b). CNBC has made a comparison of gasoline and electricity prices in the US and determined the cost of adding 100 miles (160 km) of range to a vehicle. This is based on the fact that; a new ICEV has an average fuel-efficiency of 25.7 miles per gallon. 2022 model EVs have an average miles per gallon equivalent of 97, using 34.7 kWh per 100 miles. This comparison shows that as of February 1st, 2022, 100 miles worth of gas cost $14.08 and electricity costs $5.14. This is a national average and for cities like San Francisco and Boston it is almost twice as expensive to charge. Electricity prices have remained relatively consistent over the past three years, while the price of oil has increased (Rosevear, 2022). The Biden administration has implemented new regulations for automakers, requiring new cars to average 49 miles per gallon (20.8 kilometers per liter) in 2026. The current average is 36 miles per gallon (15.3 kilometers per liter). This is an effort to push automakers to produce more EVs (Ohnsman, 2022a).

Tesla pioneered the EV market and helped change people's perception of electric vehicles. As mentioned earlier, Tesla utilized the power of the early adopters to create a premium sports car that redefined the perception of electric vehicles. Tesla has since the original Roadster increasingly focused on adding technological features like autonomous driving to their vehicles. Autonomous driving was on the top of Gartner's Hype Cycle of Emerging Technologies in 2016 (Sumantran et al., 2017). Tesla tapped into the hype, with the hardware for autopilot already installed in new models in 2014. The development of autopilot features continued with over-the-air software to add new features to existing models (Tesla, 2014)

Customers in the automotive industry have a high degree of independence in the purchasing decision, depending on their specific needs. For electric vehicles there are more limited options, decreasing the customer bargaining power. There are also several challenges for the adoption of BEVs, such as the premium price, range, and availability & time of charging. The continuous development of BEVs and charging technology is one part of the development in the industry when it comes to consumer preferences. The other big part is state and local regulations and climate goals set by lawmakers. This plays a big role in the development of charging infrastructure and the discontinuation of ICEVs.

4.1.5 Industry rivalry

Analyzing the EV-market you must also consider the car market as a whole. EV's are taking market share away from combustion engines and are starting to compete more with traditional brands. The passenger vehicle market is made up of big players, with nearly half of global sales coming from other brands (Appendix 3). Toyota made up 9.5% of global sales in 2021, Volkswagen 7.2%, Ford 6.8%, and Nissan 6.3%. The same is evident when looking at global revenue, which is also dominated by the same four firms (Appendix 4) (Statista, 2022b). Toyota had the biggest market share in 2021, sold 9.6 million vehicles in 2021 (Toyota, 2022). Volkswagen delivered 4.9 million vehicles for the brand, and a total of 8.6 million units for all its brands in 2021 (Volkswagen AG, 2022).

Global vehicle production by top 5 and top 10 firms

	1998 (m)	1998 (%)	2008 (m)	2008 (%)	2017 (m)	2017 (%)
Top-5	28.6	54.1%	33.2	47.9%	41.3	42.6%
Top-10	40.8	77.0%	47.9	68.9%	64.7	66.8%
Total	52.9	100%	69.5	100%	96.9	100%

Table 1 Data retrieved from (IOCA, 2017); various years

As seen in the Table 1, there have been a change in the market fragmentation since 1998. Top 5 manufacturers used to be responsible for 54% of global production across the industry and top 10 firms 77%. These numbers have been declining through the years to a market share of 42% for top 5 firms and 66% for top 10 firms in 2017 (OICA, 2017). As the global automotive market has developed over the past decades, it has created new opportunities for more companies and diversified the market share. One of the main reasons for this diversification is the differences in consumer preferences based on the region. This is due to a number of characteristics such as regulations, climate, cultural, geo-physical, and socio-economic differences. The North American market has a favoritism for pickup trucks and larger vehicles, and the category of "light truck" almost only being present in this market. Similarly in Japan where small and micro car models have a bigger market share, or in Brazil where ethanol flex-fuel vehicles are popular. These different markets must be considered when analyzing the market as a whole (Nieuwenhuis & Wells, 2015). Even though there is a trend of diversification, 10 companies still control 2/3 of the market which makes it highly concentrated. It is traditionally dominated by long-established firms that were some of the first to invest significantly to exploit both economies of scope and scale in the industry (Wong, 2018). With the increasing trend of M&A of smaller firms since the 1990s, together with strategic partnerships, the automotive industry has developed oligopolist features in the way that it is dominated by a few big automotive groups. This has also resulted in fierce competition among these large players (Hertenstein, 2020). Figure 5 below shows the distribution of revenue by top auto manufacturers.

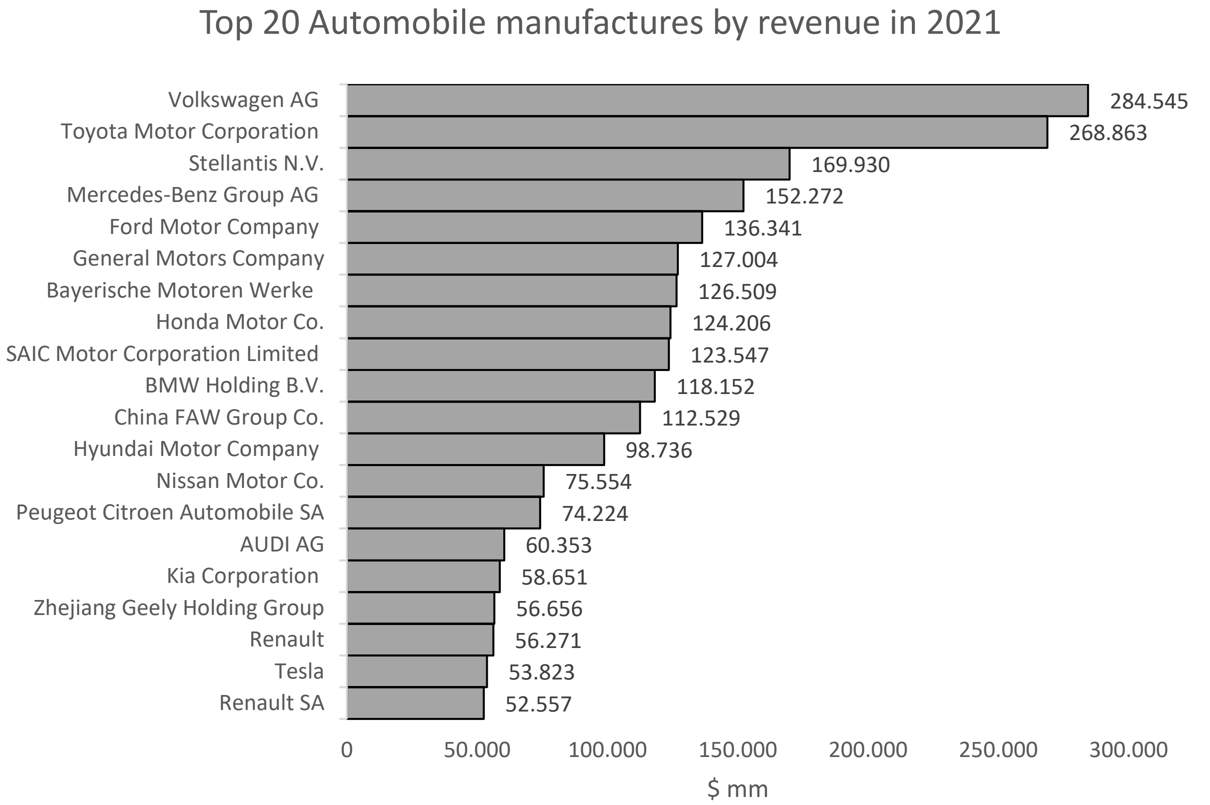

Figure 5 Data derived from S&P Capital IQ Company Screening - Automobile Manufacturers Revenue, Source: (S&P Capital IQ, 2021)

The M&As has resulted in automotive groups owning what used to be several independent brands. However, depending on company structures, revenues are reported differently. An example is Volkswagen AG which includes several car brands such as Cupra, Seat, Skoda, Volkswagen, Audi, Bentley, Lamborghini and Porsche (Volkswagen Group, 2022). In Figure 5, Audi AG is listed as an independent company since it is a subsidiary of Volkswagen Group who has a 100% ownership in the company. It is also worth noting that Audi AG is in charge of production, distribution and sales of both Audi and Lamborghini cars (S&P Capital IQ, 2021). Similarly, General Motors have also acquired a number of brands including GMC, Chevrolet, Buick, and Cadillac (GM.com, 2022). Stellantis N.V. is a recent merger of Fiat Chrysler and Therefore PSA Group, now counting 16 brands (Manfredi, 2020). Therefore, it is relevant to look at automotive manufacturing groups and the construction of these, when analyzing the consolidation in the industry. There are several examples of manufacturers doing joint ventures and cross-ownerships of firms. Nissan Group owns a 15% share in Renault, while Renault owns 43% of Nissan. The companies are together in the Renault-Nissan-Mitsubishi Alliance together with Mitsubishi Motors which Nissan acquired 34% of in 2016. This is an example of a very close strategic alliance with shared production facilities and suppliers (Guillaume & Tajitsu, 2020).

There is also a correlation with the top production countries and the origin of the biggest firms in the industry. China is the biggest global producer followed by the USA, Japan, India, South Korea, and Germany. The top five manufacturers have their origin in three of the top six countries. Toyota is Japanese, Ford is from the US and Stellantis is partly from the US, Volkswagen and Mercedes-Benz are German (OICA, 2021a). The oligopolist features caused by M&As are due to the production and supply chain characteristics in the industry. The automotive industry requires significant capital investments into PP&E to produce vehicles that are economically viable and at a sufficient quantity for a global market reach. As mentioned earlier, there is also a complex supply chain with a vast network of suppliers (Wong, 2018)

In the same way that BEVs are considered a competitor to ICEVs, other engine types are as well. Although not as widespread as BEVs, automotive manufacturers are also developing and producing fuel-cell vehicles powered by hydrogen. Fuel-cell electric vehicles (FCEVs) work similarly to plug-in hybrids but using hydrogen rather than gasoline to power an electric motor that drives the car. Currently the only two passenger vehicle models in production are the Toyota Mirai and Hyundai Nexo, and with a modest 5918 and 9629 units sold globally in 2021 the technology is still far from the scale of BEVs (Collins, 2022). Hyundai-Kia, Toyota, Honda, and VW are set to launch 25 FCEVs by 2025. FCEVs do have advantages in terms of being lighter and quicker to refuel than lithium-ion batteries, but the refueling network is not very developed yet. Big investments into Power-to-X technology especially in Europe, converting power from renewable energy production into alternative fuels for energy storage, could benefit the development of the FCEV market, but is generally not seen as any substantial threat to BEV vehicles (Frost & Sullivan, 2021).

BEV companies can in general benefit from the future growth of the market as customers look for more environmentally friendly alternatives to ICEVs. However, established firms are transitioning into this field and offering more models as fully electric. Volkswagen and Mercedes each made $85B UDS worth of EV-related investments in 2019. Mercedes plans for 25% of sales coming from EVs in 2025, and 50% in 2030. Many other carmakers have goals of producing 1 million plus EVs in 2025 (Statista, 2021b). These ambitions are a serious threat to new players entering the market, previously taking advantage of the market space in the up-and-coming BEV market. A BEV company like Tesla is still far behind other carmakers like Toyota, Volkswagen, Ford, and Nissan in total vehicle sales. The current EV market consists of a few different actors with mainly traditional combustion engine brands like Volkswagen and Mercedes and a few EV-exclusive manufacturers like Tesla and XPeng.

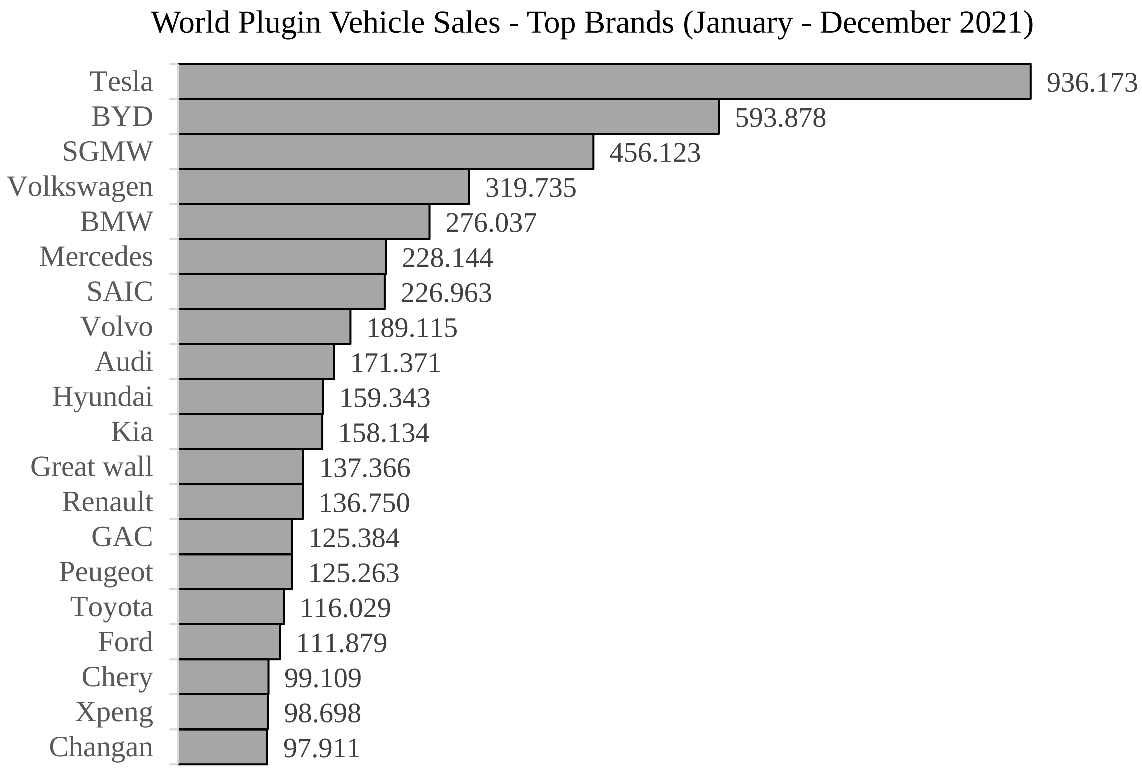

Figure 6 World Plugin Vehicles Sales - Top Brands (January-December 2021), Source: (Pontes, 2022)

A total of 6.45 mil plug-in electric vehicles were sold in 2021. The graph above in Figure 6 shows how Tesla dominated the 2021 EV sales numbers with 936.172 vehicles sold during the year, amounting to a 14.4% market share. This was followed by Chinese manufacturers BYD (9.1% market share), SGMW (7% market share), and a number of European brands like Volkswagen, BMW, and Mercedes. Tesla exclusively sells BEV's, and with a global sale of 4.5 million units they had a 21% market share in this category (Pontes, 2022). Compared to the worldwide passenger vehicle sale in 2021 which was 72.9 million units, electric vehicles still make up a relatively small percentage, around 9% in 2021 (Statista, 2022b).

Tesla's Model 3 was the best-selling EV in 2021 with 500.713 units, followed by Wuling HongGuang Mini EV with 424.138 units, and Tesla Model Y with 410.517 units. There is a big gap from these three top-selling models down to Volkswagen ID.4 in fourth place with 121.631 units (Carlier, 2022a). Looking at BEV sales numbers for automotive groups for 2021, Tesla is still number one with a 21% market share. Chinese SAIC Group has a 13% share, followed by Volkswagen Group (10%), BYD (7%), and Hyundai-Kia (5%). Especially among the Chinese companies there is a ramp-up in production of BEVs (Pontes, 2022). The BEV industry thereby has an even more consolidated nature compared to the global automotive industry.

In terms of Tesla's competitive advantage, there are a number of keys to the current and future development of this. Looking at Tesla's current sales channels, the company sells most of its vehicles directly to customers through its website, avoiding many of the challenges faced by traditional dealerships. It is possible to buy a few pre-configured Tesla's through its dealerships, mainly trade-ins or demo models. Dealerships are a lot fewer compared to other automakers and mainly function as showrooms and repair shops. Rather, Tesla used locations with heavy foot traffic like malls to display their vehicles in recent years. Tesla are shifting this strategy to focus even more on the online space with digital consultations and manage test drives remotely (Lambert, 2021b). The traditional car dealership model has several logistics challenges and dealerships see a decrease in profits. These challenges only increase with the introduction of online customizations and built to order production that Tesla among others are using (Inampudi, Kramer, Maurer, & Simmons, 2019). Tesla's competitive advantage compared to most other carmakers, is producing cars based on the orders put in by customers. The concept is known as full postponement or pulsed flow of products (Paton et al., 2011; Valentin, 2018). Tesla receives down payment before the production begins. Production is easier for Tesla to plan knowing the demand and having a waiting list for delivery. The benefit from the consumers is that they become investors in the product and are rooting for the development of the car, but it is crucial that consumers do not see the waiting time as a disadvantage (Valentin, 2018). Another key to Tesla's competitive advantage is the utilization of elements of Industry 4.0 into the company, described as Teslism by Valentin (2018). Tesla was recently ranked top when it comes to digital transformation according to industry analyst firm ARC Advisory Group (Banker, 2022). Tesla has a strategic and integrated approach to digital technologies, implementing them all the way through its value chain. Tesla aims to build processes better from the start, rather than trying to improve processes over time (Banker, 2022). Tesla also has the advantage of being born with a digital mindset with both its production processes and business model. How Tesla use this to its advantage, is seen in the current semiconductor shortage. Tesla counted on its in-house software engineering to adapt the vehicle’s software to use alternative chips. The close relationship with semiconductor suppliers also played a significant role for Tesla to combat disruptions (Elliott, 2021). Tesla has created an ecosystem around its business, much like Apple, where the business lives inside. Customers cannot get repairs through third-party mechanics. Tesla sells directly to consumers rather than through traditional dealerships or franchise dealers like most car makers (Valentin, 2018). The Tesla Gigafactory is showing the future of large-scale manufacturing and smart factories. The size of the factories allows the firms to gather much of production in one location and to design more efficient production processes within the factory space. The automotive industry as a whole, and especially Tesla, has had a focus on the use of industrial robots for manufacturing. Industry 4.0 will increase the focus on this utilization and the integration of data in the process (Goundar, 2021). Besides Gigafactory layout, hypermanufacturing is causing current production to be more efficient than other automakers. The Fremont plant had the biggest production output weekly of any North American auto factory in 2021 with an average of 8,550 cars per week. Toyota’s Kentucky plant was second with 8,427 cars a week on average (T. Randall & Pogkas, 2022).

4.2 Heavy-duty trucks industry

In addition to the automotive industry, the researchers also analyze the heavy-truck industry. This is due to Tesla’s entry into the industry with the announcement of the Tesla Semi in 2017 (LeBeau, 2017). The industry has similar characteristics in terms of high entry barriers and economics of scale to keep the price down. The industry is facing different challenges when it comes to the transition away from ICEVs compared to passenger vehicles. The market, while still having oligopolistic features, is made up of different manufacturers than passenger vehicles and the addressable market is much smaller than the automotive industry. The customer segment is also different, focusing mostly on B2B sales (Welch et al., 2020).

The total commercial vehicle production in 2021 was 23.1 million vehicles, with the majority coming from light commercial vehicles and only 23% being heavy- and medium-duty trucks in 2018. The biggest markets for commercial vehicles in 2019 were the U.S. (12.7 million units sold), followed by China (4.4 million units sold), Japan (894 thousand units sold), and India (855 thousand units sold). 4.3 million heavy trucks were produced globally in 2021 (OICA, 2021a). The heavy vehicle market is dominated by a few manufacturers. The biggest manufacturers of heavy vehicles, including both trucks and busses, are Mercedes ($42.5 billion), Volvo ($27.7 billion), Volkswagen ($27.4 billion), and Paccar ($17.1 billion) (Statista, 2021c). The U.S. market consist almost exclusively of these manufacturers. As of 2021, Mercedes has the biggest market share through its two manufacturers Freightliner (37.7%) and Western Star (2.7). Paccar is second, owning Peterbilt (14.8%) and Kenworth (14.6%), followed by Volvo (10.2%) and Volvo-owned Mack (8.4). Volkswagen has 11.9% of the market through its subsidiary Navistar ("U.S.: class 8 truck market share by manufacturers 2021 | Statista," 2022). The heavy truck market was worth $190.5 billion in 2021 and is expected to grow to $280.5 billion in 2026, with a CAGR of 7.34% (Mordor Intelligence, 2022).

BEV heavy trucks are currently being developed by several companies, both established firms like Volvo and Mercedes, as well as new entrants like Tesla and Nikola. BEV heavy trucks are facing barriers for widespread adoption. The range is limited due to the size of the battery. Bigger batteries significantly increase both the weight and the cost of the vehicle. The charging time is another issue. Big batteries take longer to charge, which is not ideal for long-hauling of freight where trucks drive many hours without stopping (Welch et al., 2020). The majority of the heavy truck market is made up of diesel engines, with HEV trucks taking up more of the market. HEV trucks still have the advantage of not needing long charges and have smaller batteries than BEV trucks which keeps the weight and price down (Mordor Intelligence, 2022; Welch et al., 2020). BEV heavy trucks are currently most viable for shorter routes such as for urban delivery. Many cities have restrictions on emissions from ICEV trucks and companies see the possibilities in replacing them with BEV trucks. The adoption of BEV trucks also comes through government incentives like subsidies on purchases or road tolls, which are mostly in place in Europe, North America, and China (Welch et al., 2020). There is also the issue of added price compared to ICEV trucks. While companies save on fuel costs, it can be difficult to justify a higher price point for BEV trucks (Ferris, 2017). Alternatives to BEV heavy trucks such as fuel cells, could prove more viable for long-haul transport. This is due to the shorter refueling time and lighter weight of fuel cell vehicles (IDTechEx, Wyatt, & Gear, 2021).

Companies have tried to solve the current barriers for BEV heavy truck adoption for long-haul trucking. Volkswagen are testing electrified road tracks in Germany, where trucks can charge while driving using electrical cables similar to trains. This solution limits the need for a big battery and allows trucks to be on the road for longer. The project is currently in the early stages, being tested on three stretches of road in Germany with 22 trucks (Volkswagen, 2021).

4.3 Energy generation and storage industry

The researchers have chosen to focus mostly on Tesla's vehicle production and separately on its energy generation and storage. This is due to car sales being the primary part of the company's business, making up most of the revenue. Only 5% ($2.8 billion) of its $53.8 billion total revenue came from the energy generation and storage business in 2021 (Tesla, 2022e). Globally, the total photovoltaic (PV) solar market accounted for 138.2 GW installed in 2020. China is the biggest market for solar deployment, with 48.2 GW installed. Most of this market is driven by commercial utility-scale installations. The United States remains the second largest market for solar deployment with 19.2 GW installed in 2020, a 43% growth since 2019. Also here, the market is driven by the commercial market. Towards 2025, China is still expected to be the biggest market, with a compounded annual growth of 21% with 409 GW new capacity installed. The United States is expected to still be the second largest market with 224 GW capacity in 2025. India is projected to grow 191% and Germany 81% from 2021-2025 (SolarPower Europe, 2021).

The residential market demand is to a large extent driven by incentive schemes by state- and local governments. In the US residential market, the federal solar investment tax credit (ITC) dropped from 30% in 2019 to 26% in 2020, resulting in a 43% market growth to 19.2 GW. The future growth of the residential market is dependent on supporting tools like reduced taxes and low-interest loans for homeowners to install solar. These incentives are mostly decided on a local- or national government level (SolarPower Europe, 2021).

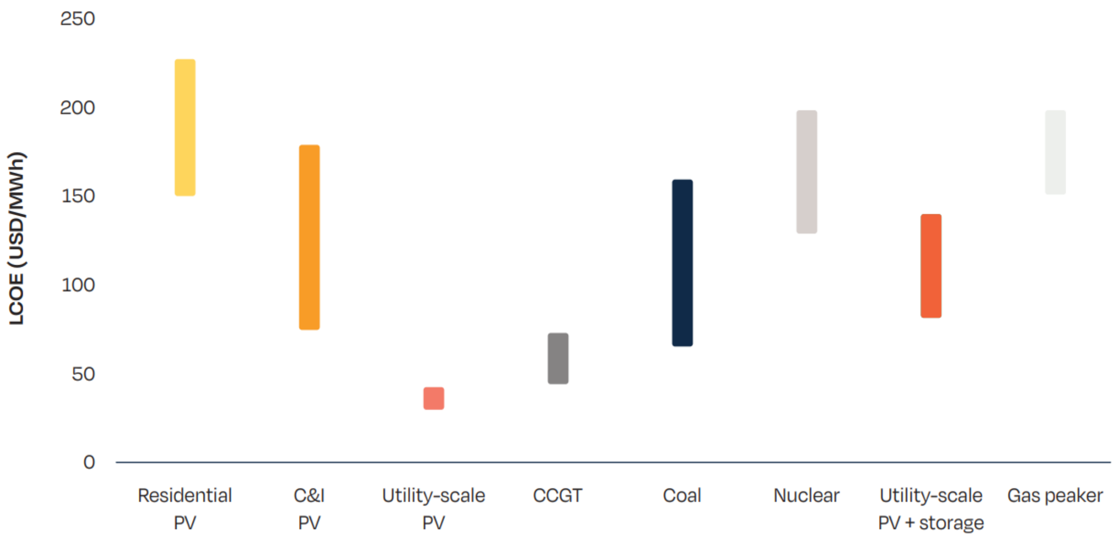

Figure 7 Solar Electricity Generations Cost in Comparison with Conventional Power Sources 2020, Source: (SolarPower Europe, 2021)

Figure 7 shows how utility-scale solar installations (>1000 kW) are the most cost-efficient, cheaper than both residential (<10 kW), commercial (<250 kW) and industrial (<1000 kW) installations (SolarPower Europe, 2021). It is generally much simpler to build a substantial volume of utility-scale solar installations, than creating a network of distributed rooftop installations. Especially in emerging markets like India there are struggles with setting up networks of rooftop solar installations. Utility scale installations have mostly been in China, India, UAE, and US, while residential solar has seen growth in all markets. Politicians often prefer rooftop installations over large-scale ground installations due to the large land use, especially in European countries with higher population density. Rooftop installations saw a growth globally 46% to 60 GW in 2020, while utility-scale grew by 3% to 77 GW globally. The slow growth in the utility-scale sector was mainly due to the pandemic halting bigger projects. Utility-scale solar installations are projected to have the biggest future growth from 77 GW in 2020 to 169 GW in 2025. Rooftop installations are expected to grow from 60 GW to 96 GW in the same period (SolarPower Europe, 2021) (Appendix 5).

Tesla's energy generation and storage business consists of three main parts; the installation and development of solar panels, their home energy storage Powerwall, and commercial energy storage solutions Megapack and Powerpack (Tesla, 2022g). The Powerpack is being phased out after the introduction of Megapack (Tesla, 2022a). Tesla Powerwall cost $11,000 without the accompanying solar cells, while the Powerpack is $172,000. The Tesla Megapack starts at $1.8M for 1 Megapack (1.3 MW, 2.6 MWh) (Tesla, 2022g). Tesla have made a some strategic acquisitions in recent years, acquiring Maxwell Technologies in 2019 to further expand its battery production capabilities (C. Randall, 2020).

Tesla's energy generation and storage division started as a separate company by the name of SolarCity, founded in 2006 by Peter Rive and Lyndon Rive with Elon Musk, their cousin, as chairman. The company faced financial troubles and Tesla acquired the company in 2016 in a highly controversial $2.6 billion deal (Bursztynsky & Kolodny, 2021). The two companies had worked together prior to the acquisition, SolarCity installing Tesla Powerwalls and launching a joined effort to develop solar roof tiles for residents (Golson, 2016). Since the acquisition of SolarCity, Tesla's solar deployment has decreased significantly. Since the height in Q4 of 2016 at 201 MW, the deployment has since fallen to 27 MW in Q2 of 2020. Solar deployment has since picked up, and Tesla deployed 85 MW in Q4 of 2021 (Appendix 6). Even though Tesla has gained market share in recent quarters, they are far from their previous heights with SolarCity. Tesla dropped to fourth place in the US residential market with 3.7% market share. The biggest player in the commercial US market is Sunrun with 13% of a market that grew 30% in 2021 to 4.2 GW (Connelly, 2022).

Tesla made a grand reveal of its future solar roof tiles in 2016, however the product was not fully functional at the time. The individual roof tiles never made it to market, and are currently installing modules that resemble roof shingles. Since the presentation, Tesla has experienced further problems, especially with installation. Total cost can be two to three times as much as initial estimates due to the complex nature of installation. In 2021, Tesla retroactively raised prices for quotes already given to customers, in one instance from $75,000 to $112.000. Elon Musk has later admitted that Tesla highly underestimated the complexity of solar roof installation (O'Kane, 2021). While a few hundred solar roofs have been installed, the majority of installations have been traditional solar panels. SolarCity had their own installers, but Tesla has outsourced much of the work to third-party roofing specialists due to the complexity (Hull, 2021).

Together with the announcement of Tesla's solar tiles, the company also announced plans to build a new production facility in Buffalo, New York dedicated to solar production. The Gigafactory was supported by $750 million from the state of New York, with a promise from Tesla to employ 1,460 people. Tesla were supposed to develop and produce their own solar panels together with Panasonic at the plant, but it has mostly functioned as an assembly facility with premade models from suppliers in China. Majority of the world's solar cell production is coming from China, and it is both a complex production process and the market competes on very thin margins (Redriguez & Groom, 2018).

Tesla's energy generation and storage does have potential, especially with its Powerwall for home energy storage and Megapack for industrial-scale storage. The increase in energy storage deployment increased by 32% in 2021, which was mainly driven by the deployment of Megapacks (Tesla, 2022e). The company deployed 3.99 GWh of energy storage products in 2021, and 345 MW of solar energy systems (Tesla, 2022a). Current deployments include a 81-unit 100 MW system in Texas, a 37-unit 46 MW system in Alaska, and a 212-unit 350 MW system in Victoria Australia (Tesla, 2022g). The revenue of Megapacks specifically is not disclosed by Tesla, but demand surpasses current production capacity and orders are currently stretching into 2023. Future projects include two installations in Australia, a 150 MW project in New South Wales and another 100 MW project in Queensland (Lambert, 2022c). With the order backlog and the ongoing global chip crisis, Tesla has been prioritizing its vehicle manufacturing business (Tesla, 2022a).

The global battery production output in 2021 was 706 GWh, with the vast majority of production taking place in China with 558 GWh. Second biggest producer is the U.S. (44 GWh), followed by Hungary (28 GWh) and Poland (22 GWh). S&P Global forecast the global production to be 1447 GWh in 2025, with China still being the biggest producer with 944 GWh. Germany will see the biggest growth according to the forecast from 11 GWh in 2021 to 164 GWh in 2025. European production is expected to grow, accounting for 25% of global production in 2025 (Yu & Sumangil, 2021). With the growth in energy storage demand, Elon Musk says that manufacturers need to produce a combined 1000-2000 GWh per year to keep up (Bellan, 2021). There are several synergies between Tesla's vehicle manufacturing and energy storage manufacturing, with the development and production of batteries as a central piece. The company's ability to successfully produce more efficient batteries at a low cost would benefit both businesses. Tesla asked its cell manufacturers to double supply in 2022, oversupplying them with battery cells and allocating excess volume to energy storage production (Bellan, 2021). As previously stated, the vast majority of Tesla's battery supply in 2020 came from its joint venture with Panasonic, and additionally supply from LG and CATL, with Tesla pursuing less dependency on its suppliers (Kane, 2021a).

