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TESLA AND THE ELECTRIC VEHICLE MARKET IN 2018

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Abstract

This Work Project presents a case study to be used in masters and executive education Strategy courses to better illustrate the dynamics of competition in markets with demand-side increasing returns. Through the real case of Tesla, this project intends to evaluate the strategic decisions pursued by the firm in the nascent electric vehicle market to overcome the hurdle of critical mass and provide a platform on which e-mobility can realize its full potential. In the analysis that follows, we conclude that Tesla created a model that exceeds the conventional auto business to allow its vehicles to move along the technology adoption curve.

Keywords: Tesla, Electric Vehicles, Demand-side Increasing Returns, Strategy

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Introduction

This Work Project presents a case study to be used in Strategy courses in Masters and executive education programs. The business case is inspired by the strategic decisions Tesla made while building and expanding an empire in the emerging electric-vehicle market.

The report aims to analyse the topics of strategy and competition in markets with demand-side increasing returns. This subject is particularly interesting since these dynamic effects tend to have strategic implications and play a significant role in competition in several important industries, particularly in new, high-technology markets, where complex technologies often exhibit increasing returns when adopted.

Building a case study was the methodology selected since a practical example would provide a unique perspective on formulating the strategy and the real-life challenges companies face when introducing a new technology in markets that display network externalities. The case illustrates a situation in which the firm is unable to profitably produce sufficient quantity to justify the existence of the industry and the dynamic process of network growth.

This work project will be divided as follows. Firstly, the description of the case will be used to study the background of the company and its overall strategy in detail, as well as the global view of the automotive and electric car industries, while addressing economic, political and psychological factors that could either promote or hinder the mass adoption of the new technology. Secondly, a brief summary of the literature will provide the most relevant concepts and insights on the topic of technology adoption in the presence of network externalities, which are essential for a thorough analysis of the practical example presented. The last part will demonstrate how the application of the case´s major issues to the theoretical approach will serve to reach a firm conclusion on the matter and provide valuable lessons on how firms should strategize on markets with such dynamic effects.

Case Study

Tesla´s Life in The Fast Lane

On October 2, 2018, Elon Musk revealed Tesla set a new company record, by delivering 83,500 cars in the third quarter alone: 55,840 Model 3, 14,470 Model S and 13,190 Model X (See exhibit 1). In this truly historic quarter, the company delivered around 80% of the total amount of vehicles it had delivered the previous year (Tesla 2018a). What is now called "the most amazing quarter in their history" was also marked by a 12% increase in Tesla´s shares, after the report disclosed a surprising profit (Kopecki 2018). Elon Musk was experiencing a spell of success, having made the most impressive progress in the history of the car industry. Tesla was now assembling 340,000 vehicles per year, instead of the previous amount of 100,000 units. (Tesla 2018a)

Not all reactions were optimistic about Tesla´s new strong trajectory as many were sceptical about the company´s ability to dramatically change its earning profile and make the business sustainable. Having only had two lucrative quarters prior to this year´s third quarter earnings report, shareholders and analysts questioned "if this is not as good as it gets from a near-term upside surprise for shares" (Kopecki 2018).

Despite Tesla´s elusive profitability and financial straits, the prevalent question on Musk´s mind was always: What is the next move? As he built a great vision for Tesla in the creation of a sustainable energy future, he transformed the company into part of a tiny contingent of enterprises with a permit to lose billions, while pursuing a dream. Elon Musk´s ambitions went beyond the ramp-up vehicle production and involved other significant cash-burning bets, such as creating an automated car-sharing solution and the acquisition of SolarCity, a solar panels provider. There was no surprise when Musk´s colleagues argued that "Elon thinks bigger than just about anyone else I´ve ever met.". (Yoffie, Baldwin and Kauffmann 2018) Now Musk just needed to ensure all this came true …

The Tesla Story

Tesla, Inc. is a U.S- based company founded in 2003 by two Silicon Valley entrepreneurs, Martin Eberhard and Marc Tarpenning. Concerned about global warming and the urgent need to find alternative fuel options, the two engineers´ initial goal was to develop a fully-electric environmentally friendly sports car. At the time the combination seemed unlikely: the option was between expensive sports cars or the Toyota Prius, which Eberhard named "dork mobile". However, he later pointed out that "people weren´t buying a Prius to save money on gas - gas was selling close to inflation-adjusted all-time lows. They were buying them to make a statement about the environment." (Copeland 2008). So why not allow the speed-loving, environment-driven and wealthy clientele to make that statement driving an electric-powered vehicle that could outperform the existent sport cars?

The company encountered a significant reluctance from the venture capital community, until Elon Musk, an entrepreneur that had become a byword for ambition and other-worldly fascination in high-tech gadgets, agreed to invest $6.3 millions in Tesla (Copeland 2008). As a result of the settlement, Musk took on the role of Tesla´s chairman and, in 2006, revealed the company´s "secret" strategic plan, which included:

1. "Build a sports car.
2. Use that money to build an affordable car.
3. Use that money to build an even more affordable car.
4. While doing above, also provide zero-emission electric power generation options.
5. Don´t tell anyone." (Musk 2006) (See exhibit 2)

Tesla started to implement the master plan by releasing its first electric vehicle model- the Roadster- in 2008. It was a $109,000 fast sports coupe that was able to drive up to 220 miles on a single charge, thus demonstrating one does not need to compromise performance and design to drive electric cars (LaMonica 2008). Although wealthy clientele was eager to own

this progressive, “green” sports car, it suffered a few production defects on transmissions that hampered its mass production. Tesla then announced it would terminate production of the Roadster to centre its attention on the next model: the Model S, a high-quality family sedan, with a starting price of $66,000 (Rothaermel and King 2017). Enthusiasm for this model was running high, thus the great production scale allowed for some reductions in unit costs, placing the total cost to develop the Model S at $500 million. Opportunely, the US Government perceived this car as a promising technology that would help reduce oil dependency and granted Tesla a $465 million loan (Dyer and Furr 2016). Market reception for Model S surpassed all expectations, as it scored the highest value of Consumer Reports (99/100) in the car history (Rothaermel and King 2017) and Motor Trend explained why: “As its core, the Tesla Model S is simply a damned good car you happen to plug in to refuel.” (Gilson and Abbott 2017)

Attempting to appeal to a broader market, Tesla introduced the Model X, a sport-utility SUV with falcon-wing doors and a starting price of $100,000 (Rothaermel and King 2017). Both Model S and X were positioned in the high-end market, where customers had to pay a high premium in order to drive these electric vehicles. However, Tesla´s ultimate goal was to drive down market and release an all-electric vehicle for the mass market. Model 3, a compact sedan with a starting price of $35,000 (Rothaermel and King 2017), was the accomplishment of this dream. As the company accepted preorders, 325,000 want-to-be Tesla owners made a $1.000 deposit in order to secure a position in the waiting list, which meant a $500 million interest-free loan for the company (Hull 2016).

Trying to accomplish step 4 of Tesla´s master plan, the company enlarged its activity beyond manufacturing electric vehicles and purchased the Gigafactory, a lithium ion battery production complex, in 2014 (Tesla 2017). This factory was crucial to ensure the 500,000 vehicles per year goal was met by 2020, as this would not be possible by solely relying on the current world supply of lithium ion batteries.

Along the way, Tesla filed an initial public offering with the Securities and Exchange Commission in 2010. In its stock market debut, the company´s shares increased from $17 per share to $23.89, generating $226.1 million. By 2018, due to the outstanding increase in Tesla´s market cap, shares were worth 1,889% more than at the IPO date (Varty 2018). With a market capitalization surpassing the $60 billion threshold, Tesla had become one of the most valuable car makers in the world, alongside GM and Ford. (Rothaermel and King 2017) (See exhibit 3 and 4)

Global Automotive Industry

The automotive market registered 95.8 million global vehicle sales in 2017 and the number is expected to increase 2.5% in 2018, reaching 98 million units. Worldwide vehicle sales are set to achieve the 100 million milestone as early as 2019, with emerging markets such as China and India being the largest contributors to this sales growth (Allianz SE 2017).

Despite the strong level of competition in the global automotive industry, it can still be attractive to new players as it avails steady profitability. This market is mostly controlled by a small number of manufacturers and the high barriers to entry ensure that incumbent firms recover the profits of their investments. Besides the well-established European and American automakers, manufacturers from Korea, Japan and China have reinforced their global presence in the automotive industry in recent years (Bardt 2017).

Competing for the leading global car sales and production are Toyota Motor - with 9 million vehicles sold in 2017 and $256.5 billion in revenue - and Volkswagen – with 10.7 million units sold and $284.6 billion in revenue in 2017. Other key players include Daimler, taking the third position in terms of revenues with $202.3 billion in 2017, BMW, Honda Motor, Hyundai, General Motors, Ford Motors, Nissan, Fiat Chrysler and Tesla (Christou 2018). While the highest profitability is secured by Japanese manufacturers, the worldwide leaders on R&D and innovation are based in Germany and the United States (Allianz SE 2017).