This chapter aims to provide insights into Tesla's financial performance, to answer the research question: *"What is the estimated valuation of a Tesla Inc. share as of February 4th, 2022?"*. To improve the understanding of how Tesla's future business will develop, the fundamentals of the company must be examined. Through the chapter *4.0 strategic and market analysis* the company has been analyzed from a strategic perspective, and the ground for Tesla's unique selling point has been found. This chapter aims to add perspective as to what differentiates the company from its competitors. As the aim of this report is to find the value of Tesla, it is natural to first look at the development of the share price. Figure 8 is a visual representation of Tesla's 10-year historic share price adjusted for stock splits. The chart illustrates that much of Tesla's surge in stock price has come over the last two years, and since the start of the Covid crisis in March 2020. The stock price continued to rise and on October 25th ,2021, Tesla hit a market cap of $1 trillion, giving the company the 5th largest market cap in the U.S. only exceeded by Apple, Microsoft, Alphabet, and Amazon (Mehta & Ambar, 2021). When analyzing the future performance of Tesla, it is important to understand where the added value to the stock price is coming from, and one possible explanation to this could be the introduction of new vehicle models to the current fleet. Therefore, announcement dates of new vehicles have been added to the chart to illustrate whether this could explain the rise in share price. Surprisingly, the introduction of new products does not seem to have any major effects on Tesla's stock price. With other large companies the correlation between the introduction of new products and stock price seems to be far stronger. For example, a company such as Apple has a strong correlation between the introduction of a new iPhone model and the company's increase in stock price. Even though the iPhone is not a new product, and the market seems to be saturated with new models coming out every year, Apple continues to improve its margins. With each production announcement, Apple continues to raise the selling price of iPhones and thereby improving margins, causing the share price to increase (Kollmeyer, 2018). However, this does not seem to be the case for Tesla.

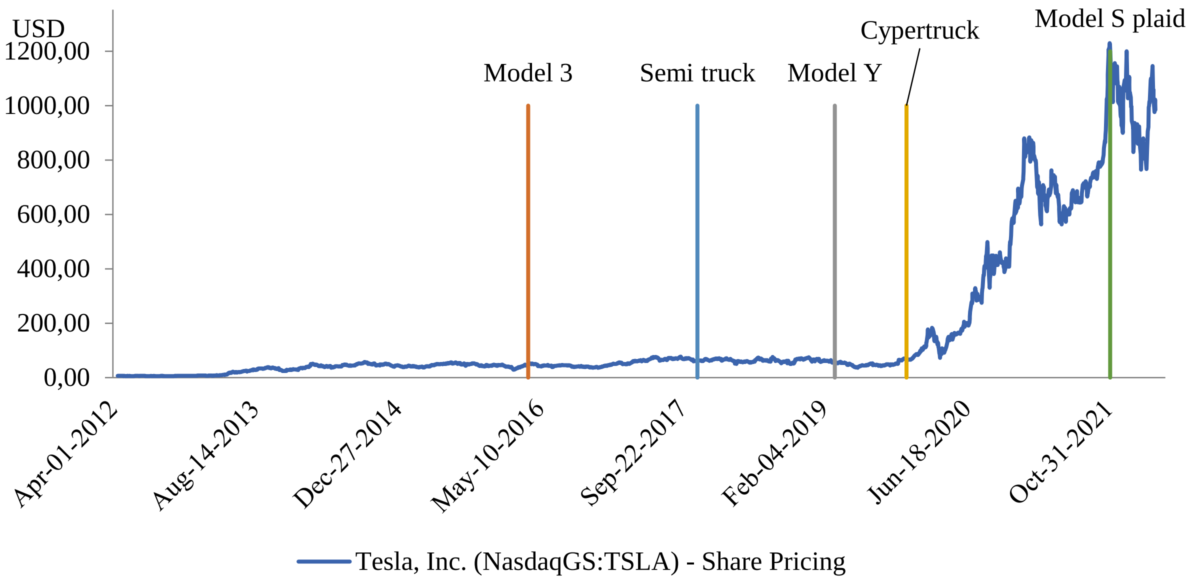

Figure 8 Tesla 10-year share price, Source (S&P Capital IQ, 2022c)

Three different ratios have been selected to compare the performance of Tesla and its closest competitors, which can be found in Table 2. First, the quick ratio is examined, to get an understanding of the firms most liquid assets against its short-term obligations (Berk, 2019).

$$Quick\ ratio = \frac{Current\ assets - inventory}{Current\ \text{liabilities}}$$

Tesla has a quick ratio of 1, which is considered to be a normal quick ratio and indicates that Tesla has exactly enough current assets to pay off current liabilities (Berk, 2019). One of the reasons to look at the company's quick ratio is to see whether the company maintains a large cash balance for its day-to-day operations, as this will affect the estimation of future working capital. Preferably, cash and investments in marketable securities will be excluded from current assets, when estimating the working capital of the firm, however exemptions are made for firms that require to maintain a high day-to-day cash balance (Damodaran, 2006).

Inventory turnover ratio for the fiscal year ending December 31st, 2021. It measures how many times a given company was able to sell its inventory in 2021. The inventory turnover ratio is calculated using the following equation (Berk, 2019):

$$Inventory\ turnover\ ratio = \frac{Cost\ of\ goods\ sold}{Average\ inventory}$$

Average inventory is calculated by averaging raw materials, work in progress units, finished goods, and finished service parts, over the two years. Finished goods include new vehicles for sale and vehicles in transit to fulfill customer orders. Additionally, energy generating, and storage products are also included in finished goods however this is a relatively small amount compared to automotive related inventory (Tesla, 2022a). For manufacturing firms, high inventory turnover is desirable since a low inventory turnover can lead to overstocking and production inefficiency, which was the case for Tesla in 2017 where the ratio was 4.4 (CapitalIQ, 2022b). In the past the low inventory turnover rate was partly due to the overly complex design of the Model X. There have been numerous reports indicating that the Model X was over-engineered causing production issues, which ultimately lowers the inventory turnover (Zhang, 2015). However, the newer Model 3 and Model Y are designed after a concept of design-for-manufacturing, where design engineers and manufacturing engineers worked closely together. As a result of this the inventory turnover ratio has improved (Valentin, 2018). As described in the chapter *4.1.3 Suppliers,* Tesla produces many of its components in-house and is focusing on increasing in-house production (Statista, 2021b). However, increasing its bargaining power towards its suppliers and producing in-house, will likely increase equipment maintenance and raw material inventory. When moving more of the production in-house a greater inventory supply of raw material is needed. Many of the raw materials used in the vehicle production, such as lithium and cobalt for the battery production and aluminum for the body parts are volatile commodities, and therefore require a reserve inventory in case of a surge in price. Additionally, there is also an incentive for Tesla to buy these materials in bulk as buying larger quantities will likely reduce costs. Having this extra inventory will directly affect the inventory turnover ratio and could explain why it is lower for Tesla than other companies in the same market such as Ford and General Motors. As the example with Tesla's vertical integration of its seat production, significant resources go into doing so and production can be difficult to scale as vehicle production grows. The production is outside of Tesla's core competencies and it adds additional inventory which could have been the responsibility of the supplier (Sage, 2017). In the Appendix 7 Tesla's historic delivers compared to its inventory growth can be found.

Additionally, to understand if Tesla's business is more efficient than that of its competitor, the asset turnover ratio is assessed. The asset turnover ratio measures how effective the company is at using its assets to generate revenue. The ratio is measured as total revenue divided by the two-year average total assets, to reduce the impact of large asset sales or purchases in a given year (Berk, 2019). In Table 2 it can be observed that the asset turnover ratio for Tesla in 2021 was amongst the best in the industry. As described in the chapter *4.1 Automotive industry analysis*

Tesla's supply chain is more resilient than its competitors and is likely the reason for the higher asset turnover rate. When competitors struggled with supply chain related production issues, Tesla was more prepared, and revenues were not affected to the same degree.

2021	Inventory Turnover	Asset Turnover	Quick Ratio
Tesla	8.2	0.9	1.0
Toyota	7.8	0.5	0.7
Volkswagen	4.2	0.5	0.9
BYD	5.1	0.7	0.7
Mercedes-Benz Group AG	3.5	0.5	0.8
Ford	10.0	0.5	1.0
General Motors	8.7	0.5	0.8
BMW	4.2	0.5	0.8
Stellantis	14.3	0.9	0.9
Honda	6.7	0.6	1.0
Industry Avg.	7.2	0.6	0.9

Table 2 Financial ratios, source CapitalIQ

To get an understanding of how Tesla's business will develop in the future and the future growth of the company, a detailed look at the company's historical quarterly financial performance is needed. As observed in Figure 9, Tesla's revenue has steadily been increasing since 2013, making the company the 19th largest automotive manufacturer in terms of revenue in 2021 (Figure 5). Additionally, Tesla has had a negative net income for a decade but has been able to become profitable in recent years, where the healthy growth is supported by a pre-tax operating margin of 15.03% for Q4 2021 (CapitalIQ, 2022b).

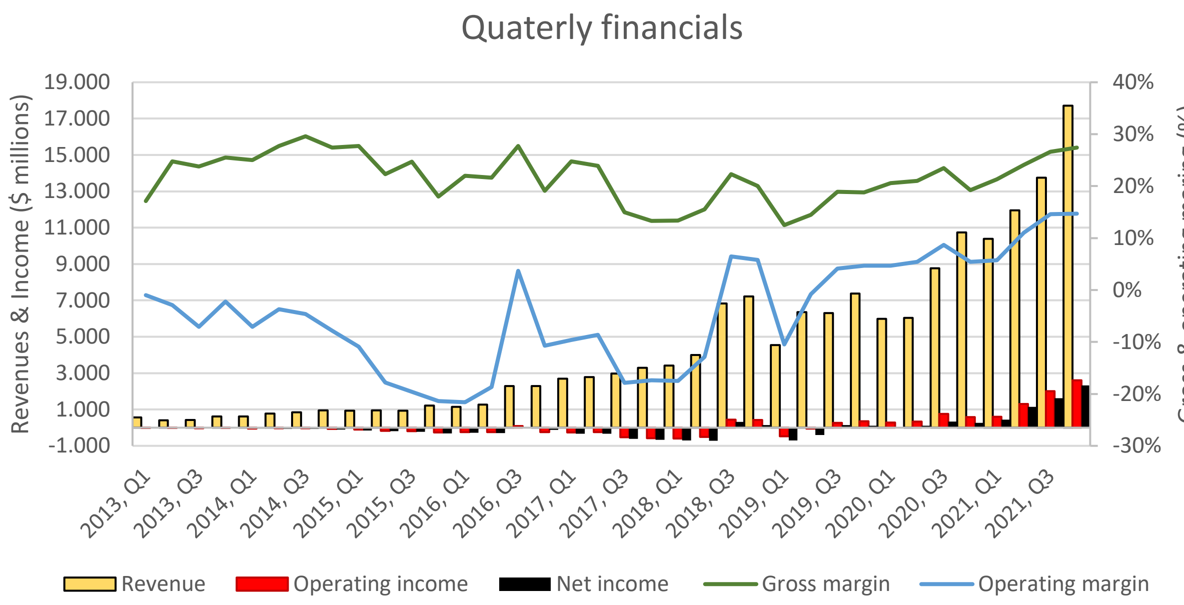

Figure 9 Historical quarterly financials

Figure 9 represents a visual representation of Tesla's quarterly financial performance since 2013. Analyzing the company's financials reveals that Tesla is becoming a more efficient company. The improvements in operating margin, show that the company is becoming better at turning sales into profits. This further validates the conclusion made in *4.1.5 Industry rivalry* that Tesla's production is becoming more efficient. One of the critiques of Tesla's high market cap in 2013 was the lack of revenue the company was able the generate (Finger, 2013). Back in 2015, Tesla was losing more than $4,000 per Model S sold (Reuters, 2015). Revenue has since grown making Tesla the world's 14th largest automotive manufacture by revenue.

Following the analysis of Tesla's historical quarterly financials along with the previous finding of Tesla current state of operating, it is observed that Tesla is in the high-growth stage of the business life cycle model. The high-growth stage is chosen over the young growth stage, as Tesla recently generated its first positive net income in 2020, thereby turning potential into profits. There are many different versions of the business life cycle model, the one chosen in this report can be found in Appendix 8. The model describes the different stages a company goes through, from the start-up stage to the young growth, high growth, mature growth, mature stable, and finally the decline stage. Typically, all firms pass through all these stages in the life of the company, apart from only a few companies, such as Apple and Microsoft, that were able to reinvent themselves and move backward in the stages. The model is built around the principle that finding new ways of generating profits becomes more difficult as the company matures (Damodaran, 2006).

As overserved in Appendix 9, much of Tesla's growth in stock price has come since the beginning of the Covid pandemic. There are numerous reasons behind the surge in Tesla's stock price, however several reasons are worth highlighting. First, as observed in the literature review, firms with a high growth-rate are impacted more severely by negative supply chain news (Hendricks & Singhal, 2003). Thereby, indicating that firms in the high-growth stage such as Tesla would be impacted more by supply chain related issues. However, this was not the case for the recovery period after the Covid pandemic. During the initial market crash and in the recovery period, younger firms experienced lower negative return and the shares gained more in the recovery period. An explanation for this could be that the production shutdown following the Covid pandemic has a set timeframe, where investors could see an end to the supply chain disruption (Damodaran, 2020). During the Covid crisis Tesla's fundamentals have also improved. In Figure 9 the increase in fundamentals across the line can be observed, which indicates the resilient of Tesla's supply chain in times of crisis. Additionally, as observed in the literature review, firms with a high debt-to-equity rate are impacted more severely than firms with a low debt-to-equity ratio during a supply chain crisis (Zsidisin et al., 2016). Tesla's comparatively low debt-to-equity ratio could also be an explanation why the company has outperformed its competitor during the pandemic.

When valuing a company is it helpful to determine where in its growth stage it is, as this will affect growth rates for a given year in the forecasting period. In doing so, the business life cycle model found in Appendix 8 is used. It is determined that Tesla is a company in the high-growth stage. Over the valuation period of 10 years the company will pass thought the mature growth stage and into the mature stable stage. It is assumed that Tesla will reach the mature stable stage by 2030.

4.5 SWOT

The SWOT analysis framework, developed by Albert Humphrey in the 1960's, highlights internal and external factors influencing a firm's competitive position. The four factors, strengths, weaknesses, opportunities, and threat can help firms create future business strategies (Hill & Westbrook, 1997). The researchers use the SWOT analysis framework to summarize the findings in the strategic analysis and highlight the factors influencing Tesla's business. The findings are summarized in Figure 10 below.

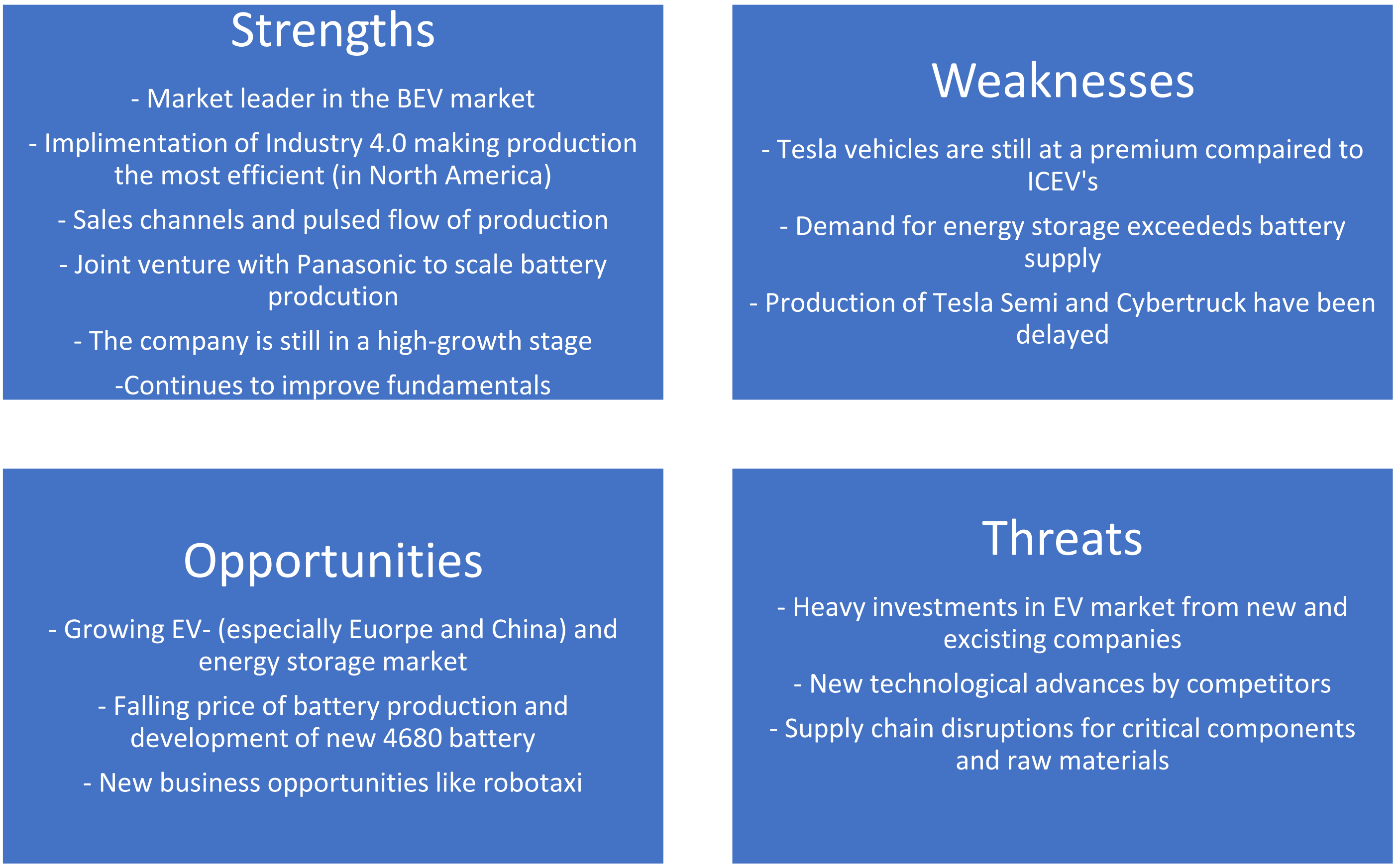

Figure 10 SWOT matrix, Source (Own creation)

5.0 Valuation

To answer the research question *"What is the estimated value of Tesla Inc. as of February 4th, 2022?"* a discounted cash flow valuation method will be utilized. In this forecasting model the future cash flow of Tesla is needed. (Damodaran, 2006) presents three different components to estimating the forecasted cash flow. First, the length of the extraordinary growth period is needed. Second, is to estimate the future cash flows in this period, and third the terminal value is needed. (Koller, Goedhart, & Wessels, 2015) recommends using a 10 to 15 years forecasting period. In this report a 10-year forecasting period is used, with a five-year detailed period. All inputs to the DCF model will be forecasted using the given forecasting period. These parameters will then be used in the calculation of the initial enterprise and stock price estimation of Tesla. In chapter *5.2 Cash flow forecasting*, a series of assumptions and parameters are used to estimate projected revenues from Tesla's businesses.

5.1 Revenue forecast

The following chapter will seek to uncover current and future revenue from Tesla's businesses, in order to estimate the enterprise value of the company.

5.1.1 Production

5.1.1.1 Current production facilities

To estimate the enterprise value of Tesla, a detailed revenue build of Tesla's future revenue stream will be conducted. First of a detailed look into Tesla's production capabilities is needed. As discovered in the section *4.1 Automotive industry analysis,* Tesla's primary source of revenue is coming from its automotive production. To estimate this, the future number of units as well as the sales price for each car model must be predicted. Multiplying these numbers will provide a detailed insight into which production units contribute the most to Tesla's revenue. However, to ensure the production capabilities can live up to the future expected production flow, a deep dive into Tesla's current and future production facilities is needed. The insights from the analysis of Tesla's production facilities will serve as a control to ensure that the estimated production rate of each model does not exceed a realistic threshold of production for each factory.

Current Primary Manufacturing Facilities

	Fremont Factory	Gigafactory 3	Gigafactory 2	Gigafactory 1
				
Location	Fremont, CA	Shanghai	Buffalo, NY	Storey County, NV
Production capacity **	Model S / Model X 100,000 Model 3 / Model Y 500,000	Model 3 / Model Y >450,000		
Square-feet	5.3 M	9.3 M	1.2 M	5.3 M
Employees	+10,000	15,000	800	7,000
Ownership*	Owned	***	Leased	Owned

*Table 3 Primary Manufacturing Facilities, *Obtained from (Tesla, 2022a) ** Obtained from* (Tesla, 2022e) *** " We own the building and the land use rights with an initial term of 50 years. The land use rights are treated as operating lease right-of-use assets."*(Tesla, 2022b) *Primary Manufacturing Facilities, *Obtained from (Tesla, 2022a) ** Obtained from* (Tesla, 2022e) *** " We own the building and the land use rights with an initial term of 50 years. The land use rights are treated as operating lease right-of-use assets."*(Tesla, 2022b)

From Tesla's 10-K shareholder deck, the production capacities of existing factories are listed, which can be seen in Table 3. In the shareholder deck it is shown that only two factories are producing vehicles at the moment, the very first Fremont plant and the 2019 Shanghai Gigafactory (Tesla, 2022e). The Tesla Fremont factory produces all available Tesla models, Model S, X, 3, and Y. Furthermore, the facility also produces Model S and Model Y battery packs and proprietary lithium-ion battery cells. The production facility covers 5.3 million square feet of office and manufacturing space along with employing over 10.000 workers. The factory was originally built by General Motors, which Tesla acquired in 2010 (Korosec, 2020b; "Tesla Factory | Tesla," 2022). However, the production capacity of batteries at the Fremont plant is not big enough to accommodate the demand from production, which results in Tesla sourcing some of its batteries from its Nevada Gigafactory. This factory mainly produces battery materials, cells, modules, and battery packs for the Model 3, Model Y, and Tesla energy products. Additionally, the factory produces vehicle drive units and energy storage components. The lithium-ion battery cells produced at this facility are manufactured in collaboration with Panasonic (Tesla, 2022a). The Nevada Gigafactory has roughly 5.3 million sq-feet of operational space and employs 7,000 workers (Korosec, 2020a; "Tesla Gigafactory | Tesla," 2022). Apart from the one vehicle assembly plant in North America, Tesla has a range of supporting factories around the globe, supporting the assembly-line with a variety of components, and many of the components used in the Fremont plant come from local production facilities. As many other car manufacturers, Tesla utilizes a wide range of original equipment manufacturer parts (OEM parts) sourced from various manufacturers around the world. However, for this analysis only Tesla's own production capabilities will be covered. From Tesla's 10-K shareholder deck, the production capacities of existing factories are listed, which can be seen in Table 3. Additionally, Tesla's have a number of other factories in North America, supporting current production and allows for more in-house production of components. The facilities are highlighted in the following section.

Tesla Kato Road Factory**:** Only two miles from the Fremont factory is the Tesla Kato Road factory. At this facility Tesla's new 4680 battery cells are also being developed, but the primary function of this facility is to manufacture the car seats going into the different Tesla models. Originally when Tesla were producing the Model X, suppliers could not deliver the complex seats and Tesla therefore had to bring this part of the production in-house (Shahan, 2019b).

Megafactory Lathrop**:** This factory produces the larger Megapack used for energy storage, which are produced from lithium iron phosphate (LFP) battery cells from Chinese battery producer CATL (Darryn, 2021). LFP battery packs are cheaper to produce, since they do not contain any cobalt and Tesla has also been able to extend the range of vehicles using this newer type of battery (Darryn, 2020).

Tesla Toronto Automation**:** This facility mainly focuses on research and development of Tesla's new 4680 battery cells. Tesla wants to produce the new battery cells in-house, which are expected to be used in the Model Y. However, to ramp up production, Tesla must rely on its current partnership with Panasonic to produce enough batter cells. It is expected that Panasonic will start the production in Q1 of 2024 (Loveday, 2022). Apart from research and development of the new battery cell, the factory also produces production-line equipment that will be used in the production-line of upcoming Gigafactories in Texas, Berlin, amongst others, where the batteries will be produced. This facility is therefore essential in Tesla's future growth, since the research here could significantly reduce the cost of each battery pack (NMSC, 2022).

Tesla Tool and Die Factory: This facility was obtained by Tesla in 2015 when the company purchased Michigan-based Riviera Tool. The purchase was part of a vertical acquisition for Tesla, since the company was already producing tools and dies for stamping equipment used in Tesla's production (D'Angelo, 2017).

Grohmann Automation: Consists of three facilities located in Neuwied, Neutraubling, and Prüm in Germany. These factories are all included under the subsidiary *Tesla Grohmann Automation GmbH* and obtained in the acquisition of the German engineering firm Grohmann Engineering. The firm specializes in the production of equipment used in the manufacturing of battery packs used in electric vehicles. Before the acquisition, the firm worked with Tesla amongst other automakers to develop automated manufacturing equipment, however these connections to other automakers were cut to focus on the Model 3 production line. Daimler Group has later publicly stated that this strategic acquisition by Tesla directly affected its business and was one of the reasons for the delay of electric Mercedes-Benz SUV's due to battery shortage (Loveday, 2020). In 2021 its factory in Prüm received a massive expansion and the factory will likely play a key strategic role in the expansion of future factories, such as the Berlin and the Texas factory, as well as in the production of future battery packs (Alvarez, 2021).

***Shanghai Gigafactory*:** To cover the Chinese market Tesla has set up a factory in Shanghai. The factory is the second Tesla factory that is currently producing vehicles. The facility produces both Model 3 and Model Y primary for the Asian market. The Shanghai Gigafactory was built to reduce manufacturing and transportation costs as well as eliminating tariffs that would drive up vehicle costs in local markets. The Shanghai Gigafactory was the first greenfield investment in vehicle production for Tesla, which carries a number of advantages. While Tesla acquired the Fremont as a brownfield investment, the Shanghai Gigafactory is purpose-built for Tesla's production set-up (Tesla, 2022h; Valentin, 2018).

The final manufacturing facility from Table 3, is the Buffalo Gigafactory or Gigafactory 2. This factory has 1.2 million sq-feet of production floor and employs 1,500 people and was acquired from the 2016 take-over of SolarCity (Hanley, 2020). The facility produces clean energy generation products, such as solar panels and Solar Roof, solar panels built into roof tiles. Furthermore, the facility also produces energy storage products, such as the Powerwall home battery and the Powerpack battery system for commercial and utility-scale sites ("Tesla Gigafactory 2 | Tesla," 2022). Additionally, the factory also produces the V3 Supercharger, the latest version of Tesla chargers (Hyatt, 2019).

Currently, Tesla is working to establish two additional manufacturing facilities, one in Berlin and one in Texas. Production of Model Y vehicles has already begun at the Texas Gigafactory, however Tesla is still awaiting final certification for the production facility before it can start producing vehicles for sale (Tesla, 2022e). Furthermore, the factory is also expected to produce Tesla's upcoming pickup-truck, the "Cybertruck". The factory is projected to cost $1.06 billion with an expected completion date in 2022 (Bellon, 2021).

The Berlin Gigafactory is expected to produce Model Ys, mainly for the European market. According to Reuters, the factory is expected to cost $5.5 billion and is in the process of hiring new workers to the factory (Schimroszik & Steitz, 2022). At the Berlin facility, Tesla will also produce its own batteries and unlike previous battery manufacturing facilities the intention is to produce these without a partnership with an external battery producer (C. Randall, 2020). Initially, the batteries used in production at the Berlin factory will come from China, and most likely from CATL which Tesla has an exciting partnership with to supply batteries for the Model 3's produced at Tesla's Shanghai factory (Alvarez, 2020).

5.1.1.3 Production rate

Tesla delivered 936 thousand vehicles and produced 930 thousand vehicles in 2021. Q4 of 2021 was the most productive quarter with 305 thousand vehicles produced (Business Wire, 2022). Greater production output at its plants is key to meet future orders, but ramping production is an ongoing process. Tesla's Fremont factory currently has the biggest production capacity at 600,000 vehicles annually. Tesla believes that production can be expanded beyond this (Tesla, 2022e). As mentioned earlier, the Fremont factory is the most efficient automotive plant in North America with a weekly output of 8,550 cars on average in 2021 (T. Randall & Pogkas, 2022). In 2021, the factory produced more than 430,000 vehicles in the 12-month span from Q4 2020-Q3 2021 (Tesla, 2021b). Tesla had the biggest change in production output in North America from Q1 2020 to Q1 2020. While automakers like Ford and GM had a 5% decrease in production output, Tesla had a 45% increase in volume (Macquarie Research, Hong, Lee, et al., 2021).

Shanghai Gigafactory production capacity was more than 450,000 vehicles in 2021 (Tesla, 2022e). The factory is on track to produce 600,000 vehicles in 2022 after Tesla sold 56,515 Chinese made vehicles in February 2022 alone. Tesla previously stated that the goal for Shanghai Gigafactory is to produce 1 million vehicles annually (Lambert, 2022a). The Berlin Gigafactory started production in March of 2022. The production capacity of the factory will be 500,000 vehicles. JPMorgan forecasts the factory to ramp production with 54,000 vehicles in 2022, 280,000 in 2023, and 500,000 in 2025 (Mihalascu, 2022b). Tesla opened its most recent factory in Austin Texas in April 2022, with a capacity of at least 500,000 vehicles in 2023 according to Elon Musk (Ohnsman, 2022b). Tesla produced 930 thousand vehicles in total in 2021 (Business Wire, 2022).

Tesla mentions the production capacity of new plants and it is worth noting that two factors are to be kept in mind. As seen with the Berlin Gigafactory, production ramps up over years towards full capacity. The second is the theory on capacity utilization, which says that increased capacity utilization leaves less room for production errors and causes slower response time. Appendix 10 shows how production inventory and lead time grows exponentially as capacity utilization approaches 1.0. High variability in production will result in this occurring sooner, leaving less room in the capacity (Lovejoy, 1998; Schmidt, 2005).

As mentioned in *4.1 Automotive industry analysis,* Tesla's Gigafactory and approach to Industry 4.0 with the use of robots allows them to increase capacity utilization. Tesla's production and postponement strategy allows for orders to be placed before production begins. It lowers the need for additions like safety stock and inventory of finished products and allows the company to have a higher capacity utilization (Valentin, 2018). The average capacity utilization in the automotive industry in the US. was 69.6% in Q4 of 2021 (Federal Reserve, 2022). With 430,000 vehicles produced in Q4 2020-Q3 2021, the Fremont plant had a capacity utilization of 72% (Tesla, 2021b). Tesla's total production was 930 thousand units in 2021 (Business Wire, 2022). The total capacity was 600 thousand at the Fremont plant, but the total capacity for Gigafactory Shanghai is reported by Tesla to be over 450 thousand without specifying the exact capacity (Tesla, 2022e). Depending on the exact capacity of Gigafactory Shanghai, the capacity utilization across factories is estimated to be 88% or lower. Based on the original estimates of a 500 thousand unit capacity, this means a 1.1 million unit capacity and a 85% capacity utilization rate across factories (Reuters, 2021b). These numbers suggest a higher capacity utilization rate at Tesla's plants compared to other automakers, in line with the suggestion mentioned earlier regarding increased efficiency. Based on these numbers, the researchers will use a capacity utilization rate of 85% as the base for Tesla's future production facilities.