Automotive industry has always focused on innovation towards superior mechanical and electric engineering performance, while the consumer was merely a bystander in this process. Notwithstanding, these historical market conditions are about to be changed. In fact, this sector is set to face some unprecedented transformations with the development of four mobility megatrends: autonomous, connected, electrified and shared ("ACES") (Knupfer et al. 2017). These trends are strongly interconnected and reinforcing, as alternative fuelled vehicles allow easier integration and management of components, thus facilitating autonomous driving technologies. Also, the new sharing mobility business models will mostly employ electric vehicles due to their lower running costs when compared to the standard combustion engine models (Knupfer et al. 2017). According to Mary Barra (CEO, General Motors), "The auto industry is poised for more change in the next five to ten years than it's seen in the past 50." (Wollschlaeger et al. 2015)

Electric Vehicles Market

Overview

The megatrends mentioned above are driving the transition to e-mobility as a new record for the global stock of electric vehicles was reached in 2017. The 3.1 million electric cars in circulation worldwide meant an increase of 57% from the previous year (Bunsen et al. 2018). Regarding sales, 2017 marked the conquest of the 1 million units' threshold, with 1.1 million electric vehicles sold worldwide. China, the U.S. and Norway were the three leading markets accounting for 68% of all electric vehicle sales that year (Bunsen et al. 2018).

The up to date global investment on electric vehicles has reached the $90 billion threshold and it continues to grow as established automakers such as Volkswagen, Daimler, Nissan and Volvo reinforce their commitment to the gradual electrification of their fleet (Lienert 2018). As a result, there was an increase in the number of automakers producing electric vehicles and in the size of their production (See exhibit 5). In 2017, there were ten companies - BAIC, BMW,

BYD, Geely, GM, HyundaiKia, SAIC, Tesla, Toyota, Volkswagen - exceeding 50,000 cars in annual sales, compared to only five firms in the previous year. China accounted for nearly 50% of the overall production in 2017, with Chinese electric vehicle models being sold predominantly in the country. Likewise, the leading electric vehicles produced outside of China are largely unavailable there, with Tesla models being the exception (Lutsey et al. 2018).

The dynamic first half of 2018 indicates e-mobility will continue to experience a strong momentum and Tesla is the big market share winner with 12% of the total electric vehicles sales of 2018, followed by the Chinese car manufacturer BYD with 11% market share and the Renault-Nissan-Mitsubishi alliance with 10% market share (Kane 2018) (See exhibit 6).

Despite the increasing enthusiasm around alternative fuelled vehicles, global electric vehicles sales still amount to less than 1% of the almost 100 million units sold every year in the car industry (Bunsen et al., 2018). Along these lines, Tesla, considered the world´s most recognized electric vehicle brand, sold just over 100,000 cars with its three available models in 2017, illustrating why e-mobility is not yet considered by most car manufacturers a lucrative opportunity (Varty 2018).

Rising Consumer Confidence

Consumer excitement for e-mobility has dramatically increased over recent years, boosting the share of potential new vehicle buyers that would consider purchasing an electric car. The unrivalled amount of Tesla´s Model 3 preorders in 2016 perfectly illustrates this shift in consumer demand.

Misconceptions about price, driving performance and safety are being mitigated and replaced by a change in the consumer demand towards more environmentally-friendly vehicles. Significant technology improvements and the reduction in the total cost of ownership of an electric vehicle - due to a combination of lower maintenance costs and fuel savings - have contributed to the rising number of consumers who are now aware of EV benefits. However,

despite the significant advances in battery packs and design of electric vehicles, many potential customers are still put off by the limited availability of supporting services and charging network. (Knupfer et al. 2017).

Policy Landscape

Governments throughout the world play a leading role in fostering the transition to e- mobility by tightening emissions standards with global agreements and providing purchase incentives for "greener" mobility options, such as financial incentives and tax credits.

Additionally, the proliferation of charging stations worldwide, having achieved 430,000 public infrastructures in 2017, is crucial to foster attraction for electric vehicles, especially in populous cities. Governments are crucial in the rapid increase and standardization of charging methods as the distress regarding low driving ranges is further aggravated with the currently insufficient infrastructure electric vehicles depend upon. (Bunsen et al. 2018) (See exhibit 7).

The Battery Barrier

Prices of lithium-ion battery packs have impressively decreased from $1,000/kWh in 2010 to $209/kWh in 2017, which means a 79% decline in seven years (McKerracher et al. 2018). The advances in the efficiency of batteries have also contributed to the 30% improvement in the estimated vehicle range per charge (Knupfer et al. 2017). Thus, the downward trend in battery prices and increasing range has lead to the eventual price parity between electric vehicles and combustion engine vehicles, while alleviating potential buyers 'concerns about estimated range.

Despite the impressive seven-year decrease in battery pack prices, the technology´s economics are still unfavourable when compared to combustion engine motors. With a 2017 estimated price of $209/kWh, a 60 KWh battery pack translates into a $12,500 component of the electric vehicle, explaining why some of the initial manufacturers burned through cash and lost money with every car sold (Knupfer et al. 2017). This battery barrier will still hinder automaker's

profitability as long as the battery costs do not drop enough on the cost curve to ensure technology is no longer prohibitively expensive (Chatterjee and Terez 2018).

Capital Crunch

The need to simultaneously invest in different industry megatrends leads to a serious shortage of capital, delaying necessary investments in research and development, new plants and strategies regarding electric vehicles. Besides autonomous driving technologies and connectivity, car manufacturers intend to increase combustion engine efficiency through improvements in the transmission, smaller and lighter construction, aerodynamics and hybridization (Knupfer et al. 2017). Therefore, it is a strategically costly period to be a car manufacturer.

Tesla´s Strategy: Building the Network

"Electric cars, batteries, and renewable energy generation and storage already exist independently, but when combined, they become even more powerful – that's the future we want." (Tesla 2018b)

Start High with a Great Product

To create its customer base, Tesla decided to initially target a high-end niche segment of the market - with the Roadster and Models S and X - to get the environment-friendly and luxury enthusiasts to jumpstart the process. While this rather small segment would not lead to many sales, if successful, it would allow the early adopters to subsidize the technology development, placing Tesla one step ahead to expand its product line (Chatterjee and Terez 2018). Since then, Tesla has gradually expanded to other customer segments with its low-priced Model 3, attracting mainstream mobility seekers who want basic mobility solutions with low maintenance costs and consumers interested in adopting green technologies, but unwilling to pay a large premium for them.

Best in Class

Tesla´s superior competencies regarding electric powertrain development arose from its focus on the conceptual property of four components: battery pack, power electronics component, high efficiency engine and electronic control software (Perkins and Murmman 2018).
Unlike the traditional car manufacturers, who inserted a battery in the standard combustion engine platform, Tesla completely changed its cars construction by building the systems and drivetrain around the battery, removing transmission and changing the technology basis of the traction control. Besides the more integrated drivetrain, Tesla also took up the scientific challenge of creating a strong and economically favourable battery pack that could fully power its cars. By creating its own methods for linking battery cells and applying coolant through the entire pack, Tesla significantly improved the performance and range of its lithium ion batteries (Dyer and Furr 2016). Lastly, as vehicles become more technology-savvy, Tesla stands out with its software design capabilities, with the unprecedented ability to update the car software over the air. Using the Tesla app, clients can remotely update their vehicle into a smarter, safer and more intuitive car.

Factory Despite the small production volume, Tesla assembles all its vehicles in a factory in Freemont, California, in an attempt to benefit from the economies of scale that electric vehicles - with high fixed costs and learning economies - tend to present. To leverage on existing industry infrastructures, the plant was purchased from Toyota and GM, and later adapted to become a highly automated factory, making extensive use of robots that performed several tasks on different models.

Gigafactory While most car producers outsourced an increasing number of their components, Tesla pursued a prospectively game-changing strategy, by choosing to vertically integrate all the major modules of the powertrain, thus retaining control over their supply, quality and developments. Therefore, in a partnership with Panasonic, the firm integrated backwards into

a battery production complex in Nevada, the Gigafactory. Everything about the complex was massive: once completed, it would be the largest building in the world, producing "35 GWh/year of lithium-ion battery cells, nearly as much as the rest of the world´s battery production combined" (Tesla 2017).

By internalizing the battery production, Tesla was able to reduce costs across the entire value chain, allowing the firm to progressively develop models with higher ranges and competitive prices.

Not Customers, Fans

Service Tesla contrived its Service Division to subsidize one aspect of the ownership experience, by owing several service centres that operate under Musk´s instructions to never make a profit. Additionally, as the firm´s electric cars have fewer moving parts compared to the combustion engine vehicles, servicing and maintenance can often be done by technicians at the customers' own home. This significantly improved customer satisfaction and saved Tesla both time and money, freeing service centres to focus on more complicated issues. The firm has also focused on increasing its maintenance and service capacity, which Tesla has doubled in 2017 alone, through an increasing number of service centres and efficiency improvements of 50% in the existing locations. The significant expansion in service was also due to the enlargement of the Mobile Service fleet. The 230 vehicles not only helped to improve the service´s productivity, but also expanded Tesla´s coverage area (Tesla 2018a).

Distribution Tesla believed the traditional distribution model, based on dealers, was dated and costly to consumers, and, as such, it built its proprietary sales network. To create a seamless direct-to-consumer strategy, the firm relied on two distribution channels: online purchasing and direct sales at Tesla´s owned retail stores. These are located at high foot traffic areas, so that Tesla´s sales representatives can interact and educate a large number of potential customers. By keeping the sales in-house, Tesla is able to offer outstanding customer service, prevent

misinformation developing around its electric vehicles and capture a larger revenue share from the vehicles sold.