5.1.2 Vehicle forecasting

5.1.2.1 Global vehicle forecasting

There is a yearly exponential increase in EV's sales, reaching 6.49 million units globally in 2021. Tesla had a 14.4% market share of total units sold in the EV category with just over 936.000 units sold in the 12-month span. Compared to other car makers in the category, Tesla is exclusively producing battery electric vehicles. Looking at BEV's specifically, Tesla had a 21% market share of the 4.4 million BEV's sold in 2021. BEV's accounted for 68% of global sales in the EV category (Pontes, 2022).

Looking at near-term projections, the market is also expected to grow, with BEV sales reaching 12.5 million units in 2025, making up 12.5% of the total global light vehicle market of 100 million vehicles (Macquarie Research, Hong, Park, et al., 2021). In 2030, BEV's will make up 28 million units (25.6%) of the global light vehicle market of 110 million units. Europe, China, and the US are the three major markets for BEV sales accounting for 96% in 2021. This is projected to remain above 90% towards 2030 (Macquarie Research, Hong, Park, et al., 2021). Especially Europe and China have regulations to phase out ICEVs. The penetration for BEVs in the European market is expected to be 39% (8,8 million vehicles) in 2030 vs. 6% today (1 million vehicles). This is driven by current regulations stop the sale of new ICEVs and future emission standards Euro VII coming into effect in 2025 (Macquarie Research, Hong, Park, et al., 2021). China will remain the biggest BEV market in the coming decade, growing from 2 million vehicles in 2021, to 12,6 million vehicles in 2030, accounting for 41% of light vehicle sales in the country. Like the European market, the growth is driven by stricter emission regulations, but also a heavy investment in the EV market from state-owned companies, expanding production (Macquarie Research, Hong, Park, et al., 2021). The US have also started imposing regulations of automakers recently, which will drive the change in the automotive market (Ohnsman, 2022a). Despite this, the penetration of BEVs is still behind Europe and China with 3% (443 thousand vehicles) in 2021, and 26% (4,5 million vehicles) in 2030. Many automakers have made 50% target for the share of annual sales in 2030, including GM, Ford and Stallantis, however these targets are not legally binding. The introduction of EV pickup trucks and an expansion in the charging infrastructure could see the US market nearing European and Chinese penetration rates (Macquarie Research, Hong, Park, et al., 2021). Global ICEV sale will fall to 47.6% of total sales in 2030 as consumers transition to

EVs and regulations increase production costs for ICEVs (Macquarie Research, Hong, Park, et al., 2021).

Looking long-term beyond 2030, global BEV penetration is expected to reach 46% of light vehicle sale in 2035, and 58% in 2040 (Macquarie Research, Hong, Park, et al., 2021). BloombergNEF are working with two scenarios for the development of EV adoption moving towards the year 2050. The Economic Transition Scenario (ETS) assumes that no major regulations are put in place, but that the market is simply driven by development of EV car technology and the fall in battery pack prices to make EVs both more attractive and affordable. In this scenario there is a big emphasis on access to home charging. Here markets like the U.S. are seeing a bigger adoption due to the acceleration of home charging options, compared to markets relying on public infrastructure. The European market also see high adoption rates of 90% by 2040, whereas Asia and other more price sensitive markets have a lower adoption rate. In the ETS scenario, the number of internal combustion engine cars keeps increasing until 2027 and there will still be more than 900 million of them in 2040, making up more than half of the global passenger vehicle fleet. Other alternatives like fuel cell cars see increasing numbers in the 2030s. Even though the numbers will increase to 8.6 million in 2040, it will only make up under 1% of the total number of cars (Appendix 11) (BloombergNEF, 2021).

The other scenario is the Net Zero Scenario where significant policy changes and initiatives are required to research the goal of a global carbon net-zero emission by 2050. According to the International Energy Agency's report on "Net Zero by 2050", this scenario needs to become a reality to reach the goals of COP26 and the 2015 Paris agreement. The electrification of road vehicles plays a central role in making this vision come true. One of the key milestones according to the report is a stop of new internal combustion engine passenger vehicles by 2035, and 64% of global sales coming from PHEV, BEV and FCEV vehicles in 2030, growing to 100% in 2050 (International Energy Agency IEA, 2021b). In the Economic Transition Scenario, EVs will make up 169 million of the global fleet in 2030, whereas as there needs to be 218 million on the road to be on track for net-zero emission. Policy changes and investments in electric infrastructure is key to the development in the EV market, that is projected to grow from $7 trillion between 2021 and 2030 to $46 trillion towards 2050. The investments made in today's leading markets will help drive down the price for entering emerging markets like India, both when it comes to battery price sand electric infrastructure. The road to net-zero by 2050 also comes with more investments in public transport and other alternative transport options, however the global passenger vehicle fleet is still expected to grow to 1.5 billion from 1.2 billion cars today (BloombergNEF, 2021). According to McKinsey & Company report on the future automotive market, the market is projected to increase by 2.53% annually from 2015 to 2030. The revenue from one-time vehicle sales is projected to grow to $4,000 billion in 2030 (Paul Gao, Kaas, Mohr, & Wee, 2016).

The adoption of electric vehicles to the level discussed above is also dependent on the development of battery solutions and electric infrastructure. The cost of battery packs worldwide is expected to decrease from $137/kWh in 2020 to $58/kWh in 2030, more than halving the cost over 10 years. Cost have been on an exponential decay since 2011 cost of $917/kWh (BloombergNEF, 2020). With the decrease in production cost and progress in technology, the average range of BEVs is expected to increase to 440 km with a density of 450 Wh/kg, compared to 300 km and 295 Wh/kg in 2020. This is more than doubling the range from 2015 average of 195 km (Gaffner & Berking, 2018).

5.1.2.2 Tesla existing vehicle forecasting

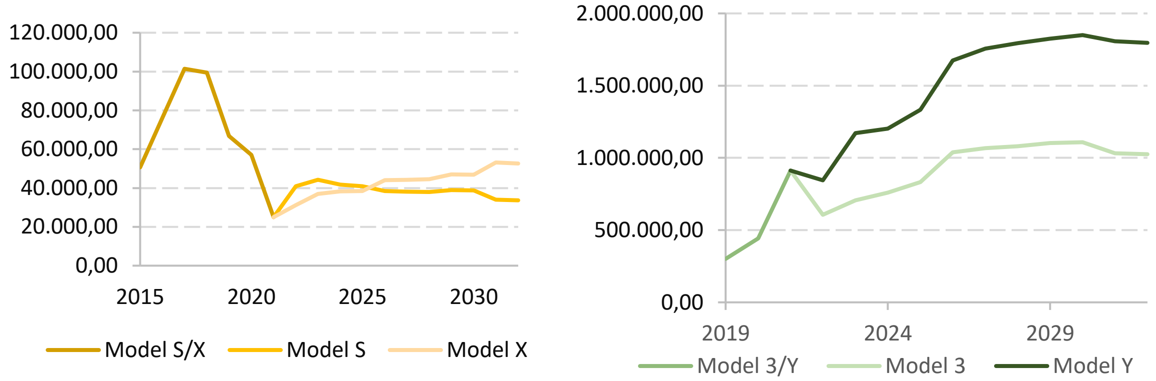

Figure 11 Tesla vehicles forecasting, Source: Bloomberg

Tesla has been able to penetrate the PEV market very well and has two vehicle models in the top three of most sold cars in 2021. In 2021 the Tesla Model 3 was the best-selling plug-in electric vehicle worldwide followed by the Chinese microcar; Wuling Hongguang Mini EV, with 424,000 units sold in 2021 (Carlier, 2022b). However, this model caters to a different market segment than what Tesla sells to. The Mini EV has a limited range of 120 Km with a mere 17 hp compared to the Model 3's 400 Km range and 325 hp, because of this the car's selling price starts at $4,162 (Reuters, 2020). The third best-selling plug-in electric vehicle in 2021 was the Tesla Model Y with an estimated 411 thousand units sold (Carlier, 2022b). Looking at a broader market segmentation Tesla has been doing a good job at capturing market shares in the mid-sized vehicles market segment, with Model 3 being the second most sold car world-wide in the category in 2021, only exceeded by the Toyota Camery. In 2021 Toyota sold an estimated 691k Camery's thereby capturing 8.2% of the total market (focus2move, 2022a). The third best-selling plug-in electric vehicle in 2021 was the Tesla Model Y with an estimated 411 thousand units sold. Based on the number of Camery's sold it seems unlikely that Tesla will be able to sell an estimated 1.03 million Model 3's by the year 2030. However, it is worth noting that the Camery is not Toyota's only sedan and that Toyota has a range of models they can sell to this customer segment. On the contrary, Tesla only has the Model 3 and the Model S in this product category. As previously stated, the total market size of BEVs was 4.5 million units in 2021, with the Model 3 capturing 11.13% (Pontes, 2022). When looking at the forecasted market for BEV's by 2030 the estimated market share of the Model 3 will amount to 4.14%, which seems reasonable given the presumably increase in competition (Macquarie Research, Hong, Park, et al., 2021).

In 2020, the first Tesla Model Ys were delivered and in 2021 it was the 10th best-selling SUV world-wide. The top selling car in 2021 was the Toyota RAV4 with its 1.03 million units sold and a 3.1% market share of the total SUV market in 2021 (Focus2move, 2022a). According to the Bloomberg estimates, the Model Y is expected to sell 1.8 million units by 2030, which translates to a market size of 6.7% of the total 26.8 million BEV's. This is a decrease of about 2.3% market shares from the 9% in 2021. Again, this aligns with the expectations of Tesla's overall market shares, that are expected to decrease (Bloomberg, 2022)(Appendix 12).

As for Tesla's older models the Model S and X, the number of units sold seems to stay consistent with current sales over the 10-year forecasting period, which makes sense considering the models have been on the market for a number of years (Figure 11). As seen from Figure 11, the number of Model S sold does decrease in 2021, which is due to a mix of supply chain issues related to factory shutdowns and the fact that the model was a bit outdated. However, in 2021 the Model S received a facelift which explains the expected increase in units sold by 2022. Over the forecasted 10-year period the number of Model S's are expected to steadily decrease as newer Tesla models hit the market. Regarding the Model X, this model received a facelift in 2021 with the introduction of a new "Plaid" version of the vehicle (Auto Express team, 2021). Combined with the fact that this is the largest model in Tesla fleet of cars secures its unique selling proposition.

For the existing models sold by Tesla, the price points for the first 4 year are average selling prices based on Factsets estimations. For the Model S and X an increase of 1% per annum in the selling price is used after the four years. For the Model Y and 3 a 1% decrease in selling price per annum is used, since it is expected that the selling price of these vehicles will decrease since they are "mass market" vehicles unlike the more premium Model S and X.

5.1.2.3 Tesla upcoming vehicles forecasting

Tesla has three upcoming models which have been confirmed by Tesla: The Cybertruck, an electric pickup truck, the Roadster, an electric supercar, and the Semi truck, an electric semi-truck. To estimate the future revenue stream for Tesla these models must also be included. According to the Bloomberg estimations the Cybertruck is expected to sell quite well, starting with a mere 7,000 vehicles in 2022 and increasing to over 400k vehicles by 2032 (Bloomberg, 2022). The demand for the Cybertruck is supported by the more than 1.25 million pre-orders Tesla has already received for the model (Mihalascu, 2021). According to the Bloomberg estimates, Tesla is expected to sell just over 255k Cybertruck by the year 2030, thereby the model will capture just shy of 1% of the total forecasted BEV market (Bloomberg, 2022). Looking more specifically at the pick-up market, the best-selling truck in 2021 was the Ford F-series with 877,720 units sold, which equals to 14.3% of the pick-up truck market share (Focus2move, 2022b). It is worth noting that 98% of Ford F-series trucks are sold in the U.S. and Canada, making this the largest market for pick-up trucks (Focus2move, 2022b). There have also been concerns with the size and build of the Cybertruck, not being road-legal in the EU and able to meet safety standards (Reid, 2019). The Cybertruck selling price is expected to start at around $40,000 for the base model, however this does not include the $10,000 fully self-driving option. Looking across the entire range of Cybertruck options and versions it is expected that the average selling price will be $60,000 across the 10-year period (electrek, 2022). The selling price is slightly higher than its competitors with the Ford F-series starting at around $30,000. The $60,000 price tag of the Cybertruck is closer to the high-performance F-series Raptor, with its starting price at $68,000 (Ford, 2022).

The Roadster is expected to have a base price at $200,000 when it launches in 2023, and the more expensive founder's edition is expected to cost $250,000. Over the 10-year period, it is expected that the average selling price per Roadster will be $210,000 (Dorian, 2022). Projected sales numbers for the Roadster have been obtained from the Bloomberg terminal (Bloomberg, 2022).

The Semi Truck is expected to have an average selling price of $182.500 per truck, which is in between the base price of $150,000 and the premium price of $200,000 (Levin, 2021). Sale of the Semi Truck is expected to start in 2022 with 1,500 units sold going up to 22,800 units sold in 2032 (Bloomberg, 2022). 4.3 million heavy truck were produced globally in 2021 (OICA, 2021b). The market was worth $190 billion in 2021 and is expected to grow to $280 billion in 2026 (Mordor Intelligence, 2022).

It is estimated that the centralizing of the supply chain, moving production in-house, and closer to other production facilities by building the Nevada Gigafactory, has reduced the cost of battery production by as much as 35%. The reductions come from reducing production time, labor, and transportation inefficiencies (Statista, 2021b). Because of these cost reductions strategies, it is expected that Tesla can deliver more affordable vehicles in the future.

Little is known about Tesla's road map of future vehicles, however during the Q&A session at the 2020 Q2 Tesla earnings call Elon Musk was asked how Tesla would achieve the long-term goal of selling 20 million vehicles per year. His response to this was.

"I don't think we can comment on our detailed product road map beyond what's announced because we want to reserve that for product launches, but it would be reasonable to assume that we would make a compact vehicle of some kind and probably a higher-capacity past vehicle of some kind. These are likely things at some point, but I do think there's a long way to go with 3 and Y and with Cybertruck and Semi. So it's a long way to go with those. I think we'll do the obvious things."(Musk, 2020).

The compact vehicle that Elon Musk is referring to is most likely the anticipated Tesla hatchback (Page, 2021). A hatchback falls in the category B, defined as subcompact cars (FELIPE, 2019). The introduction of this vehicle has been linked to the opening of the Berlin Gigafactory since the hatchback model is more popular in the European market. A 2019 report from JATO Dynamics estimates that 50% of the world's global hatchback sales in that year came from the European market (Munoz, 2020). Again, this is in-line with Tesla's strategy to centralize its supply chain and move production closer to where sales are highest. When estimating the future potential for a Tesla mass market hatchback a good estimator is to look at the sales numbers of other hatchbacks. We estimate that the production of a Tesla hatchback will start in 2023 where annual sales for that year will be 100K. This estimation is based on the first-year production sales number of the Model Y, which began production in 2020 with 86K vehicles sold. Ever since the beginning of Tesla's first mass market car the Model S first-year production number has been increasing. This is likely because internal production knowledge and efficiency increases with each new model being introduced. Additionally, it is estimated that a new hatchback will build on the same platform as the Model 3 and the Model Y, two models that already share about 75% of the same components (Lambert, 2020). Sharing components with exciting models reduces production complications. Therefore, it is estimated that first-year production numbers will be slightly higher than for the Model Y. in comparison the Volkswagen ID3, a product with many of the same characteristics and the same customer segment, delivered the first ID3's in 2020 and that year 54.495 units were sold in Europe alone (carsalesbase, 2022).

When estimating the sales figures for the last forecasting year, 2031, estimation of the total subcompact market for 2019 is used. In this year the best-selling vehicle in this category was the VW Polo. For the given year an estimated 7.2 million vehicles were sold and captured about 7% of the total subcompact market Appendix 13a. However, estimating that the Tesla hatchback will become the best-selling subcompact vehicle in 2030 may be unrealistic, and it is therefore assumed that the vehicle will capture 5% of the subcompact market by 2030. Estimations of the sales figure of a Tesla hatchback in 2030 can be found in Appendix 13a. To verify the estimated sales numbers for the Tesla Hatchback in 2030, sales from another hatchback is used. Ford's best-selling hatchback of all time is the Fiesta, and two best-selling years for this model are 2009 and 2010. In 2010 Ford sold an estimated 400.000 units of the Fiesta in Europe and around 800.000 globally. 2009 was the bestselling year of the facelifted '09 version of the Fiesta, with an estimated 920.000 units sold globally. According to our estimates Tesla will be able to capture 81.5% of the 2009 Ford Fiesta sales with a mass market hatchback, this in terms will mean that Tesla will sell an estimated 590K hatchbacks this year.

When estimating the future sales figures of Tesla's upcoming vehicles, a range of assumptions has been put in place. For the years between the introduction of the new model in 2023 to the end of the forecasting period in 2030, a straight-line estimation approach has been used to estimate the sales numbers for all upcoming models. Since projected sales numbers for the total vehicle market have only been obtainable for the year 2030, the year 2031 is estimated based on a slight reduction in vehicle growth of -2%. This is done as it is expected that Tesla will become a stable growth company by 2031 and will therefore have to introduce newer models in the future to keep the stable growth. FELIPE (2019) only presents sales figures for the first two quarters of 2019, it is therefore assumed that the first half of the year will mirror the second half. Furthermore, it is assumed that existing sales figures will stay consistent for the forecasting period. For example, when estimating the future market share of the VW Polo it is assumed that the vehicle will be able to capture the same market share. Additionally, it is also assumed that upcoming Tesla models will capture market share from existing players on the market, and that the total market size will not increase beyond that forecasted market size. These assumptions are also applicable for the estimation of Tesla's other upcoming vehicles.

It is estimated that Tesla can produce even more affordable cars in the future, we therefore anticipate that Tesla will produce a new vehicle starting at $15,000. Based on the existing launch pattern of Tesla's vehicle 2026 seems like a reasonable year to launch this model. A price tag of $15,000 will put the car in the same price-range as the Chevrolet Spark and the Mitsubishi Mirage in the U.S. market. These vehicles are categorized as city-cars and fall into category A (FELIPE, 2019). In Appendix 13b estimated sales numbers of a Tesla city car are presented, the 2030 projected sales figure is based on 2021 sales figures of the KIA Picanto, the sixth best-selling city car in 2021 (focus2move, 2022b). In 2021 this vehicle captured 3.7% of the city car market, and it is estimated that Tesla will be able to capture a similar market size with a city car starting at $15,000. It is assumed that a city car will be smaller than existing Tesla models and because of this the vehicle will not be able to share as many components with previous models. Therefore, it is estimated that the vehicle will sell 50,000 units the first year of production.

Based on existing launch patterns it is estimated that Tesla will produce another vehicle the following year to keep up with demand. This time it is assumed that Tesla will produce another SUV and a cheaper version of the existing Model X, starting at $25,000. Similar to the city car this model is expecting to sell 50K units in the first year of production, based on similar assumptions. To predict sales numbers for 2030 the 8th best-selling SUV in 2019 is used, the Kia Sportage. In 2021 this vehicle captures about 1.2% of the combined global SUV market, and it is anticipated that Tesla will capture a similar market share with the introduction of a second SUV. Projected sales figures for a second Tesla SUV can be found in Appendix 13b.

In the quote from Elon Musk, he also mentions a high-capacity vehicle. Rumors of an upcoming electric van were further confirmed in a conference call following the release of 2020 Q4 earnings call where Elon Musk said, "*I think Tesla is definitely going to make an electric van at some point"*(Lambert, 2021d). Elon Musk further explained that Tesla has not already produced such a van because of battery cell output constraints. Therefore, we estimate that Tesla will not deliver a van before 2028 (Lambert, 2021d). The average selling price of a Mercedes Sprinter van is about $40,000, which is used as the average selling price for a new Tesla van (Mercedes, 2022). For the first year of production, it is assumed that Tesla can sell 50,000 vans. It is estimated that there will be a great demand for electric cargo vans, and that only production limitations will stop Tesla from selling more. Since a van will likely use a different platform and different components from those of Tesla's existing models, production will likely experience issues and bottlenecks.

To estimate sales numbers for the van, in the last forecasting year, the projected market size of this market segment is used. The projected global light vehicle market in 2030 of 110 million vehicles, includes passengers and commercial vehicles, and is used to estimate production volume for a Tesla van for the given year (Macquarie Research, Hong, Park, et al., 2021). In 2019 Mercedes sold a combined 438,400 vans, which represented 11.6% of the total light commercial vehicle market (Mercedes-Benz, 2022). For the forecasted revenue from a future Tesla van, it is assumed that Tesla, in 2030, will capture a quarter of Mercedes's light commercial vehicle sales in 2019. Thereby, capturing about what would represent 2.9% of the market for light commercial vehicles in 2019.

Now that the combined vehicle fleet for Tesla has been forecasted for the years 2022 to 2031, an estimate of the total market share for Tesla can be computed. The expected forecasted market share will provide an indication of the validity of the vehicle forecast. Combining the estimated total market size of the global light vehicle market in 2020, of 80 million vehicles according to Macquarie Research, Hong, Park, et al., (2021), with the number of deliveries from Tesla provides an estimated market share of 0.62% (Tesla, 2022a). The estimated number of global light vehicle deliveries in 2030 is 11 million, which equals to a market share of 4.3% for Tesla (Macquarie Research, Hong, Park, et al., 2021; Tesla, 2022a). When compared to the global automotive market share in 2021, a market share of 4.3% will put Tesla in between Kia (3.6%) and Chevrolet (4.4%) in terms of units sold (Focus2move, 2022c). For the battery electric vehicle market, global deliveries in 2020 is estimated to be 2,3 million vehicles, giving Tesla an estimated market share of 22%. For the forecasted year 2030, the global market size of BEVs is estimated to be 28 million (Macquarie Research, Hong, Park, et al., 2021). Combined with the estimated deliveries of Tesla vehicles for this year results in a market share of 16.8%. This is in-line with the discoveries made in *3.0 strategic analysis* that competition in the battery electric vehicle market will increase, and that Tesla will likely have to give up some of its market share. From these numbers the number of Tesla Semi Trucks have been subtracted, since these numbers do not fall under the category light vehicle trucks.

5.1.2.4 Forecasting revenue from leasing operations

Tesla made 3.05% of its revenue from automotive leasing in 2021 (Tesla, 2022a). However, estimating future revenue from automotive leasing is difficult since it depends on market conditions and the overall value of the second-hand car market. In 2021 the value of used vehicles increased drastically, and many choose to buy themselves out of their lease contracts. Since the buyout value of the vehicle was determined, perhaps, years before 2021, many saw the profitable opportunity. The rise in value of used cars was due to supply chain issues and a lack of vehicles to sell (Eisenstein, 2021). In the estimated revenue from automotive leasing, revenue over the past three years is used to compute an average. The computed average amounts to 4.16% of total automotive revenue for the given year, this will be used to estimate revenue from automotive leasing in the forecast period. The reason for using total revenue from automotive sales is that revenue from automotive leasing depends on, number of vehicles sold and the value of the vehicle. This estimate is quite high considering the current market conditions and value of used cars. However, on April 15th, 2022, Tesla introduced a no lease buyout policy, eliminating the opportunity for customers to buy the leased car after the end lease period (Lambert, 2022e). It is assumed that the change in Tesla's leasing policy will boost revenue from automotive leases, and channel revenue that would otherwise go to the second-hand car market into Tesla. Hereby, justifying the pre-2021 ratio between revenue from automotive sales and automotive leasing.

5.1.2.5 Forecasting revenue from service and others

Revenue from service and other consists of revenue from vehicle services to vehicles outside of warranty, vehicle insurance revenue, and sales of retail merchandise such as T-shirts and caps. Additionally, revenue from service and others also consists of sales by Tesla's acquired subsidiaries to third party customers, which covers a broad range of revenue streams (Tesla, 2022a). Revenue from service and others is estimated based on Bloomberg's predictions. However, Bloomberg's estimations of service and others are only conducted based on the production of the Model S, Model X, Models Y, Model 3, Cybertruck, and the Semi Truck and does not include other future vehicles. Therefore, the percentage of service and others of revenue for these models has been calculated and is used to estimate the total revenue from services and others (Bloomberg, 2022).

5.1.2.6 Forecasting revenue from regulatory credits

Tesla and other zero emission vehicles makers are entitled to receive regulatory credits from governments. These regulatory credits are provided by a range of government bodies in the European Union, China, and certain states in the U.S. Tesla receives these credits for free and are then allowed to sell them to other automotive manufactures that do not live up emission requirements. One example of this is Stellantis, which brought $2.43 billion worth of regulatory credit from Tesla between 2019 and 2021 (Kharpal, 2021). A benefit of regulatory credits is that they are almost pure profits for Tesla since they incur no direct expenses to earn them. Regulatory credits therefore have an imminent effect on Tesla's automotive gross margin and in 2021 these credits add $1.46 billion in revenue to Tesla (Forbes, 2021). Since the cost associated with the revenue from selling regulatory credit is minuscule, income from these credits is directly added to the pre-tax EBIT, to avoid including it in the cost of goods sold. As regulatory credits are directly related to the number of vehicles sold, this ratio is used to estimate future revenue from regulatory credits. In 2021 revenue from regulatory credits amounted to 3.3% of automotive revenue (Tesla, 2022a). Revenue from regulatory credits is expected to reduce as other automobile manufacturers produce more zero emission vehicles themselves and the need to buy credits lowers. Although revenue from regulatory credits has been volatile for Tesla in the past, future revenue is assumed to stay constant at 3.3% of automotive revenue until 2026. After 2026 it is assumed that revenue from these credits will reduce to 0% of automotive revenue by 2031 (Kharpal, 2021).

5.1.3 Forecasting revenue from energy generation and storage

Tesla is focused on ramping up production and installation of energy storage and solar energy systems. In 2021, 3.99 GWh of energy storage was deployed, and 345 MW of solar energy systems (Tesla, 2022a). Tesla has seen a number of big utility scale installations in recent years, with an order backlog going into 2023 (Lambert, 2022c). The stationary energy storage market size in 2021 was estimated to be $31 billion, and is expected to grow to $224 billion in 2030 (Precedence Research, 2022). Tesla's energy generation and storage business generated 2.79 billion in revenue in 2021 (Tesla, 2022a). Tesla's solar deployment dropped since the acquisition of SolarCity, and it has picked up in recent quarters as seen in Appendix 6. Tesla solar panels and Solar Roof is only possible to buy with an accompanying Powerwall, advertising it as a full home energy setup for storing energy and charging a Tesla vehicle (Tesla, 2022g). While these synergies are there, there are a number of inherent issues with the production, including low margins and a complex installation process, as mentioned in *4.3 Energy generation and storage industry,*, Looking at the global market, rooftop installations which are Tesla's primarily installations, also carries a number of issues and is less efficient than utility-scale installations (SolarPower Europe, 2021). The growth in 2021 was primarily driven by Megapack deployment, which also has the most future potential when it comes to energy storage (SolarPower Europe, 2021; Tesla, 2022a). The researchers estimate the energy generation part of the category to not be a significant part of future revenue for the category. Most recently, Tesla paused the installation of its Solar Roof in March 2022 due to supply chain issues (Lambert, 2022b). This could suggest that Tesla would seek to not have solar installations as part of its future business. Tesla's current strategy to deal with supply chain issues is to prioritize its vehicle production and divert excess battery cells to energy storage. The same is the case with the lack of semiconductors. Tesla revenue of total energy storage market size was 8% in 2020 and 9% in 2021 as seen in Appendix 14. The researchers assume that Tesla can capture 5% of the market in 2030 and 2031, accounting for $13.66 billion in 2031. The number can be supported by forecasts from Bloomberg, estimating Tesla revenue from energy generation and storage to be $14 billion in 2030 (Bloomberg, 2022).

5.1.4 Future production facilities

The validate the vehicle production forecasts a closer look at Tesla's future production facilities is needed. If the forecasted production ramp-up is too aggressive Tesla will not be able to scale its business at a high enough rate to keep up with demand. A deep dive into the future regional demand for Tesla's vehicles is also need since production facilities will likely be located in these areas based on Tesla's host-market production strategy (Tesla, 2020c).

5.1.4.1 Future vehicle production facilities

As a result of stricter environmental regulations on manufacturers, Europe and China are the two main markets for EV production in the near future (Macquarie Research, Hong, Park, et al., 2021). As mentioned earlier, the U.S. are putting restrictions on car makers, but not to the extent of China and Europe currently. Looking at production by region, China is expected to further accelerate its production of EVs to 5.8 million units in 2027, up from 552.000 units in 2017. China is the global leader in EV production with 57% in 2017 but is expected to see slight decrease to 44% in 2027 as other regions' production volume grows. However, the Chinese market will continue to dominate production in the future (Brinley, 2020). One of the markets to grow in production is Europe, where the production is expected to reach 3.87 million vehicles in 2027 with a 29% share of global production. North America is continuing to be the third largest production region through 2027, growing from 141.000 EVs in 2017 to 1.52 million EVs in 2027, accounting for 10% of total light vehicle production in the region. The stricter regulations in Europe and China, combined with a slower demand increase in North America, result in carmakers deciding to delay launches for EVs in North America and focus on other markets first (Brinley, 2020).

Automotive manufacturers often produce vehicles in the same region that they are to be sold (Nieuwenhuis & Wells, 2015). The concept is known as host-market production and firms choosing this strategy for their global production can be due to several reasons. The availability and cost of suppliers, logistics cost and time, tariffs, and access to knowledge. The logistics cost and time is often one of the main reasons for companies to choose host market production, considering the value-to-weight ratio of the product. High value density products like cars, are more viable to ship globally than inexpensive ones like soda for instance (Hsuan et al., 2015). In the automotive industry, one of the main reasons for host-market production is the popularity of different models in different markets. As mentioned in *4.1.5 Industry rivalry*, different markets favor different types of cars, leading automakers to produce these in the market (Nieuwenhuis & Wells, 2015).

The global passenger vehicle production was 57 million units in 2021. Global production is dominated by Asia, and specifically China, producing 21.4 million vehicles in 2021, making up 36% of global production. Japan is the second biggest individual producer globally and in the region with 6,6 million vehicles, followed by India with 3.6 million units and South Korea with 3.2 million units. Europe was the second biggest region, producing a combined 11.3 million vehicles, 19.8% of global production, with Germany being the biggest individual producer of 3 million units. North America has a relatively small part of global production, producing a total of 2.5 million cars, and the U.S alone produced more than 1.5 million of them, 2.6% of global production. This leaves plenty of room in other markets for Tesla to produce. While global production has decreased 15% from 2019-2021, there has been an increase in 2020-2021 of 2%.

China was the only major production country to not have a decrease in production over the period 2019-2021. There was a slight decrease in production in 2020, but almost no change over the period. This is compared to other major producers like Europe and the U.S. with 26% and 38% decreases respectively. China saw a 7% increase in 2020-2021, with Europe (-5%) and the U.S. (-19%) production numbers continuing to decrease (OICA, 2021a).