Supercharging the System

Tesla is also trying to accelerate the industry´s growth through charging stations and related infrastructures deployment. Creating a global supercharging platform with 11,234 superchargers distributed amongst 1,359 conveniently located stations, Tesla has assured that charging blends easily into its clients´ lives (See exhibit 8). The integrated trip-planner on the tesla´s touchscreen automatically routes the owner through superchargers on the way to the destination. Superchargers deliver energy swiftly, enabling Tesla owners to charge 80% of the battery within 30 minutes and to monitor and get notifications about the charging status in the Tesla app. Besides de superchargers, Tesla has also invested in partnerships with hotels, restaurants and shopping centres to grow its network of Destination Charging Partners, making charging at destinations as effortless as charging at home. In order to increase compatibility with the standard public charging network, Tesla vehicles can also be charged at those stations and other non-Tesla electric vehicles can use the firm´s charging platform with a J-1772 adapter. (Tesla 2018c)

A Sign of Good Faith

While focusing significantly on technological advancements, Tesla understands it cannot expand the entire market single-handedly. Therefore, the firm has engaged in an open source movement to foster the progress of electric vehicle technology, making its strong patent portfolio available. In response to Tesla´s move, established automakers such as BMW and Nissan revealed their plans to use the firm´s technology. As Musk stated "Our true competition is not the small trickle of non-Tesla electric cars being produced, but rather the enormous flood of gasoline cars pouring out of the world´s factories every day.", and the best way to accelerate

the transition to sustainable transportation is a shared, rapidly-developing technology platform (Backler et al. 2015).

A Strategic Portfolio Expansion

With a mission to revolutionise all the major forms of transportation, Tesla has also expanded its product portfolio to the commercial sector, unveiling its long awaited all-electric Semi-Truck in 2017, whose production is set to start as early as 2019. As commercial vehicles are usually driven more frequently and for longer journeys, there is a faster amortization, making organizations important elements in the integration of electric vehicles into their vehicle stock. Customers will be able to choose from the 300 miles version, priced at $150,000 or the 500 miles version, priced at $180,000 (Tesla 2018d). The first Semi prototypes are currently in their test phase and have been spotted carrying battery packs from Gigafactory1 to Freemont production facility (Lambert 2018).

Investing in China

Tesla has announced plans to establish a bigger presence in China, the world´s largest market for electric vehicles, with a new Shanghai factory known as "Gigafactory 3". The plant is expected to gradually increase its capacity, starting with 250,000 cars and battery packs each year, with the first vehicles being assembled in about three years. The strategic choice of location was driven by the fact that China´s largest cities, such as Shanghai, Beijing and Guangzhou have been imposing significant restrictions regarding combustion engine vehicles and are also the home of the country´s wealthiest consumers, who are more likely to take an interest in the firm´s electric cars. Tesla´s expansion to China will strengthen its position in the global electric vehicle market, as China´s commitment to sustainable transportation and the unrivalled size of its market have been driving electric vehicles mass adoption (*Why Tesla´s Billion-Dollar China Play is Key to Its Survival* 2018).

Automated Car-sharing Service

Tesla is focused on improving the self-driving technology of its vehicles in order to transform them into a source of income for Tesla´s owners. As technology matures, every vehicle produced in the firm´s factory, is now fully equipped with the hardware required for full sell-driving capability. It is important to note that the refinement and approval of the self-driving feature will come with a significant time gap. Thus, Tesla is currently using partial autonomy with its Autopilot driving experience, which automatically adjusts speed, changes lanes, exits the freeway, self-parks and allows Tesla owners to summon their vehicle to and from the garage (Tesla 2018e).

When the full-self driving capability is approved, Tesla plans to leverage the concepts of sharing economy and car ownership to deploy to a new business model. Customers will be able to generate income with their vehicle while they are at work or on vacation, by adding them to the Tesla shared fleet. Since most people only use their vehicle in a small fraction of their day, a car sharing service with Tesla vehicles will reduce the total cost of ownership and allow everyone to ride in a Tesla (Musk 2016).

Moving beyond the Auto Business

By the end of 2016, Musk orchestrated yet another big bet by acquiring SolarCity - a company specialized in solar energy services - for $2.6 billion (Chatterjee and Terez 2018). This addition changed the company´s mission from "accelerate the advent of sustainable transportation" to "accelerate the advent of sustainable energy" (Tesla 2018b), which led the company to drop the word "Motors" from its formal name. Tesla´s corporate image was now irrevocably changed, as it became the first fully integrated company that offered solar energy production, energy storage and transportation (Chaterjee and Terez 2018) (See exhibit 9).

To take advantage of an overlapping product interest, Tesla created an entire sustainable ecosystem by offering an end-to-end clean energy product. Combining the vehicle, the solar

panel system and the Powerall – a rechargeable lithium-ion battery manufactured in the Gigafactory - would allow customers to consume energy in the most efficient way. The idea was that the Powerall could integrate with the solar panels to capture and store energy, powering both the car and the house (Gilson and Abbott 2017).

As both companies shared the goal of accelerating the transition to a sustainable future, Musk saw the acquisition as the logical progress. Tesla´s experience in design and manufacturing would help improve the solar technology, while the firm´s own products would benefit from SolarCity´s sales and distribution channels, the expertise in installation and the convenient financing products (Gilson and Abbott 2017).

What´s next?

As Tesla continued to expand its network many wondered what the company´s next move would be. Was Musk´s final goal to dominate the e-mobility industry using Tesla´s battery production primarily to achieve mass adoption of electric vehicles? Or would Tesla change its core business to battery production and energy storage, providing other car manufacturers with its lithium-ion battery packs? Or was Musk´s vision even higher, using SolarCity to promote sustainable energy solutions across the world?

Teaching Note

Network Externalities

Due to the fact that the DSIR phenomenon is central to market dynamics and competitive strategy in many important industries, we present some fundamental insights on how they affect the performance of competing firms. We begin by reviewing the main concepts and frameworks behind markets with network externalities and analysing their main sources. We then explore how they influence the nature of competition and, finally, their implications on the adoption of a new technology.

A market is characterized by demand-side increasing returns or, more commonly, network externalities, when the perceived benefit a consumer derives from the consumption of the product increases along with the number of other consumers. Consequently, when comparing rivalling products, consumers will tend to choose the one that others are choosing, which leads the product to exhibit "increasing returns to the size of the user population" (Saloner, Shepard and Podolny 2005, ch.12).

These consumption externalities can arise from direct or indirect network effects. Direct network effects are "generated through a direct physical effect of the number of purchasers on the quality of the product." (Katz and Shapiro 1985, p.424). One representative example would be the telephone: since there is no use from talking to oneself on the telephone, consumers can only derive value from the product, if there are other users connected to the same network. Additionally, indirect network externalities may occur due to the interdependence between the primary good and the availability of complementary goods and services, which are only gradually provided as the number of adopters rise (Katz and Shapiro 1985). A classic example would be the video game consoles and the corresponding software: the value of a video game console increases with the volume and variety of video games.

Whether the underlying sources of DSIR are direct or indirect, markets with strong network effects often display unstable dynamics and path dependence towards a single winner. This winner-takes-all characteristic of the market is driven by a mechanism known as positive feedback. If a technology exhibits DSIR, people value how many people already use the product – its installed base of users – and how many people will use it in the future. A sizable installed base yields strength in the market, making the technology more attractive to potential consumers, which results in a larger share of new purchases. This, in turn, will feed back to increase the installed base. As firms or technologies grow they improve the value they offer to their current and future users, becoming even stronger. Thus, potential consumers tend to choose the product with the largest installed base, transforming a small advantage in market share into a sustainable competitive position (McIntyre and Subramaniam 2009). The DSIR benefits offered by the product with the largest installed base allows the market leader to charge a premium price for it. Therefore, most of the competitive strategies employed by firms in these markets are investments to swiftly grow and, ultimately, become the big winner. This shifts the focus of competition from within the market to competition for the market and explains why many firms in network markets present skyward stock prices, while burning through cash and struggling to make the business profitable (Grant 2016, ch.9).

Network effects play a crucial role on the diffusion path of the new technology and whether the market adopts it in the first place. As willingness to adopt a new technology with DSIR highly depends on the expected number of other users, its adoption profile is typically S-shaped. Early adopters, eager to try the new product, are willing to adopt it even if they do not expect to benefit from the DSIR advantages. Beyond that point, successive users are more difficult to attract as they are only willing to adopt the technology when they see the majority of people have done so as well. These intermediate adopters represent the critical mass beyond which a bandwagon effect may appear, creating momentum for the adoption of the product. As there

may be multiple equilibria, coordination and expectations are important to manage the interdependencies among potential adopters. If potential users believe the technology will be widely adopted and become the standard, everyone will adopt it. On the other hand, if consumers are pessimistic and the technology fails to attain enough market penetration, it reverts to a non-adoption outcome. (Saloner, Shepard and Podolny 2005, ch.12).

The firm´s ability to induce such bandwagon effects determines the survival of the technology. Therefore, the strategic exploitation of network effects unfolds a set of core strategies designed to push the market into the critical mass:

- **Attract unconditional adopters** – When introducing a new product in the market, firms need to establish an early installed base of users that can jumpstart the process of mass adoption. Therefore, swiftly signing the pioneers and avant-gardists, who are most eager to try the new technology, will reinforce the firm´s position in the market and create momentum for the successive users to do so as well (Shapiro and Varian 1999).