As stated in Tesla's 2020 Impact Report, while formerly producing in one location and exporting globally, their new production facilities are meant to produce and deliver vehicles locally in its three major markets of North America, Europe, and China. This strategy also goes for suppliers, with 86% of components for Model 3 and Y produced in Shanghai coming from China (Tesla, 2020c). Tesla's production in Shanghai will reduce logistics and manufacturing costs, as well as tariffs, and make vehicles more affordable (Tesla, 2022a). As previously stated, the current Shanghai Gigafactory had a capacity of over 450 thousand units in 2021 and is on track to produce 600 thousand in 2022 with the long-term goal of 1 million units annually. In November 2021, Tesla announced plans to invest $188 million to expand Gigafactory Shanghai, without specifying the increase in production capacity (Reuters, 2021b). Shanghai currently functions as Tesla's main export hub for markets like Germany and Japan, with half of vehicles exported globally. There are reports of Tesla planning a second Gigafactory in Shanghai, with the ability to produce 2 million cars annually, underlining the strategic importance of China for Tesla's future production (Reuters, 2022). Compared to other automakers producing in China, Tesla is the first and only foreign company to produce without being part of a joint venture with a Chinese company (Reuters, 2021b). If Tesla can keep this competitive edge, it could create an even bigger incentive to expand production in China. Considering current production plants by other automakers, one plant producing 2 million vehicles annually would make it the biggest plant in the world by capacity. The world's biggest factory, Hyundai's Ulsan plant in South Korea, produced 1,5 million vehicles in 2019 (Statista, 2021a). As mentioned, Tesla's Fremont plant has the biggest single factory output in North America with an average of 8550 units weekly in 2021, and an estimated 444 thousand units yearly. The Nissan Smyrna plant had the biggest output in a year with 645 thousand units during the year (T. Randall & Pogkas, 2022). Texas Gigafactory is expected to produce 500,000 vehicles annually in 2023 according to Musk (Ohnsman, 2022b). Tesla Berlin Gigafactory will have a capacity of 500 thousand vehicles, and according to JPMorgan, production ramping will happen gradually towards 2025 (Mihalascu, 2022b).

The table in Appendix 15 shows the forecast for the future production facilities for vehicle manufacturing and their capacity, based on the analysis. While Tesla's capacity utilization rate in its Fremont factory is greater than the industry average in North America, the researchers believe that Tesla can further improve this in the future due to its production capabilities. The capacity utilization is believed to be even greater for the company's purpose-built factories like the ones in Shanghai, Berlin, and Austin, where production layout can maximize efficiency. The vehicle production forecast shows the maximum capacity of current and future facilities in units in Appendix 15. As highlighted previously, the researchers estimated an 85% capacity utilization rate for future production facilities. Tesla has shown their ability to build factories that have a more efficient output than competitors. While the conditions in China could make it possible to build one plant that could eventually rival the output of Hyundai's Ulsan plant and eventually produce 2 million cars annually, the researchers estimate other new Tesla facilities to have a lower output. The estimated yearly production capacity for future factories not discussed specifically, but it is estimated to be 500 units yearly when fully developed based on competitor's factory outputs. In regard to production ramping, the researchers expect Texas Gigafactory to have a similar capacity in the first year as Gigafactory Berlin (100 thousand vehicles). The researchers estimate that future factories are able to have similar capacity in the first year. The ramping is estimated to increase by 250 thousand vehicles annually per factory, based on Gigafactory Berlin and Gigafactory Texas estimations. Based on the two factories, it takes about two years to establish a new factory, Texas Gigafactory taking two years to complete and Berlin two and a half. Based on the current timeframe between a new Tesla production facility, the researchers estimate a new factory every 3-4 year is realistic, which also fits with capacity demand in the forecast.

For potential future Gigafactory locations, Tesla has made moves to explore Indian suppliers, creating rumors of a future factory in India (Reuters, 2021a). Other big production countries like Japan function as a major exporter of left-hand drive cars, exporting almost half the vehicles produced in the country (Statista, 2022a). The specific locations of future plants are also based on Tesla's strategy of host-market production, which would suggest that factories should be distributed globally based on sales regionally.

5.1.4.2 Future battery production facilities

As stated throughout the analysis of Tesla, its battery production is a central of part of its business. Batteries are one of the main costs of the vehicle production and Tesla seeks to decrease the cost in various ways, Tesla does have the ambitions to produce more of its batteries themselves, cutting down expensive materials like cobalt, and taking more control over its raw materials suppliers (Jin, 2022; Petrova, 2021; Tesla, 2020c). Tesla is however for the foreseeable future dependent on strategic partnerships with battery producers like Panasonic. Tesla's Nevada Gigafactory is built and operated as a joint venture together with Panasonic. The factory's current output is 35 GWh battery cells annually and is under expansion to produce 38-39 GWh yearly. In 2021, the Nevada Gigafactory reached 1 million EV battery packs produced since the opening in 2017 (Kane, 2021b). The joint venture with Panasonic is expected to go ahead with the production of Tesla's new 4680 batteries at Panasonic's plant in 2024. The construction of two new factories are also part of the future plans (Kelly, 2022).

The Berlin Gigafactory will also be producing batteries besides vehicles. According to Elon Musk, the plant will become the world's biggest battery production plant with 100 GWh capacity annually. Long-term goals are expanding this up to 250 GWh annually (Franke, 2020). As of now, the plant will produce 50 GWh of batteries when full capacity is reached (Mihalascu, 2022b). Europe is expected to increase its global production share to 25% in 2025, with Germany accelerating production significantly. European production is led by Tesla's Berlin Gigafactory, with LG Chem producing 70 GWh in Poland, and Northvolt producing 48 GWh in Sweden and Germany. The biggest global battery producer in 2021 is China with 558 GWh, which is expected to increase in the future to 944 GWh in 2025, continuing to produce the majority of batteries globally (Yu & Sumangil, 2021). S&P Global Market Intelligence expects global production to be 1447 GWh in 2025, with Elon Musk suggesting the need for 1,000-2,000 GWh annually for future energy storage demand (Bellan, 2021; Yu & Sumangil, 2021).

Due to current supply chain issues, Tesla asked cell manufacturers to double the supply in 2022, and vehicle production is prioritized over battery packs (Bellan, 2021). For the researchers forecast, the estimations of future battery production facilities and capacity, are based on Tesla's current strategy of prioritizing vehicle production. The calculations can be seen in Appendix 14. The forecast is based on the kWh battery capacity of each vehicle and the battery capacity needed to satisfy future vehicle production. Model S and Model X have a 100kWh battery, and Model 3 and Model Y 82 kWh (ev-database.org, 2022). The capacity of the Cybertruck battery is still unknown, but the model is announced to come in three trim levels, with a speculated capacity between 100 kWh to 200 kWh (Kane, 2022c; Lambert, 2021c). The researchers selected an average of 150 kWh for the calculations based on these speculations. For other future vehicles, Elon Musk has suggested the Tesla Semi to have a 500 kWh battery (Lambert, 2021a). The upcoming Roadster is reported to have a 200 kWh battery according to Tesla (Nedelea, 2021). For future passenger cars, the researchers estimate the passenger cars to have the same battery capacity as existing models with 82 kWh based on their size and price points. The van is estimated to have a slightly bigger capacity than the Cybertruck at 200 kWh (Appendix 14). Increased range in future vehicles are not necessarily up to increased battery capacity, but is reached through a more efficient powertrain, improved aerodynamics, lighter weight, and the new 4068 battery (Lambert, 2021c). Additional to the vehicle battery demand, energy storage demand is also estimated. In 2021, 3.99 GWh of battery capacity was deployed (Tesla, 2022a). Previous years saw deployment of 358 MWh in 2017, 1.04 GWh in 2018, 1.65 GWh in 2019, and 3.02 GWh in 2020 (Tesla, 2018, 2019b, 2020a, 2021a). Total global installation was 22 GWh in 2021, with Tesla having 18% of global installations (Colthorpe, 2022).

As mentioned, Tesla's current strategy is to divert supply to its vehicle manufacturing. The forecast therefor assumes deployment to be the same in 2022 due to the supply chain issues facing Tesla. In 2021, Tesla diverted 5% of its battery production to its energy storage business Appendix 14. The researchers estimate that Tesla will divert 5% of its battery production to its energy storage in the future as well. This gives 23 GWh of battery production in 2031 for Tesla's energy generation and storage (Appendix 14). According to BloombergNEF's forecast, the energy storage market will grow 30% CAGR towards 2030. Installations in 2030 will reach 178 GWh annually in 2030 (Colthorpe, 2022). With Tesla's forecasted 20.4 GWh production in 2030, they will produce 11% of global energy storage installations.

As stated above, production output of Nevada Gigafactory is 35 GWH, expanding to 38-39 GWh, and Berlin is set to be the biggest battery production facility with 100 GWh with the goal of expanding to 250 GWh. In Appendix 14 it is stated that Tesla need to expand with 5 factories by 2031, with an output of 100 GWh, to keep up with future demand. The estimations for the number of Gigafactories needed, exclude any purchase of battery cells from other suppliers as Tesla currently does from LG and CATL.

5.2.1 Operating margin

The model for estimating Tesla's share price is anchored in the revenue forecast from its different businesses. Operating margins are therefore estimated based on these revenue streams. In the estimating of the revenue stream from vehicles sold the selling price of each model has already been determined and will not be affected by the change in operating margin. Consequently, it is assumed that a decrease in operating margin will not affect the consumers but rather Tesla through lower profit. The following three chapters Tesla's revenue expenditures, cost of goods sold, SG&A, and R&D, will be investigated to estimate the future EBIT margin or pre-tax operating margin, as a guidance a target operating margin will be used. By finding the desired operating margin in the terminal period it is possible to converge the existing margin to achieve this. In doing, so selling, general, and administrative expenses and research and development expenses will be individually estimated, while cost of goods sold will be estimated to match the desired operating margin for the given year.

As a target for estimating the operating margin the terminal period will be used, where Tesla reaches a stable growth, in the year 2032. In doing so Tesla's operating margin will be compared against benchmarks from other industries. As discovered in *chapter 4.4 financial analysis* Tesla's 2021 fourth quarter operating margin was 14.7%, which is the highest for any quarter in the history of Tesla. The margin has been growing over recent years, and we believe that this will continue. In comparison, the average pre-tax operating margin from the top 75th percentile automotive firm's is 8%. The pre-tax operating margin has been found by filtering for automotive manufactures and then selecting the 75th percentile.

In comparison the median operating margin for U.S. firms is 11%. However, based on the findings in the strategic analysis and the financial analysis it is believed that Tesla could be amongst one of the top 75th percentile of all manufacturing firms. The average operating margin for these firms is 16%. It is estimated that Tesla will reach this target by the end of the detailed forecasting period, in the year 2026. For the detailed forecasting period it is expected that the operating margin will steadily increase.

5.2.2 Cost of goods sold

Tesla's cost of goods sold consists of costs related to its automotive sales, automotive leasing, services and other, and energy generations and storage segment. Unlike other automotive manufacturers Tesla does not provided cost of goods sold in their filings, instead the company reports cost of revenue. As noted in *4.1.5 industry rivalry* Tesla uses its own distribution channels and have limited marketing expenses items that would normally be included cost of revenue. However, for Tesla costs associated with the sale of vehicle through its own dealerships are included in SG&A expenses (Tesla, 2022a). Consequently, the researchers assume that cost of revenue is equal to cost of goods sold for Tesla. In 2021, the total cost for all segments was $40.2 billion, whereas $32.4 billion came from automotive sales (Tesla, 2022a). Cost of automotive sales revenue includes a wide arrange of costs related to car production, sales, and car infrastructure. Direct and indirect costs of materials, labor cost, manufacturing overhead, depreciation of tools and machinery, shipping and logistics, vehicle connectivity, electricity, and infrastructure cost of Supercharger network, and write downs of inventory. These costs increased 65%, $12.7 billion, from 2020 to 2021, mainly due to an increase in deliveries of Model 3 and Model Y. The opening of Gigafactory Shanghai meant a change to the regional production mix, lowering the average Model 3 and Model Y cost per unit due to localized procurement and manufacturing. This also increased the automotive gross margin from 25.6% to 29.3% (Tesla, 2022a). Cost of automotive leasing revenue also increased in 2021 by $415 million (74%), mainly due to an increase in vehicle leasing and sales-type leasing caused by more vehicle sales in 2021 (Tesla, 2022a). Costs associated with services and others are cost of after-sales services, refurbish cost of used vehicles, retail merchandise, vehicle insurance, and direct and indirect costs for subsidiaries and third-party customer sales. This increased $1.24 billion (46%) in 2021, mainly due to increased used vehicle costs of revenue (Tesla, 2022a).

For Tesla's energy generation and storage segment, cost of revenue increased $942 million (48%) in 2021. Costs consist of direct and indirect material and labor costs, rent, freight, warranty, overhead costs and amortization of intangible assets, maintenance, and amortization costs of solar energy systems, and write down of inventory. Costs were mainly driven by increase in installments of Solar Roof, Megapack and Powerwall. Gross margin for the segment decreased from 0.9% in 2020 to -4.6% in 2021. Higher deployment of Solar Roof which has lower margins, combined with fixed costs associated with Powerpack were the main reason for the decrease, partially offset by the increase in Powerwall and Megapack with better margins (Tesla, 2022a).

From the analysis of Tesla's current and future business, the researchers identify a number of main elements to determine the future cost of goods sold. Tesla's main cost of goods sold is its automotive sales, which will increase in the future due to an increase in units sold, as seen during 2021 (Tesla, 2022a). Cost of materials is likely to increase in the future, mainly due to the increased cost of raw materials associated with batteries, as this is the main cost of EVs. With Tesla's efforts to secure more of its supply chain to increase resilience, such as exclusive deals with suppliers, the researchers believe that this can help counter the increased costs and ensure supply. Tesla's joint venture with Panasonic is a key to their competitive advantage in battery technology. As mentioned, 90% of Panasonic's battery supply is to Tesla, and the company is looking to change this and potentially sell batteries to other automakers. This could increase battery costs for Tesla's because they are not able to uphold the same dominant relationship with Panasonic as other automaker's demand for batteries increase. Despite Elon Musk's goals for Tesla to produce its own batteries, the company will remain heavily dependent on battery suppliers and its joint venture with Panasonic in the coming decade. Labor cost and manufacturing overhead is also expected to increase due to an increase in production facilities and staff, but host-market production will offset this cost due to a decrease in average cost per unit. New production facilities also require heavy investments in machinery like industrial robots to run an efficient production line. This is an important part of Tesla's production capabilities, and a main driver for increased efficiency in the future. Tesla is currently producing the majority of its vehicles at the Fremont plant in the U.S., shipping it to customers globally. With the introduction of host-market production, Tesla can lower the costs of shipping and logistics due to local sourcing and distribution of vehicles. It is assumed that most vehicles produced will be sold in the local market, except Chinese production which will still have a large amount of export.

For energy generation and storage, especially Powerwall and Megapacks will cause an increase in costs, due to more deployments. Better margins on these products compared to Powerpack and Solar Roof will see increased gross margins for the segment. Tesla's future deployment of solar panels and Solar Roof have seen increased deployment in recent years, but problems like thin margins and complex installations are still to be addressed. It is estimated by the researchers that the energy generation will not account for a significant part of Tesla's future revenue for the category.

Tesla costs of revenues was 83% of revenue in 2019, 79% in 2020, and 75% in 2021. At the same time gross margins grew from 16.6% in 2019, 21.0% in 2020, to 25.3% in 2021. Specifically for the automotive business, gross margin grew from 21.2% in 2019, 25.6% in 2020, to 29.3% in 2021 (Tesla, 2022a).Gross margin for Tesla's automotive business was 30.6% of revenue in 2021. This is much higher than other automakers like Volkswagen (17.8%), GM (14.2%), and Ford (12%) (Guilford, 2022; S&P Capital IQ, 2022d). Despite future challenges in production, Tesla are aiming to keep up the high gross margins by improved production efficiency and keep future costs down (Guilford, 2022)

Compared to other established automotive manufacturers, Tesla's 2021 cost of revenue of total revenue is relatively stable. Volkswagen AG had 250€ billion in total revenue with 164€ in costs of goods sold, 65.8%. The cost of goods sold includes R&D expenses (S&P Capital IQ, 2022d). General Motors Company had revenues of 127$ billion in 2021 with 100$ billion in COGS, making it 79% of revenue. The same goes for Ford Motor Company with 84% of revenue, 136$ billion in revenue and 114$ billion in COGS. This also includes R&D expenses (S&P Capital IQ, 2022b). Including Tesla's R&D costs in its cost of revenues, the cost of revenues accounts for 79.5% of total revenue (Tesla, 2022a). In the estimation of cost of goods sold, SG&A and R&D expenses are kept constant, and COGS is estimated based on operating margin.

5.2.3 Selling general and administrative costs:

Selling, general and administrative (SG&A) expenses consist of expenditures related to the personnel and facility costs associated with running Tesla's stores and showroom. Furthermore, these expenses also relate to a wide range of expenditures related to Tesla administrative operations such as finance, legal organizations, information technology, marketing, executive, and human resources. Additionally, costs associated with litigation settlements are also included under SG&A. Settlements, such as the ongoing trial over the acquisition of SolarCity (Tesla, 2022a).

In 2021 expenses related to SG&A increased by $1.37 billion or 44% compared to the previous year. The increase in SG&A spending was primarily due to an increase of $568 million in employee and labor costs related to the increased headcount and an increase in payroll taxes. Additional payroll tax amounting to $340 million stems from Elon Musk's option exercises that was awarded to him in 2012. However, SG&A expenses as a percentage of revenue decreased in 2021 to 8% from the year before where this ratio was 10%. Tesla self explains that this decrease in SG&A expenses stems from operational efficiencies (Tesla, 2022a). The historical relationship between Tesla's SG&A expenses and revenue can be found in appendix 16. SG&A expenses as a percentage of revenue are expected to fall to 6% in 2022 and then stay flat at 5% per year over the forecasting window. This is lower than that of the competitors because Tesla, compared to other automakers, spends a minimum amount on advertisement. In 2021 General Motors and Ford spent $3.3 and $3.1 billion on advertisements, which is a cost also included in SG&A. The reason why SG&A expenditures are not lower is because Tesla is expecting to increase its staff proportionally to the expansion of its production. As production volumes grow administrative costs are also expected to increase. As describe in *5.1.4.1 Future vehicle production facilities* and *5.1.4.2 Future battery production facilities* is expecting to build several new factories around the world which will drive up expenses related to the administration of an increasing global production supply chain.

5.2.4 R&D expenditures

Tesla's R&D expenses were $2.5 billion in 2021, up $1.10 billion from the previous year (+74%). The main contributor to the increase was an $506 million increase in employee costs due to more employees, $263 million increase in R&D expensed materials, $211 million in facilities, and $103 million in stock-based compensation expenses. The increased cost supported vehicle and battery development, as well as pre-production expenses for the Gigafactory Texas and Gigafactory Berlin (Tesla, 2022a).

Tesla's historic R&D expenses as a percentage of total revenue can be found in the appendix 17. Further examining this ratio shows that the fraction Tesla has spent on R&D expenditures over the years has decreased, from +20% of total revenue down to 6%. The high R&D expenses are mainly due to the development of production and technology in previous years (Valentin, 2018). As Tesla revenue is expected to grow in future years, so is the dollar amount spent on R&D also. Established automotive manufactures are spending the highest nominal amount on R&D. In 2020 the top five spenders on R&D were Volkswagen with $16.5 billion, Mercedes with $10.21 billion, Toyota with $9.87 billion, Ford with $7.1 billion, and General Motors with $6.2 billion (Bajpai, 2021). In comparison Tesla spent $1.49 billion on R&D in 2020. However, Tesla's sales numbers are still modest compared to other automotive manufacturers, as a result Tesla is the automaker which spends the most on R&D expenditure per vehicle (Lambert, 2022d).

As mentioned, Tesla has spent a large percentage of its revenue on R&D in the past when developing battery technologies and scaling production. This is one of the reasons why Tesla has been able to develop some of the most efficient BEV's on the market at a lower price point than competitors with similar range (Valentin, 2018). Future investments in R&D are key in Tesla's efforts to stay ahead of competitors. The battery pack is a fundamental part of BEVs and the main cost of the vehicle, making development of this key. Tesla's joint venture with Panasonic has been central to the development of its current battery competences and will require further investments in the future. Panasonic's sales of 90% to Tesla is not considered sustainable in the future, as Panasonic is looking to sell more to other automakers (Kane, 2021a). Investments from Tesla in the joint venture could sustain the partnership, as we see other automakers and battery manufacturers creating joint ventures. The partnership between Stellantis and LG Energy Solution in battery production in North America sees a €30 billion investment in R&D through 2025. The aim is to sustain a 30% more efficient Capex and R&D spend versus revenues compared to the industry (Stellantis.com, 2021). It would also be assumed that a joint venture would be a more efficient use of R&D expenses, drawing on the expertise from the specialised partner.

To estimate the future ratio of R&D expenses to revenue for Tesla, a closer look at its competitors is needed. Looking at more established firms than Tesla is a good indicator for how Tesla's future spending will develop. Since Tesla has spent a proportionally large amount on R&D in recent years to get the business going, it is expected that the future R&D expenses will closely follow that of the industry average. There is a limit to the amount spent on R&D before it is not efficient any longer. A further examination of the industry R&D-to-Revenue spending reveals that all the major established automotive manufacturers spend about 4% - 6% of revenue on R&D, calculations can be found in Appendix 17. Therefore, a 5% spending on R&D has been chosen for Tesla for the forecasting period for the initial DCF valuation.

5.2.5 Other operating expenses cost

In 2021, Tesla brought $1.5 billion worth of Bitcoins and sold a portion of this in March 2021, from this transaction Tesla realized a gain of $128 million. However, the price of Bitcoins fell in 2021 and Tesla recorded $101 million of impairment losses on the cryptocurrency. Therefore, a combined loss of $27 million was recorded on the 2021 income statement as restructuring and others (Tesla, 2022a). The accounting principles of which Tesla follows does not record gains from the sale of Bitcoins until realized upon sale(s), where the gains are presented net of any impairment losses(Tesla, 2022a). However, for the estimations of Tesla's enterprise value it is not expected that Tesla will invest any further in any cryptocurrency, as this is highly speculative to assume. Therefore, no income from other operating expenses will be included in the cash flow forecast.

5.2.6 Taxes

Tesla has only had a positive net income in the fiscal year ending on December 31st, 2020, and 2021, where the company had an effective tax rate of 25.3% and 11.02% respectively. When estimating the free cash flow to the firm the actual taxes paid for the firm cannot be used. The issue is that the benefits from these taxes have already been accounted for in the weighted average cost of capital since the after-tax cost of debt is used. The actual taxes include the tax benefits Tesla has received from making interest payments. Instead, it is a choice between marginal and effect tax rates, where the marginal tax rate will be lower than the effective tax rate due to the option of tax deferral. Since Tesla is a multinational company and operates in several different counties with different tax rates, (Damodaran, 2006) argues that utilizing the marginal tax rate makes far more sense than using an average tax rate, weighted by the income from each country. He argues that using the marginal tax rate of the country where the firm is domiciled in is a more accurate approach, since the income earned in each of the countries eventually must be repatriated back to the domicile where it will be taxed. Of course, this is only applicable when the tax rate in the foreign market is lower than the tax rate in the domestic market. In 2021 45% of Tesla's revenue came from the U.S. market where the corporate tax rate is 21%. In Tesla's other primary market China, the corporate tax rate is 25%, whereas the remaining 30% of revenue came from other markets. It is therefore difficult to tell what the weighted tax rate for Tesla is since the markets are not disclosed. (Damodaran, 2006) has estimated the average marginal tax rate for 26 U.S. companies in the auto & truck industry. Out of these companies an average marginal tax rate of 17.05% has been estimated for the money-making companies (Damodaran, 2022a). Tesla's 2021 effective tax rate was slightly lower at 11.02%, this is the tax rate that will be used in the five-year detailed forecasting period (Tesla, 2022a). However, Tesla cannot keep deferring taxes forever and will eventually have to pay taxes. Therefore, after the initial five years the tax rate will incrementally ramp-up with an 17% increase every year to a marginal global tax rate of 23.79%. The reason why a global tax rate is used is because Tesla is a world-wide company (KPMG, 2022).

5.2.7 Reinvestment rate

In the following chapter Tesla's reinvestment rate will be estimated, which measures how much capital Tesla is using to generate future growth. The reinvestment rate consists of the firm's capital expenditures, depreciation, change in noncash working capital, the tax rate, and EBIT. The relationship between these components can be seen in equation (5.0)

$$Reinvestment\ rate = \frac{Capex - Depreciation + Change\ in\ Working\ capital}{EBIT(1 - Tax\ rate)} \quad (5.0)$$

Following Damodaran's, (2006) approach the cash flow to the firm is computed after reinvestment. Reinvestments consist of two components: net capital expenditures, the difference between capital expenditures and depreciation, and the other component investment in working capital. It is rather difficult to estimate the individual items that make up the reinvestment rate, which is why the reinvestment rate is used to estimate the free cash flow (Damodaran, 2006). To get a better understanding of how Tesla's reinvestment rate will develop over the forecasting period, the different items that make up the reinvestment rate are examined. As highlighted in Tesla's annual report, the company's capital expenditure is difficult to forecast beyond the short-term as project conditions change over time. Ramping up manufacturing in multiple locations, along with the development of new battery technologies will cause capital expenditure to change depending on the priority and development of planned and future projects. Tesla expects that capital expenditures for 2022 and the following two fiscal years will be between \$5-\$7 billion (Tesla, 2022a). Tesla's current business generally funds itself through its growth. A number of capital-intensive projects are expected in the upcoming periods to sustain the future growth (Tesla, 2022a). As part of Tesla's current investments in production plants, it has a number of commitments regarding their capital expenditures. For the Gigafactory in New York, Tesla has committed to spend or incur a \$5 billion investment, including capital expenditure, operational expenses, COGS, and other costs from 2021 through 2029 (Tesla, 2022a). Similarly, the Shanghai Gigafactory also has obligations to spend RMB 14.08 billion (\$2.21 billion) in capital expenditures by the end of 2023 (Tesla, 2022a).

Next, a closer look of Tesla depreciation and amortization expenses is taken. For Property, plant and equipment Tesla uses a straight-line method over the estimated useful life of the asset. Tesla uses an estimated life span for machinery, equipment, vehicles, and office furniture of 3 to 15 year, while tooling has an expected lifespan of 4 to 7 years, building and building improvements 15 to 30 years, and computer equipment and software 3 to 10 years. Therefore, it is difficult to estimate future expenses related to depreciation and amortization, since it depends on future PP&E spending and the specific type of asset. As it is expected from our forecast, Tesla's future production rate is expected to increase as the company grows. It is assumed that Tesla will build several new automotive manufacturing facilities and battery production plants, which will result in an increase of PP&E expenditures. Therefore, it is expected that depreciation and amortization will increase over the upcoming years, since these facilities, tooling, and machinery have not had any time to depreciate. Compared to other more established automotive manufactures, where building might be fully depreciated.

Depreciation and amortization are strongly related to capital expenditures, since it is these assets that will be depreciated. It is therefore common practice to estimate depreciation and amortization as a percentage of capital expenditures. Additionally, the best approach of estimating the relationship between the two, is to look at an average for a subset of firms that are in the same stage of their life-cycle as Tesla (Damodaran, 2006). However, there are not many automobile manufacturers in the same life-cycle stage as Tesla. Many newly started electric vehicle manufacturers have not scaled up their production to the level of Tesla. Since the purpose is to estimate the future cash flow, and as Tesla's is expecting to become a mature company, a better estimation is to use the average of established firms.

Finally, the change in noncash working capital is analyzed. To calculate the free cash flow to the firm for Tesla an understanding of how much cash Tesla is setting aside for working capital needs is needed, since increased working capital will reduce the cash flows. The net working capital for a firm is calculated as the change in working capital over a two-year period. The working capital for a given year is computed by total current assets and current long-term debt less cash and short-term investments, current liabilities, as well as any current leases. However, in this report this will be slightly changed, as investments in marketable securities and cash will be removed from current assets. The aim of this exercise is to measure the working capital for valuation purposes. Since firms usually invest cash in Treasury bills, commercial papers, and short-term government securities this will not be included in Tesla's working capital. The reason behind this is that these assets represent a fair return for riskless investments and will therefore earn a fair return but are not needed for operations and cannot be considered a wasting asset. An exception to this role is if the company needs a lot of cash for day-to-day operations, however in chapter *4.4 Financial analysis* it is discovered the that is not the case for Tesla (Damodaran, 2006).

Utilizing equation (5.0) it is possible to estimate the reinvestment rate for Tesla in 2021. For the fiscal year ending December 31st, 2021, Tesla's capital expenditures were $8,014 million, its depreciation and amortization expenses were $2,911 million, its change in noncash working capital was $5,535 million, its EBIT was $6,523 million, and its marginal tax rate was 11%. The reinvestment rate for Tesla in 2021 is estimated to be negative 7%, the computations can be found in appendix 18. Since Tesla made large investments in capital equipment and working capital in 2020, it was not necessary to invest as heavily in 2021 to gain a positive cash flow, which is the reason for the negative reinvestment rate. In comparison, Damodaran, (2022d) estimates the global reinvestment rate for the automotive industry to be 63.73%. To verify this hypothesis, the reinvestment rate for 2020 and 2019 have been estimated to be 847% and 21%, respectively. Much higher than the industry average, again indicating that Tesla investments are lumpy appendix 18. In 2020 Tesla had abnormally large amounts of cash and cash equivalents, which directly affects the reinvestment rate. Due to the high volatility in Tesla's reinvestment rate, using an average of previous years rates is not a good proxy for the future reinvestment rate.