- **Introduce a superior technology in the market** – The quality of the product is an important strategic variable that determines the outcome in network industries. In markets that tend to tip towards a single standard, the dominant product is usually the one that exhibits the highest quality**.** Thus, to maximize the probability of becoming the big market winner, it is important for firms to introduce a superior technology that outperforms the incumbent (McIntyre and Subramaniam 2009).

- **Invest in the technology architecture and systems** – As often as not, in markets that exhibit network effects, the product´s ability to create and deliver value to consumers depend not only on its performance, but also on the development of complements and the product architecture. When assessing the potential of an emerging product, the complements, which users integrate with the focal technology, and their availability play a crucial role in consumers´ adoption decisions. Therefore, firms invest a

substantial amount of resources and time ensuring the performance of complements does not create a technology bottleneck, but instead provide value to the consumers (Adner and Kapoor 2016b).

- **Build an ecosystem of complementary products** – To leverage on their own installed base of users, firms often expand into adjacent markets by bundling and selling neighbouring products. The overlapping consumer interest and common components allow firms to exploit their key assets and create value for consumers into other product spaces ((Shapiro and Varian 1999).

- **Invest in compatibility to become the standard** – To induce the potential power of network effects, firms can use an openness approach and give up proprietary rights over the technology by licensing at low or nominal royalties or not filling for patents, for example. Committing to open standards will prompt adoption and give the firm an important first-mover advantage of a large installed base (McIntyre and Subramaniam 2009).

- **Marketing to create momentum** – When markets present strong network effects, consumer expectations regarding which product will become the standard heavily influence adoption decisions. As expectations tend to become self-fulfilling in the presence of such dynamic effects, the management of those expectations becomes an important aspect of strategy and competition. To influence the consumers´ beliefs about the future viability of a product, firms often signal the market by preannouncing products and making significant investments in the development of the product in its early stages (Shapiro and Varian 1999).

- **Penetration Pricing** – The price can be seen as a strategic variable that allows firms to grow or reinforce their installed base of users in network industries. In such markets,

> steep discounts, product giveaways or … are important strategic initiatives to gain greater market penetration in the early adoption phase of the product (Shapiro and Varian 1999).

Overall, these are the major strategic moves companies can use to shape the market dynamics and, ultimately, become the technology standard.

Application to the Case

The emerging electric vehicle market is characterized by these network effects. Therefore, designing and implementing effective business strategies to promote the acceptance of these alternative-fuelled vehicles is imperative to reach the critical mass, beyond which the adoption becomes self-sustaining (Zhou and Li 2018). As the technological leader, Tesla will profit substantially from an expansion of the electric vehicle global market. As such, in an attempt to push e-mobility towards the commercial tipping point, Tesla has not only focused on significant technology improvements, but also the industry´s network effects, by expanding its distribution, service and charging infrastructures – which the firm hopes will become the industry´s standard. In fact, Tesla´s ability to deliver on its value proposition depends on the development and commercial deployment of other critical parts of the electric vehicle ecosystem- technologies, services, standards and regulations (Adner 2006). Therefore, the firm has devoted a large amount of resources and employed a set of strategies to make their technology fully functional, grow the user base and move towards the critical mass point.

As a start-up, Tesla´s strategic entry in the electric vehicle market proved to be an effective way to attract early adopters of the technology. To avoid direct competition from large, well-established firms, Tesla initially focused on a narrow, specialized segment of the market that was not served by any other firm. Thus, the new automotive technology was introduced first in high-value sports cars and, then, diffused down the market as costs were reduced. Despite the lower volume sales potential, the need for very specialised products in that niche meant that

incumbents could not assemble a car with an economically viable price that would maintain the profit margins. As there was no existing competition, Tesla successfully introduced the technology in the market and got early adopters to jumpstart the process of mass adoption of its vehicles (Hardman, Shiu and Steinberger-Wilckens 2015).

Tesla also focused on providing a superior quality vehicle through the improvement of its core attributes. With Tesla´s surpassing competencies regarding the battery pack, engine efficiency and integrated drive train, the firm was able to introduce vehicles on different market segments that would compete with other models on price, performance and design, while operating with lower costs. Tesla´s software design capabilities also give the vehicles a cutting edge, as they allow the firm to create a tightly integrated user experience. Together with the Autopilot feature, the app developed by the firm enables customers to remotely update their car, check the current range and charge status, drive it without a key and track the location of their vehicle.

Besides trying to mastermind multiple technologies, Tesla also needed to establish an entire infrastructure for recharging and service. Given the adoption of electric vehicles is contingent on these complementary resources, the firm started to address the circular dilemma between EV adoption and charging infrastructure by heavily investing in the rollout of a wide platform of superchargers. Additionally, to ease potential customers´ concerns regarding maintenance and servicing, Tesla has significantly increased the number of service centres available worldwide and invested in the development of a mobile service fleet (Adner and Kapoor 2016a).