In instances where the reinvestment rate for one year is much higher than the other an average of previous years reinvestment rate can be utilized. However, since the 2021 reinvestment rate is negative Damodaran, (2006) suggests estimating the based on improvements in return of capital, in doing so the sales-to-capital ratio is used. This ratio captures the amount of additional investments generated by an increase in revenue (Damodaran, 2006). To calculate the sales-to-capital ratio the book value of capital is needed, which is a combination of the book value of debt and the book value of equity (Damodaran, 2006). For 2021 and 2021 the sales-to-capital ratios have been estimated to be 2.35 and 1.79, respectively appendix 18. Low sales-to-capital ratios results in high reinvestment rates when revenue is kept constant. The estimated sales-to-capital ratios for Tesla results in the company spending more move on investments than what the company is making. Instead, the reinvestment rate of Toyota is used as a proxy for Tesla's reinvestment rate in 2022. The reinvestment of another more established automotive manufacturer, Toyota, is used as it is more likely Tesla will spend a similar proportion of its earnings on investment than continue overspending (Appendix 17). In appendix 19 the three-year reinvestment rate of Toyota has been estimated to be 68% between 2017 and 2019. The reason for not including 2020 and 2021 is because Toyota received a large amount of capital from short-term borrowings, related to the covid crisis (The Japan times, 2020). The reinvestment rate will directly be affected by the increase in working capital, and since it is not expected that the company will receive such loans within the next five years, the reinvestment rates for 2020 and 2021 are left out. It is assumed that Tesla will become a stable growth company by 2031. Therefore, the reinvestment rate must match the expected growth of a stable growth company. In the chapter *5.4 enterprise value* the expected growth rate is determined to be equal to the risk-free rate, in perpetuity. If the return on capital can be estimated the reinvestment rate will consequently follow, using equation (5.0.1) (Damodaran, 2006).

$$Expected\ growth\ rate = Reinvestment\ rate \times Return\ on\ capital \quad (5.0.1)$$

Damodaran, (2022d) has estimated the return of capital for global companies in the auto and truck industry to be 6.32% in 2021. In comparison, the return on capital for the software (systems and applications) industry has been estimated to be 93.67%. The reason behind this large difference in return of capital has already been covered in the chapter *4.0 strategic and market analysis* and is linked to the high entry-barriers in the automotive manufacturing industry. Manufacturers must invest large amounts of capital into machinery and production plants, compared to firms in the software sector. Because Tesla shares many similarities with companies in the software industry the return on invested capital has been estimated to be somewhere in between that of the two industries. The similarities between Tesla and tech companies are further specified in the chapter *4.1.5 Industry rivalry*. The return on capital is estimated to be 10% in the stable growth for Tesla, slightly higher than the industry average. Tesla is still a manufacturing firm and will not be able to achieve returns similar to those of the software industry. Using equation (5.0.1) the estimated reinvestment rate for Tesla in the stable growth period is 20.30%, which can also be found in appendix 23. The nominal amount of reinvestments for Tesla is consistent with the findings in this paper, since it is expected that Tesla will increase investment spending over the next few years. Investments in the imminent future will benefit the company and reduce the reinvestment spending as production efficiency increases. The increase in investment related to the opening of new battery and automotive manufacturing facilities is further described in the chapters *5.1.4.2 Future vehicle production facilities* and *5.1.4.2 Future battery production facilities.*

When estimating Tesla's enterprise value using a Discounted cash flow (DCF) method, the weighted average cost of capital (WACC) is used to discount the free cash flow to the firm (FCFF). To calculate the enterprise value of Tesla using the DCF-model the weighted average cost of capital or WACC must be determined. (Koller et al., 2015) present the following equation (5.1) to calculate the WACC:

$$WACC = \frac{D}{V} K_d (1 - T_m) + \frac{E}{V} k_e \qquad (5.1)$$

Where D/V is Tesla's target level of debt-to-enterprise value and E/V is the target level of equity-to-enterprise value, both ratios are estimated using market-based values. In the equation K_d is the cost of debt while K_e is the cost of equity, and finally T_m is the marginal tax rate for Tesla. The WACC represents returns from debt and equity invested in the company over an alternative investment in a risk-free investment. According to (Koller et al., 2015) the most difficult component of WACC to estimate is the cost of equity. There are several methods that can be used in estimating the cost of equity, ranging from the Analysis Process Model (APM), the proxy model, to the multifactor model. However, the standard approach is to use the Capital asset model (CAPM). The CAPM was introduced by several different authors and the concepts are mentioned in (Lintner, 1965; Mossin, 1966; Sharpe, 1964) and (Treynor, 1961, 1962).

$$E(R_i) = r_f + \beta_i [E(R_m) - r_f] \qquad (5.2)$$

By utilizing the CAPM formula it is possible to estimate the cost of equity for Tesla. The formula states that the risk-free rate denoted r_f plus the levered Beta of a given security B_i times the expected return of the market $E(R_m)$ subtracted by the risk-free rate equals the expected return of the given security $E(R_i)$.

Firstly, we start by computing the last term of equation (5.2) the equity risk premium (ERP), which represents the excess return over the risk-free rate. The equity risk premium, also known as the market risk premium, represents the rate of return from a risky investment such as an index fund less the return of a risk-free security. Certain criteria must be met to classify an investment as risk-free. Investors must be certain that there is no risk associated with the investment, consequently that the investment has no default risk and that there is no doubt and the reinvestment rate. Therefore, from a purist's perspective a U.S. Treasury bond cannot be used since the reinvestment rate of the coupons cannot not be predicted. This would require the risk-free rates for each period. However, the changes from year to year tend to be rather small for well-behaved term structures. It is therefore common practice to use the U.S. Treasury rate for valuations in U.S. dollars and use long-term rates for valuations over a longer period of time (Damodaran, 2006).

Damodaran (2012) argues that it is not sufficient to look at just the local market, for multi-international firms, such as Tesla (Damodaran, 2012). Since Tesla also operates outside of its main market, the American market, these markets must also be accounted for. Tesla breaks down its revenue for 2021 into 3 different regions: United States, China, and others (Tesla, 2022a). To compute the equity risk premiums for Tesla, we look at all the markets of which Tesla operates in, since the risk exposure is different from market to market. Moody's sovereign ratings provide an assessment of the creditworthiness of a specific country. Moody's classifies the U.S. as a Aaa rating and China as an A1 rating (Moody's, 2022). For the other countries that Tesla does not specify in its earnings report, a global average of an ERP of 7.18% is used. For a mature market such as the U.S. an implied ERP of 5.17% is used and for China an ERP of 6.15% has been used. This estimate has been retrieved from Professor Damodaran's website for the month of February 2022 (Damodaran, 2022g). There are several different approaches to estimating the country risk premium, the one used here is the relative standard deviation method. First the base premium for the U.S. market is found. Afterwards, equation (5.3) is used to calculate the risk premium for the other markets. Using the standard deviation of a broad-based index for the U.S. and China, such as the S&P 500 and the SSE index, it is possible to compute the equity risk premium for China.

$$Equity\ risk\ premium_{China} = Risk\ Premium_{US} \times \frac{\sigma_{China\ Equity}}{\sigma_{US\ Equity}} \quad (5.3)$$

Tesla's revenue is divided into regions based upon the sales location of its products, with 45% of Tesla's revenue coming from the U.S., and another 26% and 30% from China and other markets respectively in 2021 (Tesla, 2022a). With this information it is now possible to calculate the weighted ERP for each of the three regions and combine them into a weighted ERP for Tesla of 6.08%:

$$ERP\ of\ Tesla = 45\% \times 5.17\% + 26\% \times 6.15\% + 30\% \times 7.18\% = 6{,}08\%$$

To compute the cost of equity using the CAPM formula, the risk-free rate and the levered beta is also needed. The risk-free must be in the same currency in which the cash flow is estimated.

Therefore, the U.S. treasury rate has been chosen to estimate the risk-free rate. The risk-free rate has been estimated to be 2.03%, using a 10-year average which can be seen in Figure 12. The 10-year average is used to normalize the risk-free rate and also to make it easier when estimating the cost of debt and the cost of equity, since a 10-year forecasting horizon is used in the valuation of Tesla (Damodaran, 2006).

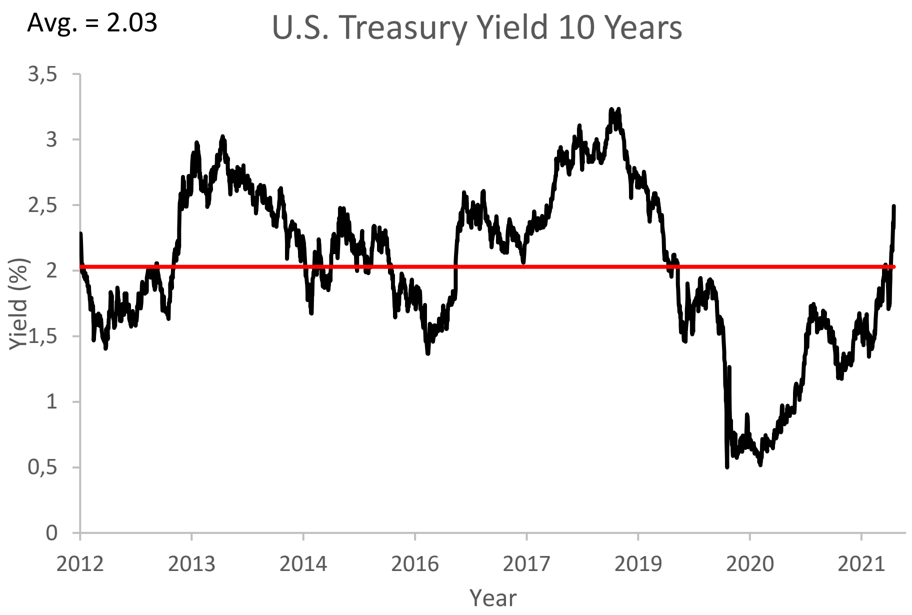

Figure 12 10-year average U.S. Treasury yield, Source: Yahoo finance

Additionally, when estimating the cost of equity, the levered beta of the stock must be determined. Koller et al., (2015) introduces several methods that can be used in the estimation of the beta of a security, for example multi-factor models such as the Fama-French 3 factor model or the covariance/variance method, which will result in different beta estimations. In this report the ordinary least squares (OLS) regression method has been used in estimating the leveraged beta of Tesla's stock. In Figure 13 a visual representation of the regression of the daily excess return of the Tesla stock against the daily excess return of the S&P 500 over the past five years, from February the 4th 2022. It is worth comparing the estimated regression beta of Tesla to companies that are facing similar market conditions, to see how Tesla is performing in comparison to these firms.

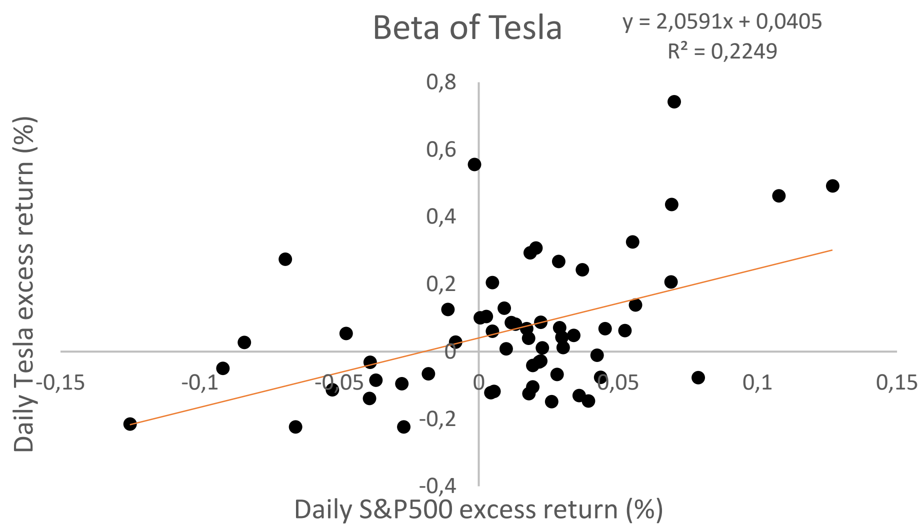

Figure 13 Regression beta of Tesla, Source Yahoo Finanace

When estimating the beta for Tesla using historic regression revealed a beta of 2.06 for Tesla. Compared to other automotive manufactures Tesla's raw regression beta is much higher than its competitors. For the same time horizon Ford has a beta of 1.10, General Motors 1.20, and Toyota 0.65 (Yahoo, 2022). Furthermore, the R-squared for the regression shows little correlation in the data sample, since the R-squared is only 22%. Additionally, the standard error of the beta is estimated to be 0.18, which means using two standard errors would show a range of the beta between 1.70 and 2.42. Therefore, to improve the accuracy of the beta estimation, an industry specific beta is used. By doing so estimation outliers will cancel out and provide a more accurate beta estimation (Koller et al., 2015). However, computing a raw regression on the betas of the sample firms fails to include the leverage factor of the financial risk investors take upon themselves when investing in a given company. The beta of a firm does not exclusively reflect the operating risk of a company, since it also includes the increased risk associated with greater debt. To combat the effect of this, the leverage must be excluded from each firm, so that firms with similar operating risks can be compared. This method builds the theories by Modigliani and Miller to remove the leverage and its tax shield (Koller et al., 2015).

To compute a more accurate beta for Tesla, the approach presented by (Damodaran, 2012) is followed. From the book the bottom-up beta method is used in the computation of the industry beta. The reason for using the bottom-up beta is that the standard error will be significantly lower than in a single regression beta. By using the law of large numbers increasing the sample size will provide a more representative beta estimation. The objective is to estimate Tesla's future beta and not its historic beta (Koller et al., 2015). When computing the cost of equity, high-growth firms tend to have higher betas and thereby a greater exposure to market risk then stable-growth firms. This is partly true since these firms tend to be niche players providing discretionary products and services and as a result having high operating leverage. This is also the case for Tesla if the market for electric vehicles is assumed to be separate market from that of traditional internal combustion engines. As the electric vehicle market and Tesla matures, they are expected to have less of an exposure to market risk and the beta will be closer to 1, or the average of the market.

The bottom-up beta approach has five steps. First, the industries that Tesla operates within must be established. From Tesla's 2022 10-k filing it is observed that Tesla primarily operates in two different industries: the automotive and the energy generation and storage industry. From the 10-k filing it can also be observed that a combined $2,789 million or about 5% of Tesla's total revenue in 2021 came from sales and leasing of energy and storage products. The remaining $51,034 million or about 95% of the business came from revenue related to the automotive production. However, using the weights obtained from the revenue is not necessary the most accurate approach, since different sector have different margins. Therefore, a more appropriate estimation is to calculate the average enterprise value for each of the two sectors, find the EV/sales ratio and multiply that by the revenue from each sector, giving us the value of each business. If a firm is operating in a low margin business the same revenue will have a lower value than in a high-margin business. In this case however Tesla energy generating and storage business only accounts for 5% of the company's combined revenue. Additionally, the EV/sales ratio for the two sectors are similar, with the auto & truck industry having 4.88 EV/Sales ratio and the electrical equipment a 3.98 ratio for the U.S. market in 2022 (Damodaran, 2022c). Therefore, the effect of the difference in margins is assumed to be negatable.

The second step is to find publicly traded firms that operate in the same industries. Starting with the automotive industry, a sample set of similar companies is obtained. Ideally, when estimating the industry beta, you want to compare businesses within the same markets, since they face similar market conditions. However, when analyzing the U.S. market, a significant spread in market capitalization and total enterprise value between the top 5 U.S. automotive companies and the rest of the industry was found. In his approach Professor Damodaran argues that if the sample size is not large enough to estimate a meaningful beta you may extend it to include firms in other regions. It can be argued that most large automotive companies operate, not only in a single market, but rather on the global market. Conclusively, they are facing similar market conditions regardless of their origin country (Koller et al., 2015). Argues a similar case in their example of Heineken's industry beta where they use beta estimates from companies such as Carlsberg to estimate the industry beta. Following this approach, a sample set of the 100 largest global automotive firms has been retrieved from Capital IQ. This sample size has further been reduced to 83 companies, removing companies that has been listed for under two years and companies with significant beta outliers. The raw beta for each firm in the sample set has been estimated using the market model (Koller et al., 2015):

$$R_i = \alpha + \beta R_m + \varepsilon \quad (5.4)$$

For U.S. companies the returns are regressed on the S&P 500 returns. For developed markets the returns have been regressed on the MSCI EAFE index and all other countries, such as China, the MSCI Emerging Markets have been used. The betas in the sample have been estimated using 2-year historical returns, thereby excluding recently listed companies such as Lucid motors, Rivian, Li Auto, and Xpeng.

The third step is to estimate the average unlevered beta for each of the industries that Tesla operates in. To estimate the industry unlevered beta, the debt-to-equity ratio and the effective tax rate of each firm has been computed. To estimate the unlevered beta Hamada's equation is utilized, which is based on the theories of Modigliani and Miller's (Hamada, 1972).

$$\beta_L = \beta_U \left[1 + (1 - t)\left(\frac{D}{E}\right)\right] \qquad (5.5)$$

Where β_L is the levered beta, t is the tax rate, $\frac{D}{E}$ is the debt-to-equity ratio, and β_U is the unlevered beta. When debt-to-equity ratio or the leverage increases so does the beta, since investors are exposed to a greater market risk from the company (Damodaran, 2006). To compute the industry average unlevered beta, equation (5.5) is restructured to solve for the unlevered beta. Data from the global automotive industry is used to estimate the unlevered industry beta. In the estimation data from the world's largest publicly traded firms based on market capitalization is used, which can be found in appendix 20 When computing the average market value of debt-to-equity for the industry an aggregated ratio is used, rather than the average ratio. By adding up total debt and total equity for all the firms combined, the effects of extreme outliers can be eliminated. To estimate the cumulative value of debt, the most recent debt level from the annual report in a Trailing twelve months (TTM) period for each of the companies is used. Thereby, assuming that the book value of debt is roughly equal to the market value of debt. The average levered beta for the 83 selected stocks in the automotive industry is estimated to be 0.99, the debt-to-equity ratio to be 70.12% and the effective tax rate for these firms is 21.43%. resulting in an unlevered industry beta of 0.64. Equation (5.6) is used to compute an unlevered industry beta of the automotive industry.

$$\beta_U = \frac{0.99}{1 + (1 - 21.43\%) \times 70.12\%} \approx 0{,}64 \quad (5.6)$$

Now that the unlevered beta for the automotive industry has been found, the beta for the other sector Tesla operates in, the energy and storage sector, must be found. The industry that most closely resembles this industry is the "storage batteries industry". Again, following the same approach as with the automotive industry, a global data set of Tesla's competitors in the storage battery industry has been selected. Since renewable and alternative energy solutions is an emerging industry the number of American as well as global firms is relatively scarce, however it is possible to college 42 companies within this industry after significant outliers have been excluded (Tryggestad, 2022). The average 2-year beta for the 39 companies in the sample is .749, with an average tax-rate of 18.96%, and a debt-to-equity ratio of 7.70%. The 39 firms and their subsequent data can be found in Appendix 21. The unlevered beta for the storage battery industry is computed in equation (5.7).

$$\beta_U = \frac{0.96}{1 + (1 - 21.5\%) \times 7.70\%} \approx 0{,}91 \quad (5.7)$$

The fourth step is using the weights of the different industries that Tesla operates in to calculate the unlevered beta for Tesla. The weighted average of the betas provided the bottom-up unlevered beta for Tesla, using the following formula, utilizing the already estimated weight for the two different business units:

$$unlevered\ beta_{firm} = \sum_{j=1}^{j=k} \left(unlevered\ beta_j \times Value\ weight_j\right) \quad (5.8)$$

Using the estimated weights and betas for Tesla's different businesses, the following bottom-up unlevered beta has been estimated:

$$0.64 \times 95\% + 0.91 \times 5\% \approx 0{,}65$$

Finally, in the last step five the estimated beta of Tesla can be determined, by first estimating the current market values of debt and equity to compute the debt-to-equity ratio. As of January 31^{st,}

2021 Tesla had 1,033,507,611 shares of common stock outstanding (Tesla, 2022a). On Friday February 4th, 2022, it is presumed that the number of common stocks was the same, on this day the closing stock price for the Tesla stock was $923.32, giving a total market value of equity of $954,258 million dollars. Next the market value of debt must be determined. (Damodaran, 2006) proposes that to convert the book value of debt into market value debt, the entirety of debt can be treated as a coupon bond. The coupon rate of this bond would be equal to the interest expenses on all of Tesla's debt, and the maturity of the bond would be a weighted average of the existing maturity of outstanding debt. S&P is currently valuing Tesla's credit rating at BB+, which is used in the computation of the cost of debt, which again is used to valuate this coupon bond (Cbonds, 2021a). Furthermore, the book value of debt must also be determined. From Tesla's most recent 10-K filing it is obtained that the company has a market value of debt for the fiscal year ending December 31st, 2021, of $8,904 (Tesla, 2022a). The book value of debt has been determined by adding the current portion of leases ($869), long-term debt ($4,285), and long-term leases ($2,662) to the current portion of long-term debt ($1,088) (Tesla, 2022a). To find the market value of Tesla's debt, the maturity of the outstanding debt must be converted into weighted maturity based on the face value of each security. In doing so an approximating how long there is until maturities have been made based on the maturities provided in Tesla's financial reports. The calculations behind the average maturity of Tesla's debt can be found in appendix 22. It is worth noting that the total debt in appendix 22 does not add up to what is on the balance sheet. This is likely since Tesla does not want to disclose the maturity of all its outstanding debt. The weighted average maturity of Tesla's debt has been estimated to be 2.40 years (Appendix 22). Damodaran (2006) comments on this approach saying that this is a sufficient method in estimating the average maturity of outstanding debt, even though you do not have complete access to the firm's outstanding debt (Damodaran, 2006). The risk-free rate has already been determined at 2.03% and will be used in combination with the credit spread of a security with a BB+ rating, to compute the pretax cost of debt using equation (5.9) (Damodaran, 2006):

$$Pretax\ cost\ of\ debt = risk - free + credit\ spread \quad (5.9)$$

$$Pretax\ cost\ of\ debt = 2.03\% + 1.93\% \approx 3.96\%$$

In the fiscal year ending December 31st, 2021, Tesla reported interest expenses of $371 million, which is used in equation (5.10) to estimate the market value of Tesla's debt (Tesla, 2022a).

$$Estimated\ MV\ of\ Tesla\ debt = \$371 \times \left[\frac{1 - \frac{1}{(1.0396)^{2.4}}}{0.0396} \right] + \frac{\$8{,}904}{(1.0396)^{2.4}} \approx \$8{,}945.35 \quad (5.10)$$

Using equation (5.10) the market value of Tesla's debt has now been found to be $8,945 million. (Damodaran, 2006) argues that the best source of the marginal tax rate is to use the tax code of the country where the company earns its operating income. However, for Tesla the company earns its income in a range of different countries, because of this the marginal global tax is used. As previously described in *5.2.5 Taxes* KPMG has estimated the global tax rate to be 23.79% (KPMG, 2022). Utilizing equation (5.5) the following leveraged equity beta of Tesla can be determined:

$$Equity\ beta\ of\ Tesla = 0.65 \times \left(1 + (1 - 23.79\%) \left(\frac{\$8{,}945.35}{\$954{,}258} \right) \right) \approx 0{,}65$$

Compared with the regression beta previously obtained for Tesla of 2.06 the bottom-up beta is closer to the average beta of 1.13 for the auto & truck industry in the U.S. as computed by Damodaran (Damodaran, 2022b). It is now possible to estimate Tesla's cost of equity utilizing the CAPM, equation (5.2), with the parameters, 2.03% for the risk-free rate, 0.65 for the beta, and 6.08% for the equity risk premium.

$$Cost\ of\ equity = 2.03\% + 0.65 \times 6.08\% \approx 5.98\%$$

The after-tax cost of debt must now be computed to estimate the WACC of Tesla. When estimating the enterprise value of Tesla using the DCF approach, the current cost of borrowing must be determined, which reflects the company's current credit profile. The reason for using the after-tax cost of debt over the pre-tax cost of debt, is due to the fact that interest expenses are tax-deductible. To calculate the after-tax cost of debt the formula presented by Damodaran, 2006 is utilized:

$$After - tax\ cost\ of\ debt\ for\ Tesla = (Risk - free\ rate + Default\ spread)(1 - Tax\ rate) \quad (5.11)$$

Equation (5.11) states that the after-tax cost of debt is equal to the corporate default spread plus the risk-free rate, times 1 minus the effective tax rate. The risk-free rate has already been determined so it is only the corporate default spread which is missing. The corporate default spread is a measurement of Tesla's credit risk, whereas the cost of debt shows the expected rate of return to Tesla's debt holders. Damodaran, 2006 presents several methods to determine the default spread of a company. For a publicly traded firm such as Tesla the most forward approach is to use the rating assigned to the firms by a rating agency. On October 22nd, 2021, S&P Global upgraded their rating of Tesla from BB to BB+ and likewise on January 24th, 2022, Moody's upgraded Tesla's debt rating to a Ba1 rating from Ba3 (Cbonds, 2021b; reuters, 2022). This rating is just below the Standard & Poor's BBB rating, which is considered investment grade. According to (Damodaran, 2022d) large non-financial firms with a market cap above $5 billion and a credit rating of BB+/Ba1 have a default spread of 1.93%. For the tax rate a global marginal tax rate of 23.79% is used (KPMG, 2022). The after-tax cost of debt for Tesla can now be computed using equation (5.11). Again, a marginal tax rate of 11% is used and the same risk-free rate as previously computed.

$$After - tax\ cost\ of\ debt\ for\ Tesla = (2.03\% + 1.93\%)(1 - 23{,}79\%) \approx 3.02\%$$

Now that the cost of debt and the cost of equity has been determined, Tessa's capital structure must be analyzed to estimate the weighted average cost of capital. The market value of Tesla's debt and equity has already been computed, and the objective is now to determine the proportion of each component in relation to the total capital amount. The weight of equity amounts to 99.1% and the debt portion amounts to 0.9% of the combined capital. Utilizing the WACC equation (5.1), it is now possible to estimate the weighted average cost of capital for Tesla. In the equation the tax element has been excluded since both the after-tax cost of equity and the after-tax cost of debt is utilized.

$$WACC = 99.1\% \times 5.98\% + 0.9\% \times 3{,}02\% \approx 5.95\%$$

The weighted average cost of capital for Tesla is close to the global average cost of capital estimated by Damodaran, (2022d) of 6.81% as of January 5th, 2022. Additionally, the weighted average cost of capital for Tesla is even closer to the industry average for U.S. automotive and truck manufactures of 5.69% (Damodaran, 2022f). In the estimation of Tesla's WACC the energy storage and generation part of the company's business is also taken into consideration, however it only has a minor effect on the total WACC. It is tempting to compare Tesla with tech-companies such as Apple and Google, however the WACC is higher for these companies. In 2021 the global weighted average cost of capital for the software (systems & applications) sector is estimated to be 7.63% Damodaran, (2022d). Furthermore, a 2021 cost of capital study conducted by KPMG has estimated the global WACC for the technology sector to be 8.9% and the WACC for the automotive industry to be 7.6%. The study concludes that these are two of the industries with the highest cost of capital. The reason being that regulatory and political risks along with technologically changes in these sectors are fundamental parts of the business model and increases the risk for these firms (KPMG, 2021). However, it is important to keep in mind that Tesla is still an automotive manufacturer and that the WACC is predominantly determined by the automotive manufacturing industry, which is dominated by mature manufacturing companies. It is expected that mature companies have a higher WACC than firms that are earlier in their life cycle. In a 2016 research paper by Garcia et al. findings confirm the hypothesis that mature firms generally have a lower WACC than younger firms, which justifies Tesla's above average cost of capital compared to the U.S. auto & truck sector (Garcia, Saravia, & Yepes, 2016).

5.4 Enterprise value

To answer the research question *"What is the estimated value of Tesla Inc. as of February 4th, 2022?"* The enterprise value of Tesla must be found first, to then compute the share price. The enterprise value of Tesla is computed using equation (5.12) (Petersen, Plenborg, & Kinserdal, 2017).

$$Enterprise\ value_0 = \sum_{t=1}^{n} \frac{FCFF_t}{(1+WACC)^t} + \frac{FCFF_{n+1}}{WACC - g} \times \frac{1}{(1+WACC)^n} \qquad (5.12)$$

In equation (5.12) the first term represents the cash flow for the forecasting period and the second term represents the cash flow in the terminal period. In the second term the grow rate and the WACC of Tesla in perpetuity is used along with a free cash flow that is assumed to stay constant (Petersen et al., 2017). Over the forecasting period it is expected that Tesla's credit rating will improve. As described in chapter *5.3 Weighted average cost of capital* Tesla has a current S&P credit rating of BB+. As Tesla's creditworthiness improves over time so will its credit rating. The credit rating of a company is also linked to the default risk associated with the risk that the company will default on its outstanding bonds or debt obligations (HEAKAL, 2021).

As Tesla described the chapter *4.4 financial analysis* this is becoming a stable growth company, and it is therefore assumed that credit rating agencies will improve its credit rating over time.

Historically, this has also been the case for Tesla. On December 15th , 2020, Standard & Poor's upgraded its rating of Tesla from BB- to a BB rating, and again On October 22nd, 2021, S&P Global upgraded their rating of Tesla from BB to BB+ (Cbonds, 2021a; Klender, 2020). Because of this it is assumed that Tesla credit rating will be upgraded in 2024 to a BBB-rating, which can be seen in appendix 23. To verify Tesla's future creditworthiness, a closer look at its competitors is taken. Ford and General Motors have been selected since they are two companies in the same industry and the same market and will likely be affected by similar market conditions. S&P has given Ford a BB+ credit rating and General Motors a BBB rating (CapitalIQ, 2022a). It is this credit rating of General Motors that is used as a cap for Tesla's future credit rating, as it is believed that General Motors is a stable company with low default risk.

Changing Tesla's credit rating will have a direct effect on the cost of debt. For the years beyond 2024 a BBB-rating is used and the cost of debt for these years is computed using equation (5.13) and a BBB bond spread of 1.59% (Damodaran, 2022e).

$$After - tax\ cost\ of\ debt\ for\ Tesla = (2.03\% + 1.59\%)(1 - 23{,}79\%) \approx 2.76 \quad (5.13)$$

Changing the credit rating from a BB+ rating to a BBB rating will reduce the cost of capital and subsequently reduce the WACC. The enterprise value is positively affected by a lower WACC and a higher free cash flow (Petersen et al., 2017). However, upgrading the credit rating score from BB+ to a BBB will have little effect on the valuation.

Following the approach presented by Damodaran, (2006), the cost of capital should be estimated for every year of the forecasting period. Over the forecasting period the weights of debt and equity will change along with the beta and the cost of debt. One of the advantages of using the bottom-up beta, is that it can be expressed as a function of debt-to-equity for a specific year. In appendix 23 the effect on the beta by changing in the weights of debt and equity can be seen. Additionally, by changing the weights of debt and equity the cost of capital also changes. Today Tesla receives most of its funding through equity. As seen in the chapter *4.4 financial analysis* Tesla is still relatively early in the life cycle. Young firms tend to be funded through equity primary since they cannot sustain debt because of a lack of cash flow. As the companies grow, they tend to increase earnings which allows for more borrowing. Financing through borrowing is better since the cost of debt is usually lower than the cost of equity (Damodaran, 2006). The current industry average market debt-to-equity ratio is used to estimate Tesla's cost of capital in the sable growth year. An average weight of equity of 67.63% and an average weight of debt of 32.37% for the auto and truck industry is used (Damodaran, 2022f). For the forecasting years between 2021 and the stable growth year, 2031, a straight-line estimation of the weights with a CAGR of -4.57% is used.

Since the cash flows cannot be estimated forever, the estimation of Tesla's discounted cash flow is stopped by computing the terminal value of Tesla at that point in time. (Damodaran, 2006) presents three different methods to estimate the terminal value. The first method is to assume that the firm is liquidated in the terminal year and estimate the value of the assets at that time. The second method is to use a multiple to revenue, earnings, or book value, if valuing equity the price-earnings ratio can be used to find the terminal value. The third method is the one that will be used in this report, which is the stable growth method. In this method it is assumed that the company will grow at a constant rate forever. Equation 5.14 shows how the terminal value can be computed using the discount rate, the expected growth rate, and the cash flow to the firm. In this case where we are estimating the value of a firm the discount rate that will be utilized is the cost of capital (Damodaran, 2006).

$$Terminal\ value_n = \frac{Cash\ flow\ to\ firm_{n+1}}{Cost\ of\ capital_{n+1} - g_n} \qquad (5.14)$$

As observed in the *4.4 financial analysis,* Tesla is a high growth company. Additionally, it was also observed that Tesla is still a relatively small company in a large market, leaving room for the company to grow in the future. However, it cannot be assumed that this will continue forever and at some point, Tesla will reach a stable growth. As a result, it is assumed that Tesla will become a stable growth company by 2031. A limiting factor in the stable growth method is the fact that the growth rate cannot exceed that of the economy. When estimating the stable growth rate of a multinational company such as Tesla, the growth rate of the global economy will be the limiting factor. This will not be significant for a U.S. based company since the U.S. economy represents a large portion of the global economy. Over the past 20 years the arithmetic mean growth in real GDP in the U.S. has been 2,93% (The World Bank, 2022).

Tesla's enterprise value as of February 4^{th} ,2022, is estimated to be \$555 billion. By adding back cash of \$17,576 and deducting debt of \$8.904 an equity value of \$563 billion is computed. Additionally, the number of outstanding shares according to the annual report released the same day is 1,129 million (Tesla, 2022a). When dividing the equity value by the combined number of all outstanding shares a per share price of \$498.91 is found.

5.4.1 Sensitivity analysis

When following the DCF model presented by (Petersen et al., 2017), the standard approach when conducting a sensitivity analysis is to use the terminal growth rate and the WACC in the terminal period since these values have the biggest impact on the enterprise value of the firm (Petersen et al., 2017), For the sensitivity analysis presented in Table 4 the WACC in the terminal period and the return on invested capital over the forecasting period has been used. There are two reasons for choosing the ROIC over the terminal growth rate. First, there is more uncertainty surrounding ROIC than the terminal growth rate. Second, the DCF model is built based on the assumption that the growth rate in perpetuity cannot exceed the return from a risk-free investment, therefore only allowing for little movement the growth rate before it exceeds the risk-free rate. The upper and lower limits of the sensitivity analysis are chosen based on an estimate of what Tesla realistically can achieve in extreme cases. To find the upper limit of ROIC a comparison to some of the best performing tech companies is made. Over the fiscal year ending on December 31st, 2021, Apple had a return on capital of 35.2%, which serves as the upper limit (S&P Capital IQ, 2022a). As concluded in *4.1.1 Threat of new entrants* the automotive manufacturing industry has high barriers of entry and therefore requires large capital investments in manufacturing equipment. Subsequently, radical changes to Tesla's business are needed for the company to achieve such level of return, since operating margins are lower.

It can be argued that it is unrealistic that Tesla will be able to achieve similar returns on capital as a tech firm like Apple. Damodaran, (2022d) has estimated the return of capital for global companies in the auto and truck industry to be 6.32% in 2021. Additionally, he has estimated the return on capital for the U.S. market to be 4.74%, which will serve as the lower bound of the ROIC value in the sensitivity analysis (Damodaran, 2022d). For the weighted average cost of capital, the lower limit is set by the extreme case where the weight of debt is 99% and the weight of equity is 1%. For the upper limit the KPMG's estimation of WACC for the automotive industry is used (KPMG, 2021).

WACC \ ROIC	4.74%	5.79%	6.84%	7.90%	8.95%	10.00%	15.04%	20.08%	25.12%	30.16%	35.20%
5.77%	$373	$421	$454	$479	$498	$513	$558	$581	$595	$604	$611
5.80%	$371	$418	$452	$476	$495	$510	$555	$577	$591	$601	$608
5.83%	$369	$416	$449	$473	$492	$507	$551	$574	$588	$597	$604
5.86%	$367	$414	$447	$471	$490	$505	$548	$571	$585	$594	$601
5.89%	$365	$411	$444	$468	$487	$502	$545	$567	$581	$591	$598
5.91%	$363	$409	$442	$466	$484	$499	$542	$564	$578	$587	$594
6.25%	$341	$384	$414	$437	$454	$468	$509	$529	$542	$551	$558
6.59%	$322	$362	$391	$412	$429	$442	$480	$500	$512	$520	$527
6.93%	$306	$344	$371	$391	$406	$419	$455	$474	$486	$494	$500
7.26%	$291	$328	$353	$372	$387	$399	$434	$452	$463	$471	$476
7.60%	$279	$313	$338	$356	$370	$381	$415	$432	$443	$450	$455

Table 4 Sensitivity analysis, Source: Own creation

In Appendix 24, a 3D representation of the sensitivity analysis in Table 4 can be found. The 3D plot shows the consistency of the value of one Tesla share when changing either the return on invested capital over the forecasting period or the weight average cost of capital in perpetuity. Additionally, the 3D plot shows no extreme outliers when changing the return on capital and the WACC as long as the parameters are kept within the previous mentioned constraints.

As described in the *literature review* of the different supply chain issues a company can face, supply chain issues related to supply and demand has the biggest effect on share price. A similar pattern can be seen in the DCF-valuation model used in this report. Figure 14 illustrates that the value driver with the biggest impact on the share price is “revenue”. Supply and demand issues will directly have an impact on the revenue of a company. The effects of the selected value drivers in Figure 14 is determined by changing each by ± 10%. The figure represents the percentual effect on Tesla’s share price of changing each value-driver independently.

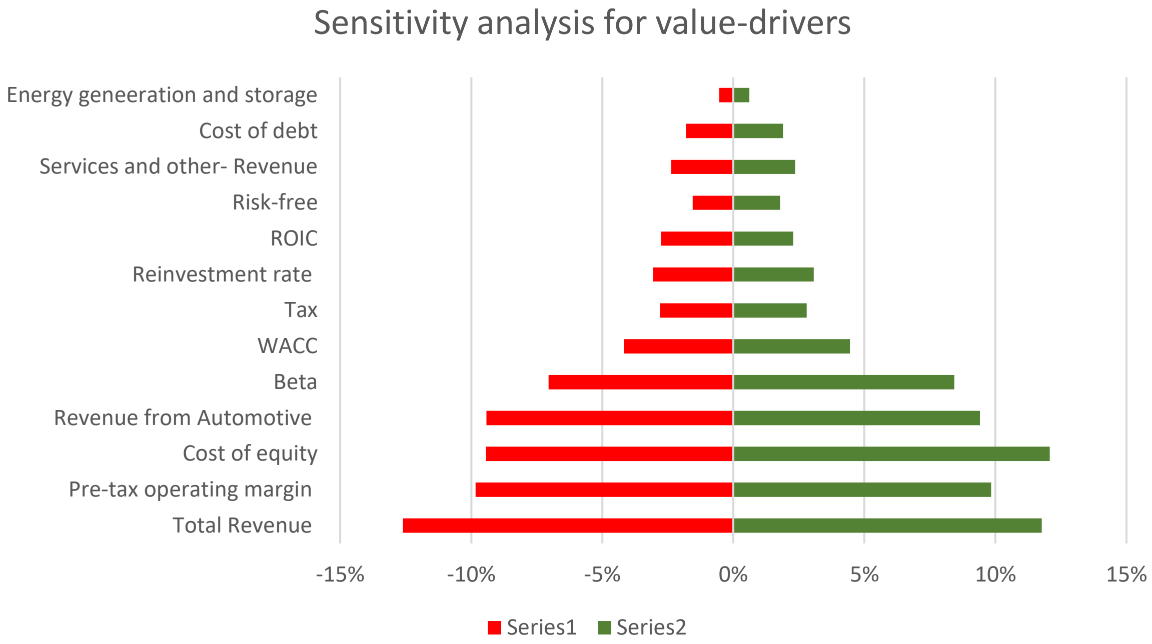

Figure 14 Impact from value drivers. Source: Own creation

5.4.2 Elon Musk case

From the analysis of Tesla and the estimation of the company's future cash from, and estimated share price of $498.91 has been estimated, which is 46% lower than the closing share price on February the 4th 2022 of $923.32. As described in the literature review Tesla is known for overestimating its target and overstating expectations for future growth. By using announcements made by Elon Musk about Tesla's future deliveries in the automotive and the energy generation and storage sector a share price for the *Elon Musk case* is estimated to be $3,061.15 (Appendix 28). Where other firms use press conferences to announce plans for the future of the company, Elon Musk uses social media communication channels. These announcements have a big impact on the stock price

In a tweet from September 2020 Elon Musk stated the following: *"That's total market, not all Tesla. We do see Tesla reaching 20M vehicles/year probably before 2030, but that requires consistently excellent execution."*(Elon, 2020). This estimation has since been changed. In a statement to Auto News Elon Musk delayed his expectations of achieving 20 million vehicles per year to early 2030's. To see if this target is realistic and to explain the high price tag of the Tesla stock price today, an enterprise DCF-valuation of Tesla has been conducted where the aim of the forecast is to achieve a production capacity of 20 million vehicles per year by the early 2030's.

More precisely the forecasted number of vehicles sold in 2031 is estimated to be just shy of 20 million vehicles with 19.56 million units (Appendix 25).

In the estimation of the share price in the *Elon Musk Case* all variables have been held constant apart from the number of vehicles sold and revenue from energy generation and storage. To estimate revenue from automotive sales the selling price of each vehicle is kept consistent with the *Researchers' Case* and only the number of units sold is changed. When estimating the number of units sold the aim is to match 20 million vehicles sold by the forecasting year 2031. Estimating the number of vehicles sold for each model will impact the total revenue since different models have different price-points. The distribution of which models will grow and by how much is estimated based on the same principles used in the *Researchers' Case*. For the Model S and X that have been on the market for a long time, future growth is consistent with current levels. As discovered in *5.1.2.2 Tesla existing vehicles forecast* the Model 3, the Models Y, and the Cybertruck are models Tesla have high expectation of, therefore these models will contribute more greatly to the total vehicle production of 20 million vehicles per year. For the Roadster and the Tesla Semi Truck these two vehicles are not expected to make up a big part of Tesla's future production fleet. The Roadster is a rather expensive supercar starting at $200,000 and therefore is not expected to sell in the same quantities as cheaper models. The Tesla Semi truck is also not expected to sell as well as the cheaper car models primarily because it is new territory for Tesla since they have not made a truck before. Another factor is the challenges that pure electric trucks are facing, mostly being used for urban transportation. Ultimately, it is expected that future models will make up a large part of future production, especially the anticipated Tesla Hatchback. Distribution of vehicles sold for each forecasting year in the *Elon Musk Case* can be found in Appendix 25. Tesla's goal of reaching 20 million cars per year is further supported by the announcements made in the company's 2022 Q1 shareholder deck, which states that Tesla wants to expand manufacturing capacity as quickly as possible. Tesla expects to achieve a 50% average annual growth in vehicle deliveries (Tesla, 2022f). Although the production ramp-up seen in Appendix 25 only has a 36% annual vehicle growth rate to reach the target of 20 million units sold, this is still significant.

The vehicle production ramp-up can be found in Appendix 26. For this case, production ramping is estimated to be the same as the *Researchers' Case* for the Gigafactory in Berlin and Texas. The annual capacity however is estimated to keep increasing to 1.5- and 2 million vehicles respectively in order to keep up with demand. Because the Fremont plant is not purpose-built for Tesla, the researchers estimate that the capacity can only be increased to 1.25 million vehicles annually. As stated, the Shanghai Gigafactory is on track to produce 600 thousand vehicles in 2022, with an estimated 1.1 mil unit capacity. The researcher estimates capacity to increase to 1,5 million in the future. The second rumored Shanghai factory is forecasted to reach 2 million vehicle capacity in 2027, and further expand capacity to 2,5 million vehicles becoming the biggest factory.

The researchers estimate that new production facilities can produce 500 vehicles the first year, assuming that set-up will decrease due to increased efficiency and a shared platform for vehicles. Production ramping is also assumed to be able to increase by 500 units annually if Tesla are to keep up with production. Appendix 26 shows how Tesla needs to establish new factories in the future to meet production of 20 million vehicles in 2031. The forecast aims to keep capacity utilization rate at the estimated 85% as mentioned in *5.1.4.1 Future vehicle production facilities*. This shows that Tesla need to have 12 production facilities globally and most of them have a capacity of nearly 2 million vehicles annually in 2031.

From our predictions of the *Elon Musk Case*, Tesla will capture 13.31% of the global light vehicle market by 2030 and 52.1% of the projected market share of the battery electric vehicle market, which is already quite a large proportion of the market (Appendix 25). Therefore, to achieve a valuation that is more in-line with the current share price, income from other revenue streams must be increased and new streams of revenue must be introduced. There are a number of revenue streams that will not be included in the valuation; sales from licensing of the self-driving software will not be included in the estimation of the share price in the *Elon Musk Case*. Mainly because it is speculative that has not been confirmed by Tesla (Yahoo News, 2020). Additionally, revenue from a potential future Robotaxi service will not be included, since there are not enough details to support how such a business plan will be implemented into Tesla's current ecosystem.

For battery production, Tesla announced on Battery Day 2020 that the goal for 2030 was for Tesla to produce 3 TWh of batteries (Tesla, 2020b). Elon Musk announced during the Q4 2021 earnings call that the potential for Tesla's Energy Storage business is to become a terawatt-hour per year energy business (The Motley Fool, 2022). Based on this announcement, the capacity for Energy storage in 2031 is set to 1 TWh. Reaching this would require at 74% CAGR in battery production towards 2031. The idea of a Terafactory presented at Battery Day 2020, with the ability to produce 1 TWh annually, however the estimates in the case is based on the capacity of Tesla's Berlin

Gigafactory of 100 GWh (Tesla, 2020b). To meet the demand of 2.8 TWh, Tesla would need to have 28 battery Gigafactories in total in 2031 based on the estimates.

6.0 Discussion - Is the share price realistic?

The development of Tesla's share price in recent years, is something that has been both heavily covered by financial news media and been part of a hefty debate among financial analysts and experts. Some believe that the company is heavily over-valued based on its cash flow, and others believe in the potential that CEO Elon Musk is envisioning for the future. Literature on Tesla's stock suggests that the stock is influenced by investor sentiment rather than only fundamentals. This was the motivation for the researchers to build a case on fundamentals regarding Tesla's future cash flow, to compare it to the market price as of February 4th, 2022. Additionally, a case on Elon Musk's future expectations of the firms is made to compare this to both the fundamentals case and the market value. The following section will highlight and discuss the findings in the analysis. The discussion will also feature a comparison between the outcomes of the cases and discuss the impact of Elon Musk's expectations regarding future cash flow on the share price.

In the valuation of Tesla an estimated share price of $498.91 is found, with a revenue in the terminal year amounting to $306 billion. Currently, Tesla is the automotive manufacturer with the 19th largest revenue in 2021 (Figure 5). According to a 2016 McKinsey & Company report the combined automotive market is projected to increase by 2.53% annually from 2015 to 2030, driven by macroeconomic growth in emerging market. Revenue from one-time vehicle sales is expected to increase to $4,000 billion in 2030 (Paul Gao et al., 2016). This projected growth rate is used in appendix 27 to estimate the yearly revenue from each of the firms with the 10th highest revenue in 2021. According to the researcher's estimates for Tesla's future growth, the company will generate a revenue of $267 billion by 2030, making the company the second largest automotive manufacture measured by revenue. The estimation of Tesla's share price is based on an optimistic projection of future revenue streams. However, it is worth nothing that the estimated share price of Tesla is 46% lower than the actual market value from February the 4th 2022 of $923.32 despite the optimistic view on future revenues.

Comparing the estimated share price to the one found in the *Elon Musk Case*, there is also a significant different in price. The case estimated the stock to be $3,061.15 per share, more than 3 times higher than the market value. The estimated revenue in the terminal year is estimated to be $2.19 trillion.

To further examine what it would take to reach a share price equal to or above the current share price of $923, Table 5 is created which is an illustration of the target operating margin and expected revenue in 2030's effect on the share price. The estimated pre-tax operating margin used in the valuation of Tesla is already rather optimistic, assuming that Tesla will be amongst the top 75th percentile of all manufacturing firms. Similar to the *Researchers' Case*, the target operating margin is the expected margin that Tesla will be able to achieve in 2026 and maintain in perpetuity. As described in *5.2.1 operating margin* the average median operating margin for U.S. firms is 11%, consequently if Tesla cannot realize the expectations to operating efficiency the value of the company will be even lower. Table 5 shows the estimated share price for Tesla, depending on expected revenue in 2030, for example if Tesla can generate revenue similar to Toyota by 2030 and maintain an operating margin of 16% the share price according to our model will be $598. The projected revenues from Stellantis, Toyota, and the different market shares are estimated based on the growth expectations to the automotive market by the 2016 McKinsey & Company report (Paul Gao et al., 2016). Table 5 shows that Tesla must capture a rather large stake of the market and achieve a high production efficiency to be able to realize the current market valuation of the company. Additionally, Table 5 is color-coded with the share prices below the current market price of $923.32 colored in green and the ones above colored in red.

Revenues in 2030 (in billions of U.S. $)

		Stellantis (6% of mkt.)	Toyota (9% of mkt.)	$400 (10% Mkt. share)	$500 (13% Mkt. share)	$600 (15% Mkt. share)	$800 (20% Mkt. share)	$1000 (25% Mkt. share)
Revenue in million ($)		$247	$376	$400	$500	$600	$800	$1000
Target operating margin	12%	$311	$455	$482	$593	$703	$923	$1,142
	16%	$407	$598	$634	$782	$929	$1,222	$1,514
	20%	$503	$742	$787	$971	$1,155	$1,521	$1,886
	24%	$598	$885	$939	$1,160	$1,381	$1,820	$2,257
	28%	$694	$1,028	$1,091	$1,349	$1,606	$2,118	$2,629

Table 5 Estimated share price for Tesla based on target operating margin and revenue in 2030, Source: Own creation

As concluded in *5.1.2.3 Tesla upcoming vehicles forecasting* Tesla will capture 4.3% of the automotive market by 2030, according to our estimations. This will make Tesla the 8th largest automotive manufacturer based on today's number of vehicle deliveries (Focus2move, 2022c).

Compared with the finding in Table 5, Tesla is far from reaching the current market expectations, according to the *Researchers' Case*. However, when looking at the *Elon Musk Case* it is estimated that Tesla will generate revenue of $635 billion from its automotive business and another $402 billion from its energy generating and storage business in 2030. From the automotive business alone Tesla will capture approximately 15% of the projected market in 2030. Following Elon Musk's expectations that Tesla will sell 20 million cars by the early 2030's and that the company will achieve an operating margin amongst the top 75th percentile of all manufacturing firms, an estimated share of $929 is found close to the current price of $923 (Table 5). There are ways to get to the current stock price, following Table 5. However, assuming Tesla will generate $600 billion from its automotive business alone requires that the company finds a way to scale production efficiency and size to fulfill orders. Although, it is more likely that Tesla will have to find other ways to generate revenue that will match the current stock price, such as revenue from energy generation and storage.

By comparing the two cases, the *Researchers' Case* and the *Elon Musk Case,* a more optimistic view on Tesla future is needed to achieve the current stock price. When explaining the mismatch in the estimated and the current stock price of Tesla it is important to accentuate that the high expectation to future growth is not the full explanation. The S&P 500 has been in a bull market for the past two years and as concluded by a report by LPL Research it has been the fastest bull market to double ever (Detrick, 2022). Furthermore, as described in the *4.4 financial analysis* the market condition since the start of the Covid pandemic has added to Tesla's stock price. These unprecedented market conditions have also added to the stock price of Tesla. As previous literature points to companies tend to be valued based fundamentals in bear markets (Coakley & Fuertes, 2006).

Looking at the operational numbers of the two cases, there is also a significant difference. For the *Researchers' Case*, it is estimated that 4.78 million vehicles will be produced in 2031 (Appendix 12). The researchers aim to keep the capacity utilization rate of future vehicle product facilities at around 85%, as mentioned in *5.1.4.1 Future vehicle production facilities*. The estimates show a production capacity of 6.06 million vehicles, with 3 new facilities added towards 2031. Tesla would have 7 Gigafactories in total producing vehicles. One facility, the second one in Shanghai, would have a capacity of 2 million vehicles in 2031. Other facilities are estimated to have a capacity between 1.11 million and 500 thousand. According to the estimates presented in *5.1.4.1 Future vehicle production facilities*, production ramping for the Berlin and Texas Gigafactories will be similar in the first years and the Berlin factory will expand further. Future Gigafactories are expected to have similar ramping. The second anticipated factory in Shanghai is estimated to have a 2-million-unit capacity in 2031. New factories will be opened every fourth year according to the forecast (Appendix 15). As highlighted in *5.1.2.3 Tesla upcoming vehicle forecasting,* Tesla will have an estimated 4,28% market share of light vehicles in 2030. For the BEV market, Tesla will have an estimated 16,8% market share.

For Tesla's battery production, five new battery factories with the capacity of Berlin Gigafactory's 100 GWh are needed to satisfy demand for vehicles and energy storage. This will be the world's biggest battery factory by capacity. Other companies like LG are producing 70 GWh in Poland, and Tesla's Nevada Gigafactory produces 38-39 GWh of batteries. The estimated number of facilities exclude any batteries that Tesla might buy from other suppliers. Meeting the demand on its own would require a new factory to be established every 2-3 year. A total of 472 GWh of batteries is the estimated demand in 2031. The vast majority is expected to go towards vehicle production, with 5% or 23 GWh going to energy storage (Appendix 14). Based on S&P Global Market Intelligence's estimated future production in 2025 of 1447 GWh as shown *5.1.4.2 Future battery production facilities,* Tesla would have a 17.1% market share.

The operational number estimated in the *Researchers' Case* is based on the researcher's analysis of Tesla's future production. As mentioned in *4.0 Strategic and market analysis* and *5.1 Revenue forecast*, much of Tesla's future production is dependent on its supply chain management. The company is facing many threats that could offset production ramping. Especially when it comes to suppliers of critical parts such as semiconductors and batteries. The researchers' have based the valuation on the analysis of the firm and the improvements Tesla has made in recent years to make its supply chain more resilient. The analysis suggests that Tesla will be able to build a strong supply chain and withstand major disruptions in the future.

For the *Elon Musk Case* the operation estimates are significantly different. Looking at the forecast, the ratio stays around the desired 85% in most years. Elon Musk's goal is to have the capacity to produce 20 million vehicles in the early 2030's. With the forecast in the *Elon Musk Case*, the company will have a production capacity of 21.75 million vehicles. To achieve this, Tesla needs to build eight new production facilities besides the newly established Gigafactories in Berlin and Texas. As mentioned in *5.1.4.1 Future vehicles production facilities*, production ramping of new factories is estimated to increase 500 thousand units annually. The researchers consider this to be plausible, considering current production ramping in the Berlin- and Texas

Gigafactory where capacity is projected to increase with 300-400 thousand units annually from 2022-2024. However, the capacity needed for individual production facilities is very high. Compared to production facilities of competitors, the world's biggest facility from Hyundai produces 1.5 million vehicles annually. Tesla's Fremont plant has the biggest production output in North America with 444 thousand units in 2021. Having 9 plants with a capacity of 2 million vehicles annually vastly exceeds the capacity of competitors. Producing 20 million vehicles also exceeds the units produced by competitors currently. Tesla is already the biggest producer of BEVs globally with 930 thousand vehicles produced in 2021. This is however still a long way from the 9.6 million vehicles Toyota delivered in 2021. This is also a big difference from the estimates in the *Researchers' Case* suggesting that Tesla needs to add three new production facilities to fulfill future production, reaching a combined capacity of 6 million vehicles in 2031.

With the expectations from Elon Musk, Tesla will produce 20 million vehicles in the beginning of the 2030's. The global light vehicle market is projected to have a 1.2%-6.7% YoY growth towards 2030, from 84 million to 110 million. The BEV market is also projected to grow to 25% of light vehicles sold in 2030. Despite the growth in this category, as well as for light- and heavy commercial vehicles, this is still a significant market share for Tesla. According to the estimates made in the *Elon Musk Case*, production will be 19.5 million vehicles in 2031, with the majority being passenger vehicles (Appendix 25). The estimated market of global light vehicles is 110 million in 2030, as highlighted in *5.1.2.3 Tesla upcoming vehicle forecasting*, and the estimated production for Tesla is 14.8 million vehicles, 312 thousand being Semi Truck and Van. This would mean 14.5 million light vehicles produced by Tesla in 2030. This would equal an estimated 13.31% market share in 2030. This is more than competitors' market shares in 2021, with Toyota at 9.5% and Volkswagen at 7.2% (Appendix 3). A 25% penetration of BEV's in 2030 would result in 27.5 million BEVs, where Tesla would have a 52.1% market share. Compared to the estimates in the *Researchers' Case* of 4.6 million light vehicles and a market share of 4.3% of total light vehicle sales and 16.8% of the BEV market, this is also a significant difference. Tesla would also have a CAGR of 36% from 2021-2031 for its total vehicles produced. This is quite high compared to the *Researchers' Case* of 18% CAGR over the period. The current automotive industry is made up of firms with a significantly bigger market share than Tesla. Competitors are also investing heavily in developing BEVs to compete with Tesla. Considering these factors, it seems difficult for Tesla to capture such a significant market share as projected in the *Elon Musk Case*.

When it comes to Tesla's future battery production, Elon Musk has made the claim that the company will have a terawatt-hour per year energy storage business in the future, as well as producing 3 TWh of batteries in 2030. This was presented at Tesla's Battery Day in 2020 and at Tesla's Q4 2021 Earnings Call. Looking at the *Elon Musk Case,* it can be seen how the battery demand will match with the estimated vehicle production, plus the 1 TWh energy storage demand in 2031 (Appendix 25). The demand for 2.8 TWh of batteries in 2031 would require 28 battery factories producing 100 GWh each. Compared to the *Researchers' Case* with 5 battery production facilities in total in 2031, this is a big difference. While Tesla has presented the concept of a Terafacotry with the ability to produce 1 TWh of battery output, current battery facilities produce far less. The Berlin Gigafactory is expected to be the world's largest battery factory with 100 GWh of output, one-tenth of a Terafactory. It would require a massive scaling of production efficiency and size to produce the volume required to fulfill the projections made by Elon Musk and Tesla. As mentioned in *5.1.4.2 Future battery production facilities,* S&P Global Market Intelligence expects a global production of 1447 GWh of batteries in 2025. Tesla would have 453 GWh of the global production in 2025, accounting for 31%. This is compared to 248 GWh and a 17.1% market share in the *Researchers' Case* for the same year.

Building the supply chain and increasing resilience becomes even more crucial for Tesla in the *Elon Musk Case.* The firm will have to secure more suppliers of critical parts such as semiconductors and battery supply, in order to increase production as significant as the case suggests. Securing the supply of raw materials would be crucial to deliver such high production output, which is something that other firms are also pursuing. Firms like LG Energy Solution, Panasonic, and CATL are also looking to expand production in the future, collaborating with BEV manufacturers and producing batteries themselves.

7.0 Conclusion

With the initial research question, the researchers set out to estimate the value of Tesla as of February 4^{th}, 2022, by building a case based on fundamentals to answer the research question: *"What is the estimated value of Tesla Inc. as of February 4^{th}, 2022?".* Additionally, the researchers seek to build a case based on investor sentiment and compare this to the initial valuation and the market price. The purpose is to show the impact of Elon Musk's expectations on Tesla's value and discuss the potential difference in price and value.

To determine the value of Tesla, the researchers analyzed Tesla and the industries it operates from both an operational and financial approach. Based on the findings in the literature review, the analysis has a specific focus on Tesla's supply chain. The analysis found significant growth in the BEV market as it replaces ICEV in the future. Tesla's current sales channels, its digital mindset, brand value, and the production set-up are all keys for future competitive advantage. Tesla utilize many aspects of lean production and industry 4.0 to their advantage. They have a customer centered approach with the customer's values as a central part of the organization. They use the concepts of lean production in their manufacturing when it comes to factory set-up and layout, mixed production, mistake proofing, and having make-to-order products with a pulsed flow. Tesla utilize the perception of added value in their products by having many additional features and services that are not traditionally found in other carmakers. Controlling its supply chain, especially when it comes to critical parts and supplies, is also determined to be crucial to future production. Tesla has made several moves to secure its supply chain and build resilience through exclusive deals with suppliers, strategic acquisitions, and insourcing. Despite the strategy to insource production, Tesla will still be dependent on strategic partnerships with battery suppliers. The energy generation and storage business is also determined to have growth potential in the future. The analysis showed challenges for the energy generation business, but significant potential for energy storage products. However, based on the challenges found in the analysis, it was determined that the company would keep to its current strategy of allocating 5% of battery supply to energy storage in the *Researchers' Case*. Batteries is a central part of Tesla's business and prioritizing vehicle production is key for the company. Growth in both industries is dependent on supporting infrastructure and incentives. Additionally, a financial analysis of Tesla's current and historic performance concludes that Tesla is becoming a more stable company in terms of fundamental performance and overall growth. The company is becoming more efficient and better at generating profits. From these conclusions, it was possible to determine Tesla's current and future business growth stage which is used in the forecasting of revenue and in the DCF-valuation.

Using the findings from the analysis, a DCF-valuation is conducted to find the estimated value of Tesla as of February 4^{th}, 2022. To compute the value of Tesla the weighted average cost of capital is estimated. The WACC for the first forecasting year closely resembles that of the automotive industry. For the DCF-valuation a bottom-up beta is utilized and as a result the WACC will change in conjunction with the beta over the forecasting period.

The researchers find the estimated share price to be $498.91, with a revenue in the terminal year of $306 billion. A further analysis of how this share price is affected by Tesla's target operating margin and its projected revenue concludes that the target operating margin is already rather optimistic for a manufacturing firm and that Tesla must generate fairly high future revenues to reach a valuation comparable to today stock price. As a result, the estimated share price is 46% lower than the market value of $923.32. The *Researchers' Case* estimate that the company will produce 4.78 million vehicles in 2031 and need a total of 7 vehicle Gigafactories to fulfill demand. This would give Tesla a 4.3% market share in light vehicles in 2030 and a 16.8% share of the BEV market. Additionally, Tesla would need 472 GWh of batteries to fulfill future demand, with 23 GWh going towards energy storage. This would require 5 new battery facilities to be built over the course of the coming 10 years.

The *Elon Musk Case* estimates the share price to be $3061.15. The case estimates the revenue in the terminal year to be $2.19 trillion. This is a significant difference to both the market value and the share price of the *Researchers' Case*. On the operational side, the *Elon Musk Case* suggests 19.5 million vehicles to be produced in 2031, based on the announcement of 20 million vehicles by Elon Musk. The estimates would give Tesla a 13.31% market share of global light vehicles, and a 52.1% market share of the BEV market in 2030. Tesla's battery production will allow for 1 TWh of energy storage, and a total of 2.8 TWh of battery demand. This would require 28 Gigafactories to be built in addition to the existing Nevada Gigafactory.

Comparing the two cases, it is evident that Tesla would need massive scaling to reach the estimation based on the announcements made by Elon Musk. The company would need a significant market share of both the future global vehicle- and battery production. Although, some of the difference between the estimated stock price of the *Researchers' Case* and the current share price can be explained by Elon Musk's high expectations to the future of Tesla, other factors such as herding behavior, fear of missing out, and the overall market value can also explain the price difference.

8.0 Further research

Considering the scope and findings of the paper, several elements are interesting in terms of further research. Analyzing Tesla's supply chain and finances, new factories play a big part in expanding the company's vehicle output. Further research could investigate Tesla's supply chain in a closed supply chain system and go more into detail with specific scenarios. This could investigate how centralized production reduces cost or see how new factories would add value to Tesla.

In terms of Tesla's share price, further investigation into the immediate effect on the stock could be made. Similar to previous research, further research could investigate the impact of announcements made by Elon Musk on an intraday level. Building on previous research, as well as the findings in the case, it could be examined how other factors such as herding behavior and social mood affect the market value of the stock. The research suggests that these other factors could also play a role in the difference between price and value. The scope of the research could also be widened to focus on potential new industries for Tesla. There have been speculations of Tesla entering into robotaxis and building a business around having Tesla vehicles act as autonomous taxis. The possibilities of this and the implications could be analyzed to determine the possible value this would add to the company.

Finally, the general research approach could be applied to other firms to see the effects of announcements for other firms. This could be compared to the findings of the paper to find trends across companies and industries.

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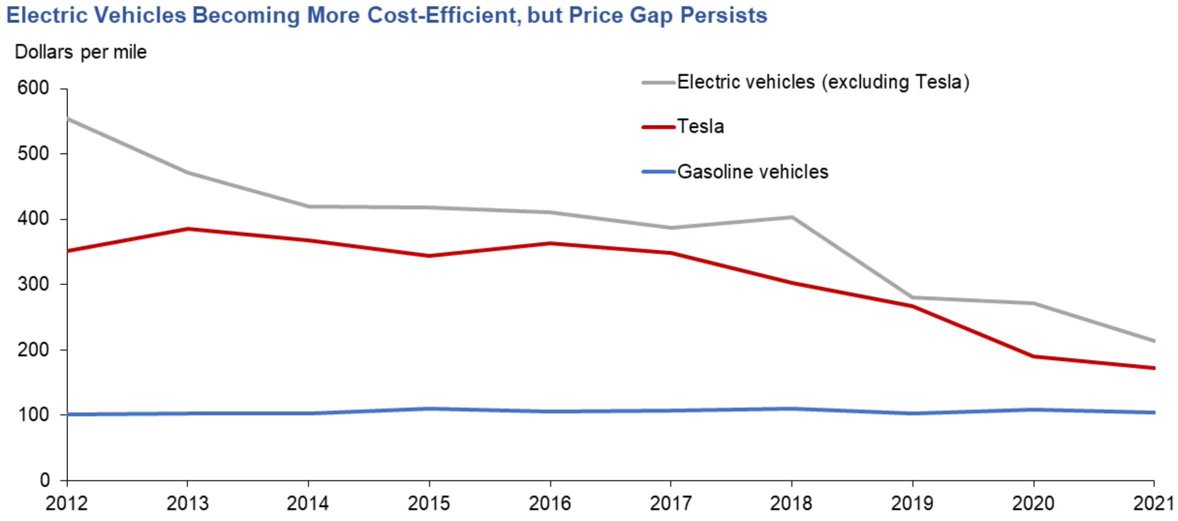
Appendix 1: Tesla’s current models

	Model S	Model X	Model 3	Model Y
				
Price	$99,900 - $135,990	$144,990 - $138,000	$46,990 - $62,990	$62,990 - $67,990
Range (miles)	396 - 405	333 - 348	272 - 315	303 - 330
Battery capacity	100 kWh	100 kWh	60 kWh - 82kWh	82 kWh
Top speed	250 km/h - 322 km/h	250 km/h - 262 km/h	225 km/h - 261 km/h	217 km/h - 250 km/h
0-100 km/h	2.1 sec - 3.2 sec	2.6 sec - 3.9 sec	3.3 sec - 6.1 sec	3.7 sec - 5.0 sec
Efficiency (Wh/km)	162 - 170	194 - 204	151 -163	172 -181

Appendix 2: Electric vehicles becoming more cost-efficient

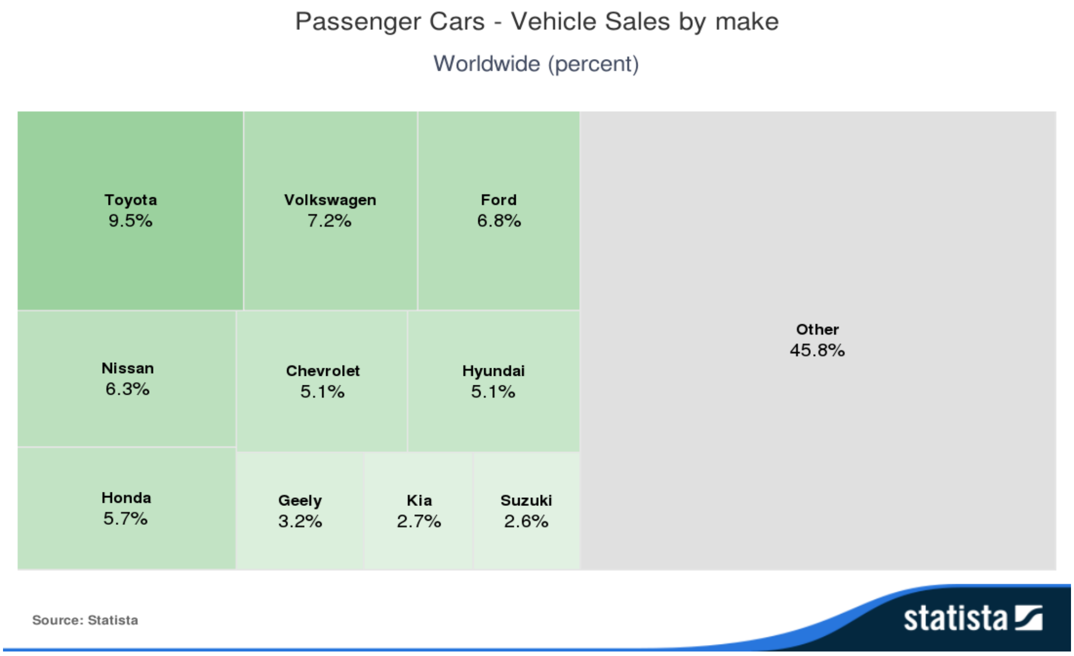


NOTES: The calculation for each vehicle is the manufacturer's suggested retail price (MSRP) divided by the vehicle range on a full charge or full tank of gasoline. Only vehicles that list a range and price are shown. Electric vehicles excludes hybrids. The medians of MSRP/range across new makes and models introduced each year are included. Dollar values are deflated using CPI-U in 2020. Gasoline vehicles exclude all types of minivans, pickup trucks, special-purpose vehicles and vans.
SOURCES: Fueleconomy.gov; authors' calculations.

Federal Reserve Bank of Dallas

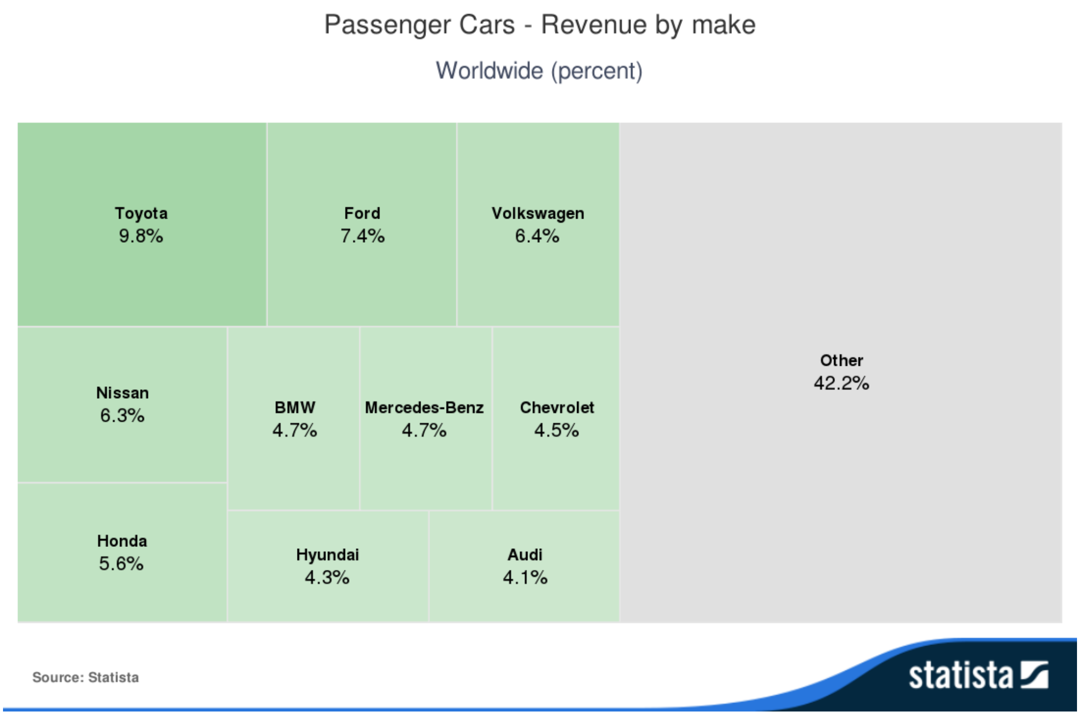
Source: (Plante & Howards, 2022b)

Appendix 3: Vehicle sales by automotive manufacturer



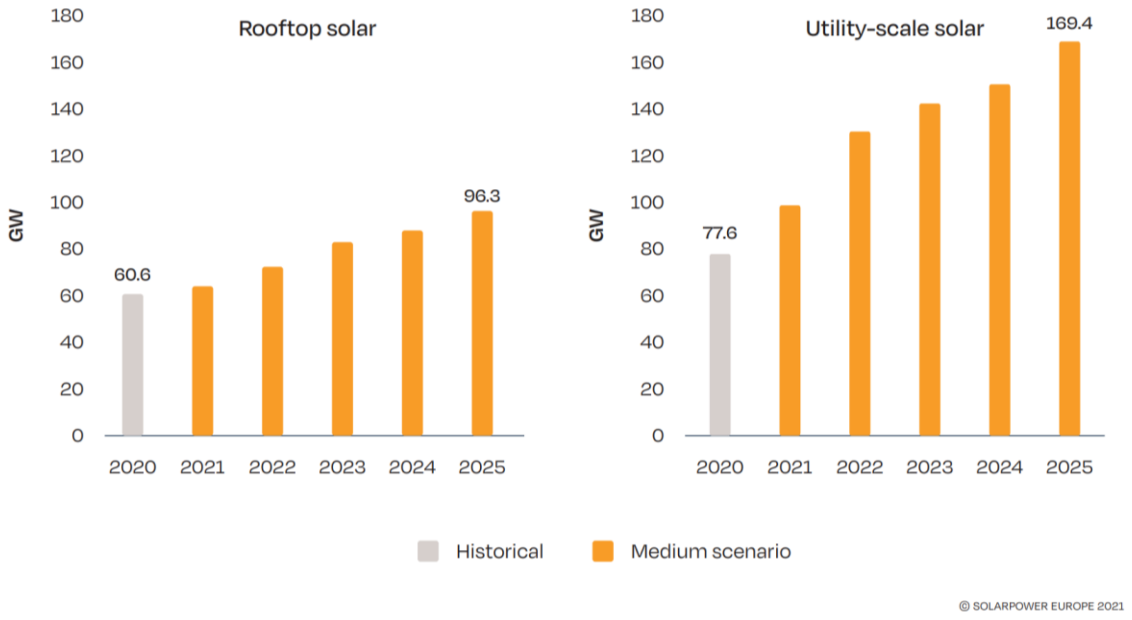
Source: (Statista, 2022b)

Appendix 4: Revenue by automotive manufacturer



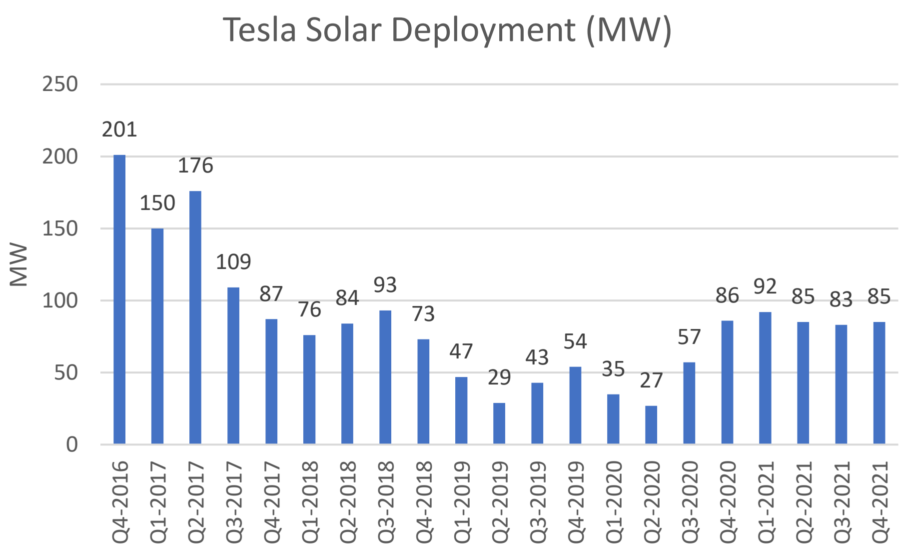
Source: (Statista, 2022b)

Appendix 5: Solar PV Rooftop and Utility-Scale Segments Scenarios 2021-2025



Source: (SolarPower Europe, 2021)

Appendix 6: Tesla solar deployment



Source: (Tesla, 2018, 2019b, 2020a, 2021a, 2022a)

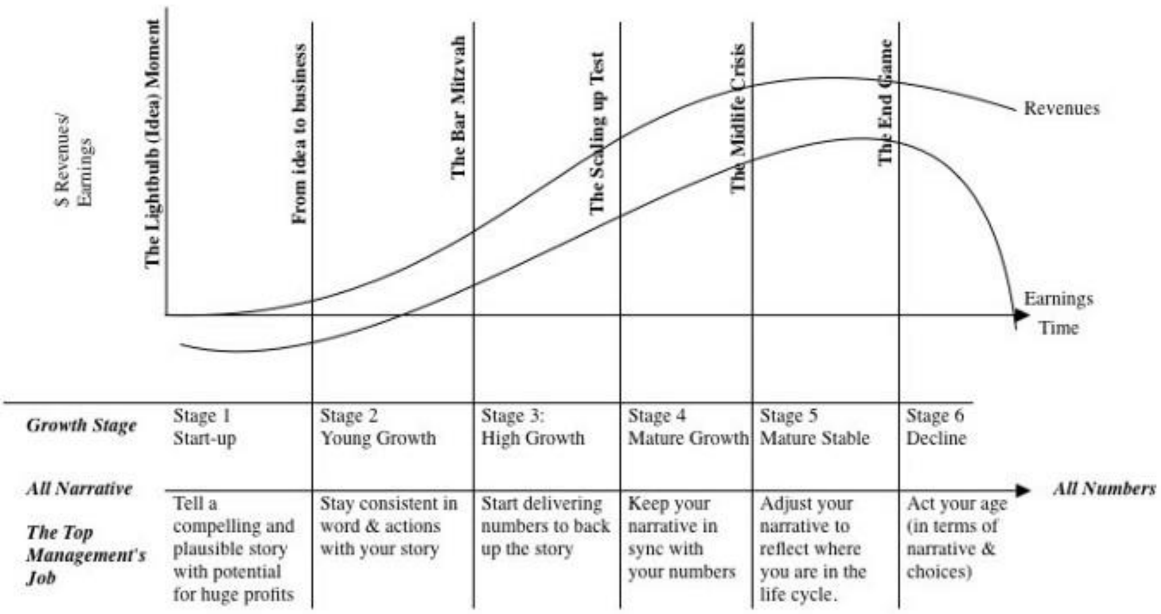
Appendix 7: Inventory growth

Total historical vehicle deliveries from Tesla and historic inventory growth

	2013	2014	2015	2016	2017	2018	2019	2020	2021
Model S	22.5	31.7	50.5	50.9	54.5	51.5	33.0	28.5	19.1
Model X	--	--	0.2	25.3	46.9	47.9	34.4	28.5	6.8
Model 3	--	--	--	--	1.8	146.1	300.9	356.6	501.7
Model Y	--	--	--	--	--	--	--	86.0	409.5
Total (Ks)	22	32	51	76	103	245	368	500	937
Deliveries		41%	60%	50%	35%	138%	50%	36%	88%
Inventory growth (2 Yr CAGR %)	161%	89%	94%	47%	33%	23%	25%	15%	27%

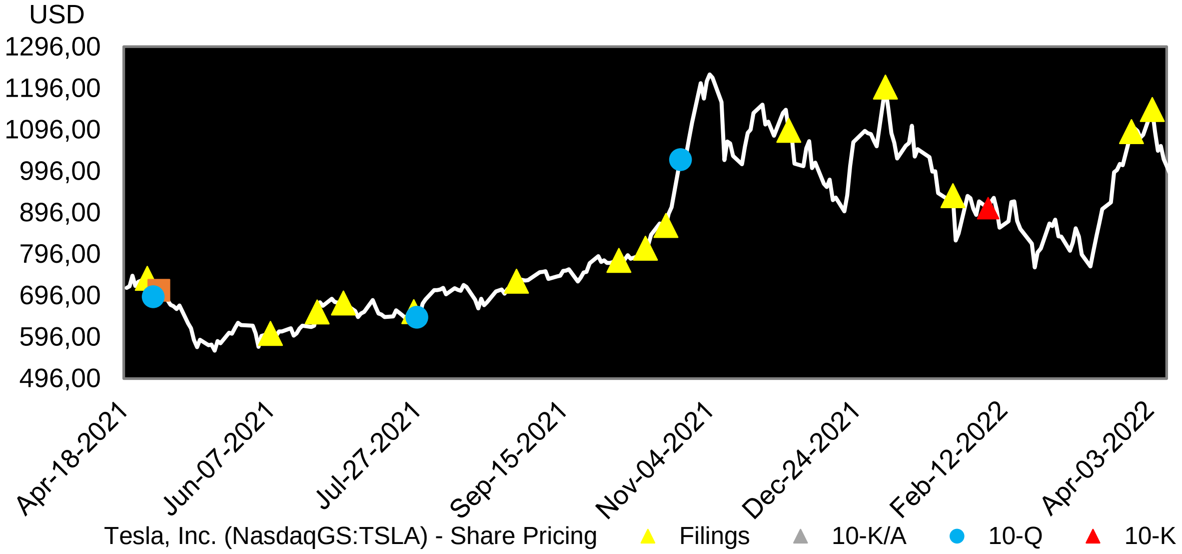
Source: Tesla annual reports (2015, 2018, 2021)

Appendix 8: Business life cycle



Source: (Damodaran, 2020)

Appendix 9: Tesla stock price since the beginning of the Covid pandemic



Source: Own creation & (S&P Capital IQ, 2022c)

Appendix 10: Capacity utilization

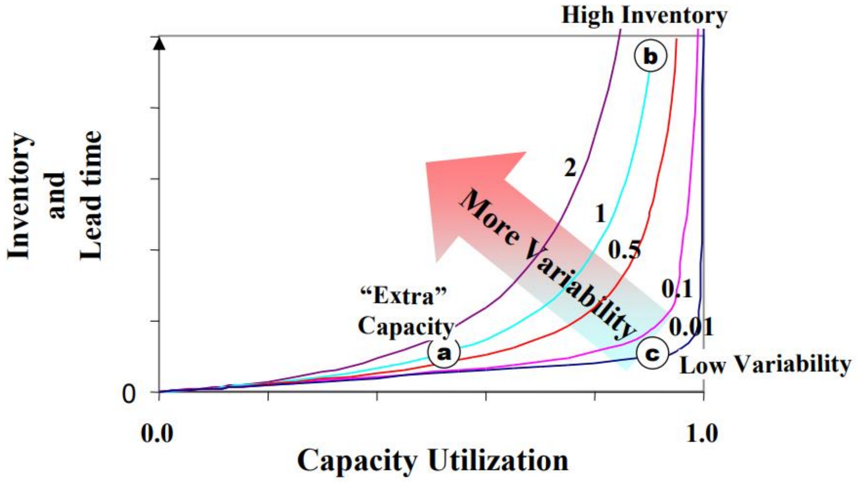
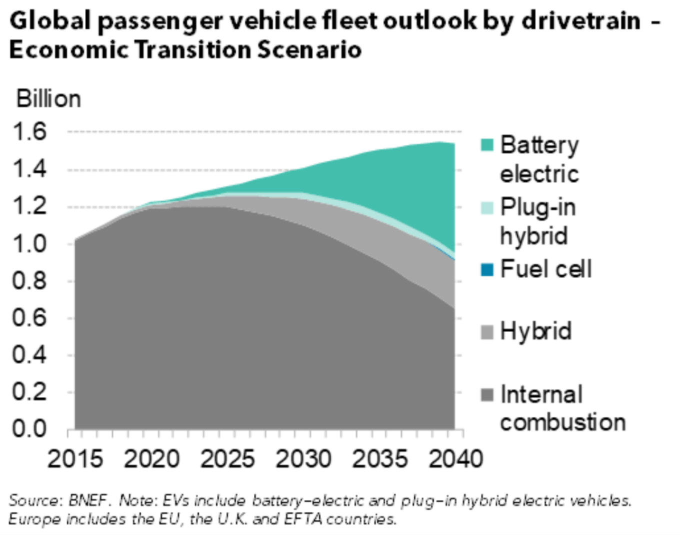


Figure 2. Inventory Skyrockets as Capacity Utilization Approaches One, and as Variability Increases, Due to the "Curse of Variability"

Source: (Schmidt, 2005)

Appendix 11: Global vehicle forecast until 2040



Source: (BloombergNEF, 2021)

Appendix 12: Tesla production and sales forecast until 2032

Street Estimate for Car Units K	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E
Model S	22.5	31.7	50.5	50.9	54.5	51.5	33.0	28.5	19.1	40.9	44.2	41.8	40.9	38.5	38.2	38.0	38.9	38.8	33.9
Model X			0.2	25.3	46.9	47.9	34.4	28.5	6.8	31.2	36.9	38.3	38.5	44.0	44.1	44.5	47.0	46.9	53.2
Model 3					1.8	146.1	300.9	356.6	501.7	606.2	705.4	760.0	833.4	1,038.1	1,066.8	1,080.3	1,102.3	1,108.3	1,032.2
Model Y								86.0	409.5	844.7	1,171.4	1,203.2	1,334.0	1,674.8	1,756.2	1,794.5	1,824.3	1,849.8	1,807.5
Cybertruck										7.0	33.1	147.1	206.3	248.9	259.0	258.4	257.7	255.7	427.0
Semi Trucks										1.5	2.7	6.7	11.1	11.3	12.5	15.0	17.5	20.0	22.8
Roadster											0.4	0.7	1.0	3.0	3.0	3.1	3.1	3.2	3.3
Mass Market Car Hatchback ($25K)											100.0	129.1	166.7	215.2	277.8	358.7	463.1	597.8	585.9
New Car #1 - ($25K)														0.0	50.0	108.4	235.0	509.3	499.1
New City Car #2 - ($15K)														50.0	70.0	97.9	137.0	191.8	187.9
New Car #3 Van																50.0	81.0	131.1	128.5
Total	**22.5**	**31.7**	**50.7**	**76.2**	**103.2**	**245.4**	**368.3**	**499.6**	**937.1**	**1,531.5**	**2,094.3**	**2,326.8**	**2,631.9**	**3,323.7**	**3,577.7**	**3,848.7**	**4,206.8**	**4,752.6**	**4,781.3**
% growth		**41%**	**60%**	**50%**	**35%**	**138%**	**50%**	**36%**	**88%**	**63%**	**37%**	**11%**	**13%**	**26%**	**8%**	**8%**	**9%**	**13%**	**1%**

Revenue Summary	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E
Total Units (#Ks)	**22.5**	**31.7**	**50.7**	**76.2**	**103.2**	**245.4**	**368.3**	**499.6**	**937.1**	**1532**	**2094**	**2327**	**2632**	**3324**	**3578**	**3849**	**4207**	**4753**	**4781**
Researchers' case	22.5	31.7	50.7	76.2	103.2	245.4	368.3	499.6	937.1	1532	2094	2327	2632	3274	3508	3751	4070	4561	4166
Elon case	22.5	31.7	50.7	76.2	103.2	245.4	368.3	499.6	937.1	1694	2642	3307	4727	5798	7235	9064	11458	14800	19560
Check										TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Total Vehicels Revenue	**$2,194**	**$3,211**	**$4,265**	**$6,842**	**$9,353**	**$15,842**	**$22,430**	**$30,095**	**$46,918**	**$78,076**	**$106,724**	**$115,912**	**$127,885**	**$157,538**	**$165,505**	**$173,050**	**$182,505**	**$196,110**	**$200,267** *In millions
Vehicle growth rate		46.32%	32.85%	60.42%	36.70%	69.38%	41.58%	34.17%	55.90%	66.41%	36.69%	8.61%	10.33%	23.19%	5.06%	4.56%	5.46%	7.45%	2.12%
Actual Total vehicle revneue	**$1,922**	**$2,874**	**$3,432**	**$5,589**	**$8,535**	**$17,632**	**$19,358**	**$24,604**	**$44,125**										
Global light vehicle market size (#ks)			89,165	93,990	96,448	95,544	91,988	80,466	84,928	90,638	94,797	97,423	100,073	103,447	105,317	107,292	108,788	110,065	
Market share of Global light vehicles			0.1%	0.1%	0.1%	0.3%	0.4%	0.6%	1.1%	1.7%	2.2%	2.4%	2.6%	3.2%	3.4%	3.6%	3.9%	4.30%	
Battery EV market size (#ks)			326	471	788	1,276	1,675	2,268	3,753	5,541	7,710	10,098	12,529	15,568	18,804	21,997	25,311	28,123	
Market share of Batter EV			15.5%	16.2%	13.1%	19.2%	22.0%	22.0%	25.0%	27.6%	27.1%	23.0%	20.9%	21.3%	19.0%	17.4%	16.6%	16.8%	

Source: Bloomberg and own estimations, Further information in attached Excel document - *Tesla-DCF*

Appendix 13a: Vehicle forecast

	Hatchback	Van	VW Polo
Vehicle type	Subcompact	LCV	Subcompact
Sub-category market size 2019 (units)	9,874,000 [6]	3789000 [3]	9,874,000 [3]
Units sold in 2019	493,700 [4]	109,600 [2]	724,000 [5]
% of sub-market	5.0%	2.9%	7.3%
Total Vehicle market 2019	92,000,000[1]	92,000,000[1]	92,000,000[1]
% of total market	0.54%	0.12%	0.79%
Total market 2030	110,065,000[1]	110,065,000[1]	110,065,000[1]
Forecast for 2030	590,642	131,121	866,164

1: Total of global light vehicle in 2019 (Macquarie Research, Hong, Park, et al., 2021)

2: 438,400 is the total amount of Mercedes vans sold in 2019, and we expect Tesla will capture a quarter of this. 438,400/4=109,600 source: (Mercedes-Benz, 2022)

3: Total market size of light commercial vehicle market in 2019. Source: (FELIPE, 2019)

4: An estimated 5% market share is used to calculate this number.

5: Global sales of VW Polo in 2019. Source (Volkswagen AG, 2020)

6: Total market size of vehicles sold in the subcompact market segment in 2019. Source: (FELIPE, 2019)

Appendix 13b: vehicle forecast b

	$25,000 SUV	$15,000 Car
Vehicle type	SUV	City car
Total SUV Market size 2021[1]	33,225,806[2]	4,000,000[2]
Units sold in 2021	(Kia Sportage)[2] 393,000	147,969[2]
% of SUV market	1.2%	3.7%
Total Vehicle market 2021	84,928,000[1]	84,928,000[1]
% of total market	0.46%	0%
Total Vehicle market 2030	110,065,000[1]	110,065,000[1]
Forecast for 2030	509,320	191,765

Source:

1: Total of global light vehicle in 2019 (Macquarie Research, Hong, Park, et al., 2021)

2: Total market size of light commercial vehicle market in 2019. Source: (FELIPE, 2019)

Appendix 14: Tesla forecasted battery factories

Battery Factories	2017	2018	2019	2020	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E	Per vehicle kWh
Average kWh per vehicle																
Model S					*1910000*	*4093000*	*4424800*	*4177000*	*4088100*	*3847200*	*3819000*	*3795600*	*3893200*	*3879100*	*3393000*	100
Model X					*680000*	*3119500*	*3693500*	*3827000*	*3849900*	*4398500*	*4414700*	*4452000*	*4696500*	*4688300*	*5315800*	100
Model 3					*41140466*	*49706596*	*57842062*	*62318606*	*68340768*	*85126824*	*87478666*	*88587388*	*90386140*	*90876664*	*84639006*	82
Model Y					*33580394*	*69262776*	*96052340*	*98662564*	*109384884*	*137330812*	*144011680*	*147149492*	*149594650*	*151682780*	*148215656*	82
Cybertruck						*1050000*	*4972350*	*22066950*	*30946050*	*37339200*	*38851200*	*38752950*	*38659350*	*38348100*	*64050000*	150
Semi Trucks						*774500*	*1366500*	*3367000*	*5540000*	*5625000*	*6250000*	*7500000*	*8750000*	*10000000*	*11400000*	500
Roadster						--	*85000*	*132500*	*205000*	*590000*	*600000*	*610000*	*620000*	*630000*	*660000*	200
Mass Market Car Hatchback ($25K)						--	*8200000*	*10586517*	*13667603*	*17645405*	*22780900*	*29411023*	*37970769*	*49021732*	*48041297*	82
New Car #1 - ($25K)						--	--	--	--	--	--	*4,100,000*	*8,887,728*	*19,266,271*	*41,764,240*	82
New City Car #2 - ($15K)						--	--	--	--	--	*4,100,000*	*5,737,645*	*8,029,408*	*11,236,560*	*15,724,730*	82
New Car #3 Van						--	--	--	--	--	--	--	*10,000,000*	*16,193,826*	*26,224,000*	200
Energy storage	358,000	1,040,000	1,650,000	3,020,000	3,990,000	6,606,387	9,116,182	10,587,143	12,181,070	15,065,060	16,118,066	17,036,202	18,656,319	20,428,373	23,194,887	5% Percentage of total vehicle battery production
Total kWh						134,612,759	185,752,734	215,725,281	248,203,375	306,968,001	328,424,212	347,132,301	380,144,065	416,251,706	472,622,616	
- Gigafactory Nevada						99,612,759	150,752,734	180,725,281	213,203,375	271,968,001	293,424,212	312,132,301	345,144,065	381,251,706	437,622,616	
Number of Gigafactores						1.00	2.00	2.00	3.00	3.00	3.00	4.00	4.00	4.00	5.00	

100000000	Per new factory
35000000	Nevada Gigafactory

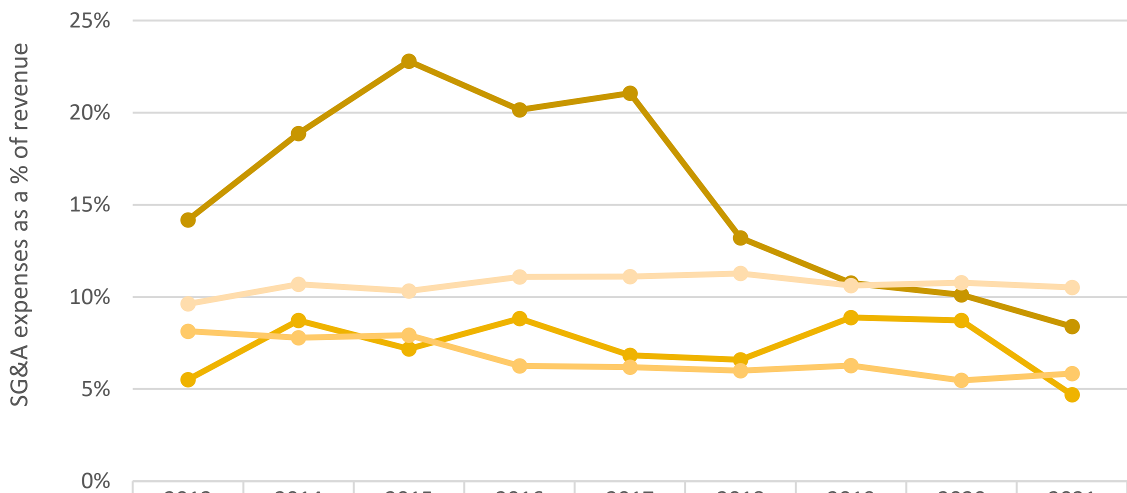
Source: Data retrieved from: (ev-database.org, 2022), own estimates, Further information in attached Excel document - *Tesla-DCF*

Appendix 15: Tesla forecasted vehicle factories

Vehicle factories	2019	2020	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E
Max Capacity (000's)													
Fremont (1159 hectares)	490	600	600	600	600	600	600	600	600	600	600	600	600
Shanghai (86 hectares)	200	450	500	1110	1110	1110	1110	1110	1110	1110	1110	1110	1110
Berlin (300 hectares)	--	--	--	99.9	518	808.08	925	1000	1000	1000	1000	1000	1000
Texas (1000 hectares)	--	--	--	100	500	750	750	750	750	750	750	750	750
Gigafactory #5	--	--	--	--	--	--	100	500	750	1000	1250	1500	2000
Gigafactory #6	--	--	--	--	--	--	--	--	--	100	500	500	500
Gigafactory #7	--	--	--	--	--	--	--	--	--	--	--	--	100
Total	**690**	**1,050**	**1,100**	**1,910**	**2,728**	**3,268**	**3,485**	**3,960**	**4,210**	**4,560**	**5,210**	**5,460**	**6,060**
Difference		*360*	*50*	*810*	*818*	*540*	*217*	*475*	*250*	*350*	*650*	*250*	*600*
Capacity utilization ratio (%)	53%	48%	85%	80%	77%	71%	76%	84%	85%	84%	81%	87%	79%

Source: own creation, Further information in attached Excel document - *Tesla-DCF*

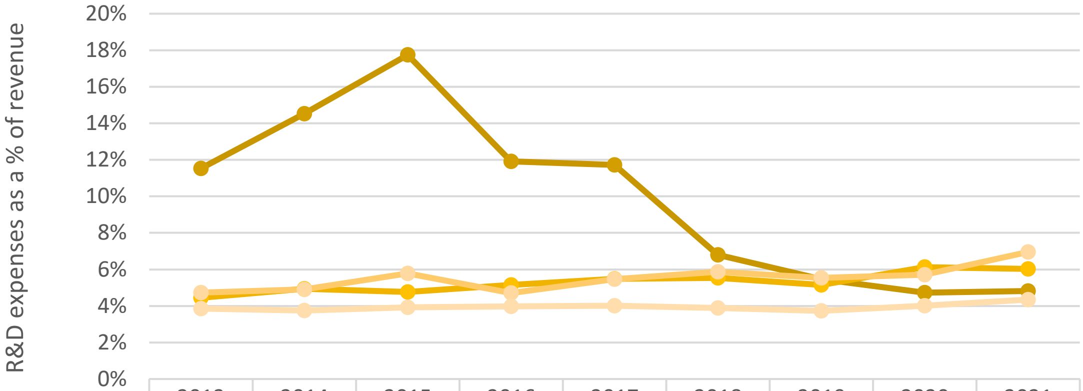
Appendix 16: Historic SG&A expenses of revenue



	2013	2014	2015	2016	2017	2018	2019	2020	2021
Tesla	14%	19%	23%	20%	21%	13%	11%	10%	8%
Ford	6%	9%	7%	9%	7%	7%	9%	9%	5%
General Moters	8%	8%	8%	6%	6%	6%	6%	5%	6%
Toyota	10%	11%	10%	11%	11%	11%	11%	11%	11%

Source: Own creation data obtained from Tesla 10-k, Ford 10-k, GM 10-k, Toyota annual report

Appendix 17: R&D expenses as a percentage of revenue



	2013	2014	2015	2016	2017	2018	2019	2020	2021
Tesla	12%	15%	18%	12%	12%	7%	5%	5%	5%
Ford	4%	5%	5%	5%	5%	6%	5%	6%	6%
GM	5%	5%	6%	5%	5%	6%	6%	6%	7%
Toyota	4%	4%	4%	4%	4%	4%	4%	4%	4%

Year

Source: Tesla 10-k, Ford 10-k, GM 10-k, Toyota annual report

Appendix 18: Tesla reinvestment rate and sales-to-capital ratio

$$Tesla\ 2021\ reinvestment\ rate = \frac{\$8{,}014 - \$2{,}911 - \$5{,}535}{\$6{,}523 \times (1 - 0.11)} \approx -7{,}44\%$$

$$Tesla\ 2020\ reinvestment\ rate = \frac{\$3{,}232 - \$2{,}322 + \$11{,}438}{\$1{,}951 \times (1 - 0.253)} = 847\%$$

$$2019 = \frac{1432 - 2154 + 2423}{80 \times (1 - 0)} = \frac{1701}{80} = 21{,}26\%$$

$$sales - to - captial\ ratio = \frac{Revenues}{BV\ debt + BV\ equity - cash}$$

$$2021\ sales - to - capital\ ratio = \frac{53823}{8904 + (30189 + 1394) - 17576} \approx 2{,}35$$

$$2020 = \frac{31536}{22225 + 1454 + 13337 - 19384} \approx 1{,}79$$

Source: CapitalIQ, (Damodaran, 2006)

Appendix 19: Toyota reinvestment

Toyota reinvestment rate *JPY, millions					
Year	2017	2018	2019	2020	2021
EBIT	1,994,372	2,399,862	2,457,201	2,399,231	2,197,748
Tax rate	25%	16%	25%	24%	22%
Change in net working capital	-1,607,288	-386,165	75,498	10,660,913	1,879,106
Capex	3,541,437	3,598,707	3,738,887	3,441,584	3,489,498
Depreciation	1,610,950	1,734,033	1,792,375	1,378,311	1,410,398
Reinvestment rate	21%	74%	110%	702%	231%

Source: CapitalIQ

Appendix 20: Automotive information

Company Name	Two-year regression Beta	Effective tax rate (%)	Market value of debt/equity (2021)
Tesla, Inc. (NasdaqGS:TSLA)	1.96	11	1.05%
Toyota Motor Corporation (TSE:7203)	0.72	22.2	106.86%
Volkswagen AG (XTRA:VOW3)	1.49	23.3	239.35%
BYD Company Limited (SEHK:1211)	1.05	12.2	8.82%
Mercedes-Benz Group AG (XTRA:MBG)	1.65	30.1	245.29%
Ford Motor Company (NYSE:F)	1.7	-	217.31%
General Motors Company (NYSE:GM)	1.8	21.8	189.34%
Bayerische Motoren Werke Aktiengesellschaft (XTRA:BMW)	1.29	22.4	234.03%
Stellantis N.V. (BIT:STLA)	1.86	12.6	76.00%
Honda Motor Co., Ltd. (TSE:7267)	1.1	23.9	160.30%
Lucid Group, Inc. (NasdaqGS:LCID)	0.97	NM	5.51%
Great Wall Motor Company Limited (SEHK:2333)	1.3	10.1	10.02%
Ferrari N.V. (NYSE:RACE)	0.789	20.1	8.99%
SAIC Motor Corporation Limited (SHSE:600104)	0.69	18.3	75.05%
NIO Inc. (NYSE:NIO)	2.09	NM	4.91%
Hyundai Motor Company (KOSE:A005380)	1.52	28.5	296.92%
Maruti Suzuki India Limited (NSEI:MARUTI)	1.0	17.4	0.27%
Porsche Automobil Holding SE (XTRA:PAH3)	1.6	0.066	0.18%
Li Auto Inc. (NasdaqGS:LI)	1.52	NM	5.01%
Kia Corporation (KOSE:A000270)	1.32	25.5	0.00%
Tata Motors Limited (BSE:500570)	1.72	NM	104.96%
PT Astra International Tbk (IDX:ASII)	0.947	20.9	28.50%
Guangzhou Automobile Group Co., Ltd. (SEHK:2238)	0.826	-	16.01%
Geely Automobile Holdings Limited (SEHK:175)	1.17	6.69	4.02%
Suzuki Motor Corporation (TSE:7269)	1.46	29.7	46.98%

Nissan Motor Co., Ltd. (TSE:7201)	0.978	NM	464.22%
Chongqing Changan Automobile Company Limited (SZSE:200625)	0.452	5.66	2.12%
Subaru Corporation (TSE:7270)	1.18	32.1	35.21%
Mahindra & Mahindra Limited (NSEI:M&M)	1.37	30.8	103.13%
Isuzu Motors Limited (TSE:7202)	1.43	39.5	30.74%
Chongqing Sokon Industry Group Stock Co.,Ltd. (SHSE:601127)	0.709	NM	9.66%
Eicher Motors Limited (BSE:505200)	0.807	23.6	0.37%
Renault SA (ENXTPA:RNO)	1.81	38.1	988.18%
Yamaha Motor Co., Ltd. (TSE:7272)	1.37	17.8	60.02%
Dongfeng Motor Group Company Limited (SEHK:489)	1.07	10.9	153.35%
FAW Jiefang Group Co., Ltd (SZSE:000800)	0.624	5.09	0.00%
Hero MotoCorp Limited (BSE:500182)	0.82	24.1	1.33%
Ford Otomotiv Sanayi A.S. (IBSE:FROTO)	1.06	-	24.87%
Harley-Davidson, Inc. (NYSE:HOG)	1.51	20.3	121.05%
Ninebot Limited (SHSE:689009)	1.66	23.9	0.17%
BAIC BluePark New Energy Technology Co., Ltd. (SHSE:600733)	0.816	33.9	63.96%
Thor Industries, Inc. (NYSE:THO)	1.71	21.8	35.16%
Anhui Jianghuai Automobile Group Corp.,Ltd. (SHSE:600418)	0.828	93.2	36.82%
Mazda Motor Corporation (TSE:7261)	1.14	1555.7	172.82%
TVS Motor Company Limited (BSE:532343)	0.728	26.1	48.16%
Lifan Technology (Group) Co., Ltd. (SHSE:601777)	0.262	25.1	19.23%
Yadea Group Holdings Ltd. (SEHK:1585)	0.624	19.2	0.79%
Fisker Inc. (NYSE:FSR)	0.44	-	21.00%
China Railway Materials Company Limited (SZSE:000927)	0.032	22.3	11.17%
PIERER Mobility AG (WBAG:PMAG)	0.726	23.5	21.70%
Trigano S.A. (ENXTPA:TRI)	1.01	20.7	10.93%
Beiqi Foton Motor Co., Ltd. (SHSE:600166)	0.779	NM	45.37%
CETC Acoustic-Optic-Electronic Technology Inc. (SHSE:600877)	0.49	15.1	0.04%
Yulon Nissan Motor Co., Ltd (TWSE:2227)	0.659	20.4	0.93%
Tofas Türk Otomobil Fabrikasi A.S. (IBSE:TOASO)	0.871	6.57	23.12%
BAIC Motor Corporation Limited (SEHK:1958)	1.03	33.9	125.71%
China Automotive Engineering Research Institute Co., Ltd. (SHSE:601965)	0.574	13.5	0.09%
Arrival (NasdaqGS:ARVL)	0.521	NM	5.50%
Winnebago Industries, Inc. (NYSE:WGO)	1.91	23.3	29.01%
DongFeng Automobile Co. LTD (SHSE:600006)	0.358	-	1.68%
Jiangling Motors Corporation, Ltd. (SZSE:000550)	0.669	-	5.76%
Loncin Motor Co., Ltd. (SHSE:603766)	0.606	#N/A	12.32%
Yulon Motor Company Ltd. (TWSE:2201)	1.01	20.2	510.58%
Haima Automobile Co.,Ltd. (SZSE:000572)	0.445	-	7.28%
IAT Automobile Technology Co., Ltd. (SZSE:300825)	0.561	7.45	1.55%
Canoo Inc. (NasdaqGS:GOEV)	0.398	-	1.21%
China Motor Corporation (TWSE:2204)	0.662	13.3	2.50%

Shenyang Jinbei Automotive Company Limited (SHSE:600609)	0.566	5.9	14.27%
Piaggio & C. SpA (BIT:PIA)	0.977	35.9	77.12%
Oriental Holdings Berhad (KLSE:ORIENT)	0.374	17.5	54.93%
UMW Holdings Berhad (KLSE:UMW)	1.37	-	78.53%
Zhejiang Qianjiang Motorcycle Co., Ltd. (SZSE:000913)	0.482	7.4	0.81%
Sanyang Motor Co., Ltd. (TWSE:2206)	0.438	17.7	74.64%
Niu Technologies (NasdaqGM:NIU)	1.37	11.1	4.29%
DRB-HICOM Berhad (KLSE:DRBHCOM)	0.942	NM	332.78%
Workhorse Group Inc. (NasdaqCM:WKHS)	1.48	NM	4.54%
Indus Motor Company Limited (KASE:INDU)	0.111	29.5	1.07%
Liaoning SG Automotive Group Co., Ltd. (SHSE:600303)	0.513	NM	11.85%
Knaus Tabbert AG (XTRA:KTA)	0.502	29.9	16.32%
Jiangsu Xinri E-Vehicle Co., Ltd. (SHSE:603787)	1.13	NM	0.00%
Qingling Motors Co., Ltd. (SEHK:1122)	0.678	3.96	2.16%
GB Auto (S.A.E.) (CASE:AUTO)	0.83	23.4	325.98%
Atlas Honda Limited (KASE:ATLH)	0.41	35.5	1.42%

Source: CapitalIQ

Appendix 21: Data on the battery industry

Company Name	Two-year Beta	Effective Tax Rate (%)	Market value of debt/equity (2021)
Contemporary Amperex Technology Co., Limited (SZSE:300750)	1.03	10.2	6.00%
LG Energy Solution, Ltd. (KOSE:A373220)	-	9.85	7.73%
Generac Holdings Inc. (NYSE:GNRC)	1.46	19.5	7.48%
Gotion High-tech Co.,Ltd. (SZSE:002074)	0.935	NM	27.05%
Pylon Technologies Co., Ltd. (SHSE:688063)	0.49	11.2	1.32%
Varta AG (XTRA:VAR1)	0.546	28.9	3.05%
Advanced Energy Solution Holding Co., Ltd. (TWSE:6781)	1.52	21.1	0.01%
Guangzhou Great Power Energy and Technology Co., Ltd (SZSE:300438)	0.784	0.25	10.17%
Shenzhen Desay Battery Technology Co., Ltd. (SZSE:000049)	0.787	16.5	17.59%
Enovix Corporation (NasdaqGS:ENVX)	2.87	-	0.65%
Far East Smarter Energy Co., Ltd. (SHSE:600869)	(0.042)	20.3	70.48%
Hunan Corun New Energy Co., Ltd. (SHSE:600478)	0.473	88.5	20.76%
Amara Raja Batteries Limited (BSE:500008)	0.627	25.9	1.02%
Stem, Inc. (NYSE:STEM)	2.83	-	36.03%
FREYR Battery (NYSE:FREY)	0.884	-	0.00%
CTEK AB (publ) (OM:CTEK)	-	24.1	11.68%
Fluence Energy, Inc. (NasdaqGS:FLNC)	-	NM	19.73%
Elentec Co., Ltd. (KOSDAQ:A054210)	1.36	2.44	29.33%
Shandong Sacred Sun Power Sources Co.,Ltd (SZSE:002580)	0.508	-	6.66%
Zhejiang Hengwei Battery Co., Ltd. (SZSE:301222)	-	12.1	0.01%
Kung Long Batteries Industrial Co.,Ltd (TWSE:1537)	0.135	24.2	0.38%
Seri Industrial S.p.A. (BIT:SERI)	0.814	NM	35.62%
ADS-TEC Energy PLC (NasdaqCM:ADSE)	0.26	NM	3.45%
AFC Energy plc (AIM:AFC)	2.42	NM	0.42%
Chongqing Wanli New Energy Co., Ltd. (SHSE:600847)	0.548	-	0.00%
Li-S Energy Limited (ASX:LIS)	-	NM	0.00%

Bosung Power Technology Co., Ltd (KOSDAQ:A006910)	0.167	NM	3.04%
Shenzhen Increase Technology Co., Ltd. (SZSE:300713)	0.208	-	1.95%
FDK Corporation (TSE:6955)	1.33	51.6	52.26%
APRO Co,. Ltd (KOSDAQ:A262260)	1.25	NM	0.18%
Romeo Power, Inc. (NYSE:RMO)	1.38	0.07	15.00%
Sangsin Energy Display Precision Co.,Ltd. (KOSDAQ:A091580)	0.903	23.7	29.75%
Leclanché SA (SWX:LECN)	1.97	NM	30.47%
Phinergy Ltd. (TASE:PNRG)	0.281	-	1.50%
Gelion plc (AIM:GELN)	-	-	0.12%
Monbat AD (BUL:MONB)	0.013	17.3	94.81%
Eos Energy Enterprises, Inc. (NasdaqCM:EOSE)	1.36	-	98.70%
CBAK Energy Technology, Inc. (NasdaqCM:CBAT)	1.52	-	15.03%
Ultralife Corporation (NasdaqGM:ULBI)	1.03	NM	29.67%
Changs Ascending Enterprise Co., Ltd. (TPEX:8038)	0.545	-	24.32%
ATON Green Storage S.p.A. (BIT:ATON)	-	22.0	7.52%
Leader Electronics Inc. (TWSE:3058)	0.463	NM	118.31%

Source: Capital IQ

Appendix 22: Tesla's Debt 2021

Debt	Face value ($millions)	Stated interest rate (%)	Maturity	Weights	Weighted Maturity (Based on face value)
2022 Notes	-	2.38%	-	-	-
2024 Notes	89	2%	2	2.09%	0.04
Credit Agreement	1,250	3.30%	1.5	29.38%	0.44
Solar Bonds	7	4.60%	4.5	0.16%	0.01
Automotive Asset-backed Notes	1,706	2.70%	1	40.10%	0.40
Solar Asset and Loan-backed Notes	800	5.30%	2	18.81%	0.38
Cash Equity Debt	388	5.50%	12	9.12%	1.09
Automotive Lease-backed Credit Facilities	-	Not applicable	1	-	-
Other Loans	14	5.1	11	0.33%	0.04
Total	4254				2.40

Source: (Tesla, 2022a)

Appendix 23: DCF-valuation of Tesla inc. - Researchers' case

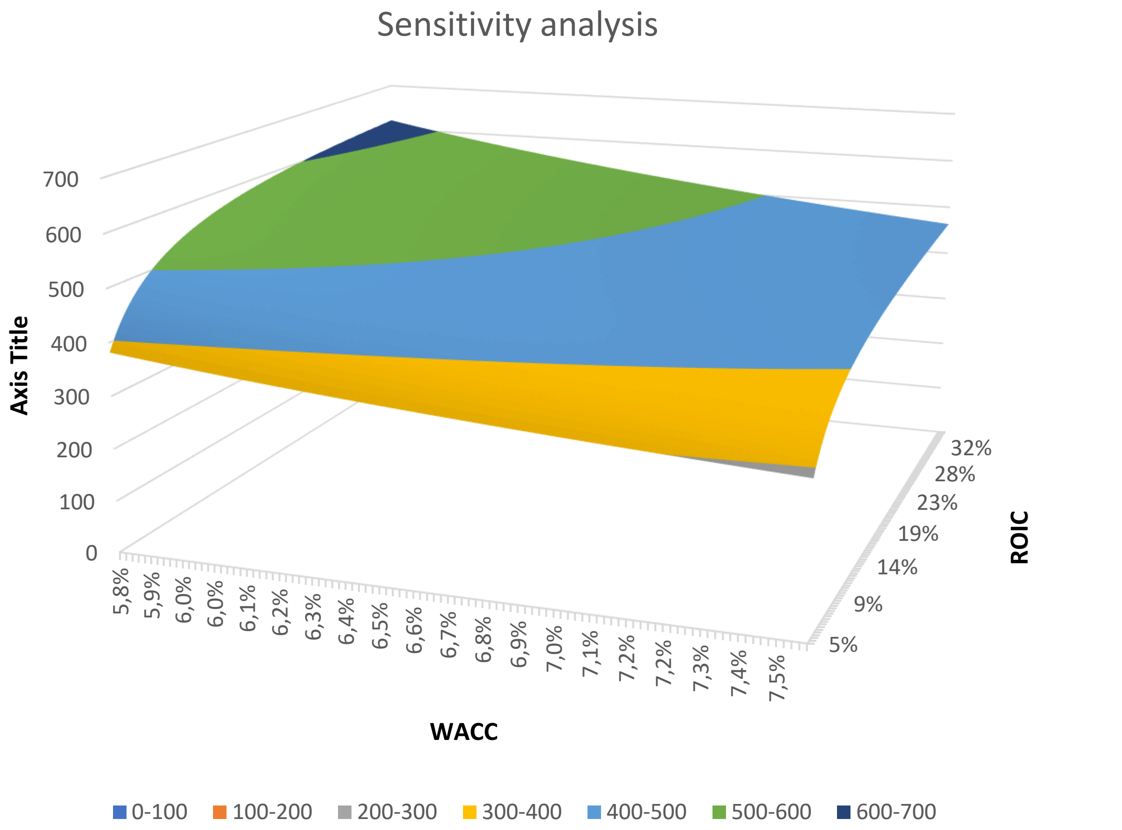
	Forecasting period										Continuing period
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Unlevered Free Cash Flow	$ 4,030.2	$ 7,494.6	$ 10,208.9	$ 13,685.1	$ 19,440.9	$ 21,676.7	$ 23,644.3	$ 25,928.1	$ 26,942.8	$ 29,185.8	$ 29,778.3
Credit rating	BB+	BB+	BBB	BBB	BBB	BBB	BBB	BBB	BBB	BBB	
Debt weight	1%	5%	9%	13%	16%	20%	23%	26%	29%	32%	
Equity weight	99%	94.96%	91.01%	87.23%	83.61%	80.14%	76.81%	73.62%	70.56%	67.63%	
Cost of debt	3.02%	3.02%	2.76%	2.76%	2.76%	2.76%	2.76%	2.76%	2.76%	2.76%	
Beta	0.65	0.68	0.70	0.72	0.75	0.77	0.80	0.83	0.86	0.89	
Cost of equity	6.0%	6.1%	6.3%	6.4%	6.6%	6.7%	6.9%	7.1%	7.2%	7.4%	
WACC	5.95%	5.98%	5.96%	5.96%	5.95%	5.94%	5.93%	5.93%	5.92%	5.91%	
Discount Factor	0.94	0.89	0.84	0.79	0.75	0.71	0.67	0.63	0.60	0.56	
PV of Unlevered Free Cash Flow	$ 3,803.7	$ 6,672.1	$ 8,580.5	$ 10,858.2	$ 14,563.4	$ 15,333.0	$ 15,794.3	$ 16,358.1	$ 16,056.0	$ 16,430.1	

10.00%	Return on capital
20.30%	Reinvestment rate
2.03%	Expected growth rate
-4.15%	CAGR
$\frac{1}{(1+WACC)^n}$	0.561036

$ 430,145.06	Terminal Value
$ 124,449.39	PV of Terminal Value
$ 554,594.45	Enterprise Value
$ 17,576.00	+ Cash
$ 8,904.00	- Debt
$ 563,266.45	Equity Value
1129	Shares
$ 498.91	Per Share

Source: Own creation, Further information in attached Excel document - *Tesla-DCF*

Appendix 24: Sensitivity analysis



Source: Own creation

Appendix 25: Elon Musk Case

Elon Estimate for Car Units K										2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E	CAGR	
Max Capacity (000's)																					
Model S	22.5	31.7	50.5	50.9	54.5	51.5	33.0	28.5	19.1	45.0	55.3	55.6	57.2	56.0	54.7	53.5	52.3	51.1	50.0	-2%	
Model X	0.0	0.0	0.2	25.3	46.9	47.9	34.4	28.5	6.8	34.3	46.2	50.9	53.9	53.2	52.6	51.9	51.3	50.6	50.0	-1%	
Model 3	0.0	0.0	0.0	0.0	1.8	146.1	300.9	356.6	501.7	666.8	881.7	1,010.8	1,166.8	1,324.8	1,504.2	1,707.9	1,939.2	2,201.8	2,500.0	14%	
Model Y	0.0	0.0	0.0	0.0	0.0	0.0	0.0	86.0	409.5	929.1	1,464.2	1,600.3	1,867.5	2,021.1	2,187.2	2,367.0	2,561.6	2,772.1	3,000.0	8%	Rav4 - 1 million
Cybertruck	--	--	--	--	--	--	--	--	--	17.6	91.3	180.9	315.0	381.9	463.0	561.2	680.4	824.9	1,000.0	21%	F-150 1 millio/year
Semi Trucks	--	--	--	--	--	--	--	--	--	1.1	1.3	6.0	14.0	22.6	36.6	59.2	95.6	154.6	250.0	62%	2.3 million semi truck globally
Roadster	--	--	--	--	--	--	--	--	--	--	2.5	2.4	2.7	3.3	4.1	5.2	6.4	8.0	10.0	25%	
Mass Market Car Hatchback ($25K)	--	--	--	--	--	--	--	--	--	--	100.0	400.0	1,250.0	1,685.0	2,271.4	3,061.9	4,127.4	5,563.8	7,500.0	35%	Toyota Corolla 1.5 million
New Car #1 - ($25K)	--	--	--	--	--	--	--	--	--	--	--	--	--	250.0	410.9	675.5	1,110.3	1,825.1	3,000.0	64%	
New City Car #2 - ($15K)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	250.0	420.4	707.1	1,189.2	2,000.0	68%	
New Car #3 Van	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100.0	126.0	158.7	200.0	26%	
Total	**22.5**	**31.7**	**50.7**	**76.2**	**103.2**	**245.4**	**368.3**	**499.6**	**937.1**	**1,694.0**	**2,642.4**	**3,306.8**	**4,727.1**	**5,797.9**	**7,234.7**	**9,063.7**	**11,457.7**	**14,800.1**	**19,560.0**	36%	Tesla longterm growth rat goal is 50%
% growth		**41%**	**60%**	**50%**	**35%**	**138%**	**50%**	**36%**	**88%**	**81%**	**56%**	**25%**	**43%**	**23%**	**25%**	**25%**	**26%**	**29%**	**32%**		

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Global light vehicle market size (#ks)	89,165	93,990	96,448	95,544	91,988	80,466	84,928	90,638	94,797	97,423	100,073	103,447	105,317	107,292	108,788	110,065
Market share of Global light vehicles	0.1%	0.1%	0.1%	0.3%	0.4%	0.6%	1.1%	1.9%	2.8%	3.4%	4.7%	5.6%	6.8%	8.4%	10.4%	13.31%
Battery EV market size (#ks)	326	471	788	1,276	1,675	2,268	3,753	5,541	7,710	10,098	12,529	15,568	18,804	21,997	25,311	28,123
Market share of Batter EV	15.5%	16.2%	13.1%	19.2%	22.0%	22.0%	25.0%	30.6%	34.3%	32.7%	37.6%	37.1%	38.3%	40.9%	44.9%	52.1%

Source: Own creation, Further information in attached Excel document - *Tesla-DCF*

Appendix 26: Tesla Elon production ramp up

Elon Musk expectations										*# of vehicles			
Gigafactory	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E		
Max Capacity (000's)													
Fremont (1159 hectares)	600	600	750	850	1,000	1,250	1,250	1,250	1,250	1,250	1,250		
Shanghai (86 hectares)	500	1,110	1,250	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500		
Berlin (300 hectares)	--	100	518	808	925	1,000	1,250	1,500	1,500	1,500	1,500		
Texas (1000 hectares)	--	100	500	750	1,000	1,500	2,000	2,000	1,500	2,000	2,000		
Gigafactory Shanghai 2	--	--	--	500	750	1,000	2,000	2,000	2,500	2,500	2,500		
Gigafactory #6	--	--	--	--	--	500	1,000	1,500	2,000	2,000	2,000		
Gigafactory #7	--	--	--	--	--	--	500	1,000	1,500	2,000	2,000		
Gigafactory #8	--	--	--	--	--	--	--	500	1,000	1,500	2,000		
Gigafactory #9	--	--	--	--	--	--	--	--	500	1,000	2,000		
Gigafactory #10	--	--	--	--	--	--	--	--	500	1,000	2,000		
Gigafactory #11	--	--	--	--	--	--	--	--	500	1,000	2,000		
Gigafactory #12	--	--	--	--	--	--	--	--	--	500	1,000	85%	Estimated capacity utilization rate
Total	**1,100**	**1,910**	**3,018**	**4,408**	**5,175**	**6,750**	**9,500**	**11,250**	**14,250**	**17,750**	**21,750**	Elon goal of 20 mil cars per year	
Difference		*810*	*1,108*	*1,390*	*767*	*1,575*	*2,750*	*1,750*	*3,000*	*3,500*	*4,000*		
Capacity utilization ratio (%)	**85.2%**	**88.7%**	**87.6%**	**75.0%**	**91.3%**	**85.9%**	**76.2%**	**80.6%**	**80.4%**	**83.4%**	**89.9%**		

Source: Own creation, Further information in attached Excel document - *Tesla-DCF*

Appendix 27: projected revenue for the automotive industry, 2021 - 2030

Rank	Firm	Revenue $mm 2021	Projected revenue $mm 2030
1	Toyota Motor Corporation (TSE:7203)	$258,408	$323,551
2	Stellantis N.V. (BIT:STLA)	$169,930	$212,767
3	Mercedes-Benz Group AG (XTRA:MBG)	$150,932	$188,981
4	Ford Motor Company (NYSE:F)	$134,589	$168,518
5	General Motors Company (NYSE:GM)	$130,509	$163,409
6	Bayerische Motoren Werke Aktiengesellschaft (XTRA:BMW)	$126,509	$158,400
7	Honda Motor Co., Ltd. (TSE:7267)	$124,206	$155,517
8	SAIC Motor Corporation Limited (SHSE:600104)	$121,961	$152,707
9	China FAW Group Co., Ltd.	$112,529	$140,896
10	Hyundai Motor Company (KOSE:A005380)	$99,214	$124,225

Source: Own creation, Capital IQ, (Paul Gao et al., 2016)

Appendix 28: DCF-valuation of Tesla inc. - Elon Musk Case

	Forecasting period										Continuing period
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Unlevered Free Cash Flow	$ 5,067.3	$ 11,413.8	$ 14,808.3	$ 24,185.3	$ 33,349.6	$ 42,866.7	$ 56,469.0	$ 75,427.3	$ 103,561.3	$ 209,034.5	$ 213,277.9
Credit rating	BB+	BB+	BBB	BBB	BBB	BBB	BBB	BBB	BBB	BBB	
Debt weight	1%	5%	9%	13%	16%	20%	23%	26%	29%	32%	
Equity weight	99%	94.96%	91.01%	87.23%	83.61%	80.14%	76.81%	73.62%	70.56%	67.63%	
Cost of debt	3.02%	3.02%	2.76%	2.76%	2.76%	2.76%	2.76%	2.76%	2.76%	2.76%	
Beta	0.65	0.68	0.70	0.72	0.75	0.77	0.80	0.83	0.86	0.89	
Cost of equity	6.0%	6.1%	6.3%	6.4%	6.6%	6.7%	6.9%	7.1%	7.2%	7.4%	
WACC	5.95%	5.98%	5.96%	5.96%	5.95%	5.94%	5.93%	5.93%	5.92%	5.91%	
Discount Factor	0.94	0.89	0.84	0.79	0.75	0.71	0.67	0.63	0.60	0.56	
PV of Unlevered Free Cash Flow	$ 4,782.5	$ 10,161.2	$ 12,446.3	$ 19,189.5	$ 24,982.5	$ 30,321.7	$ 37,721.1	$ 47,587.2	$ 61,715.1	$ 117,675.4	

-4.15%	CAGR
$\frac{1}{(1+WACC)^n}$	0.561036

$ 3,080,782.06	Terminal Value
$ 366,582.51	PV of Terminal Value
$ 3,447,364.57	Enterprise Value
$ 17,576.00	+ Cash
$ 8,904.00	- Debt
$ 3,456,036.57	Equity Value
1129	Shares
$ 3,061.15	Per Share

Source: Own creation, Further information in attached Excel document - *Tesla-DCF*