Over the years, Tesla also betted on several risky opportunities that allowed the company to grow and expand its business towards adjacent industries. Firstly, Tesla decided to vertically integrate the battery production value-chain by creating the “Gigafactory”. This complex was designed to produce the lithium-ion batteries used in Tesla´s electric cars and the powerwall, a rechargeable battery that stores energy for home consumption. As Musk envisioned an

integrated sustainable ecosystem, Tesla acquired SolarCity, a solar energy firm, to provide the solar panels that would be installed at the customer´s home and become its main source of energy. Together with the electric vehicles and energy storage devices produced by Tesla, the solar panels would allow customers to generate and consume energy in the most efficient way. Selling complementary products to its installed base of users allowed Tesla to improve profitability by enhancing customer entrenchment (Shapiro and Varian 1999).

As the development costs and risks of pioneering all-electric vehicles are considerable, especially for a small start-up, Tesla has committed to open up its technology. By aligning its IP strategy with its overall game plan, the firm is actively trying to influence the dominant design and gain the market momentum to establish leadership. By allowing other automakers to use the firm´s superior lithium-ion batteries and the network of superchargers, Tesla is trying to enlarge the size of the market, but expects that its competitive advantage will allow the firm to win in head-to-head competition (Backler et al. 2015).

Lastly, the adoption of DSIR technologies is heavily influenced by the firm´s capacity to create a compelling vision of the future. Because expectations tend to become self-fulfilling in these markets, a firm that wishes to become the leader needs to prompt the belief that its technology will become the standard (Shapiro and Varian 1999). By taking up several ambitious initiatives that required significant investments, using opensource principles, pre-announcing new models, products and production facilities and getting customer buy-in for Musk´s vision, Tesla is set out to become the long-term winner in the electric vehicle market.

Conclusion

The small electric vehicle sector of the global automotive industry is still positioned in the initial phase of the technology adoption curve (See exhibit 10). Therefore, to provide a platform on which the electric vehicle market can realize its full potential and reach mass adoption, there needs to be an equivalent innovation in the commercialization and use of the technology (Girotra 2013).

As a market that exhibits network effects, the commercial tipping point of the new technology entails some major improvements in the complementary resources in which electric vehicles are embedded. Accordingly, to ensure the value proposition of EVs is not a bottleneck, but instead provides a stepping stone for new EV growth, Tesla has adopted strategies that focus not only on the performance of the focal technology – battery and design of the electric car-, but also on the quality of the complements that users integrate with the vehicle, such as charging infrastructure and maintenance services.

To push its electric vehicles along the adoption curve and reach the critical mass point, Tesla has embraced solutions that promote the adoption of common standards regarding charging infrastructures, the expansion of the product offer and its geographical location, reduction of price points to become more affordable to a wider customer segment and the collaboration of original equipment manufacturers and suppliers to enhance technological improvements (Singh 2018).

Overall, Tesla´s case perfectly illustrates the set of strategic initiatives adopted by firms in markets with network externalities, regarding the management of complements, standards and the installed base of users, in order to win the war for critical mass.

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Appendix

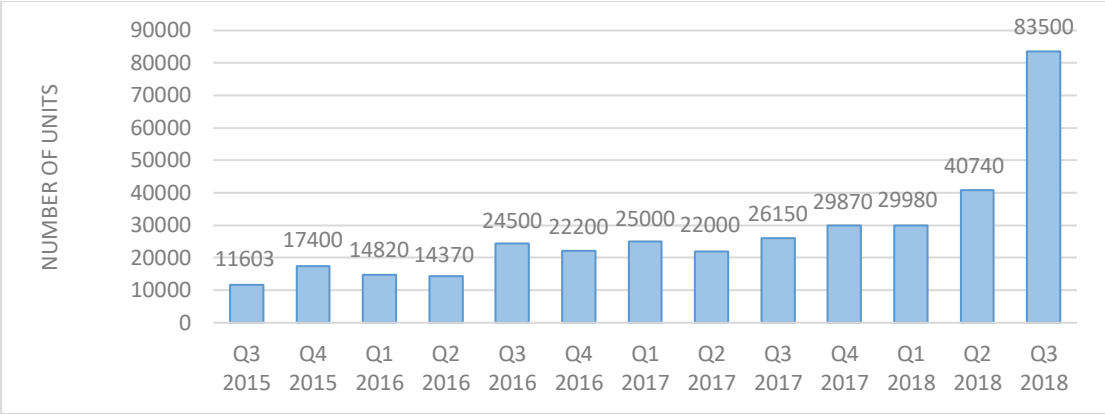


Exhibit 1: Number of Tesla vehicles delivered worldwide from 3rd quarter 2015 to 3rd quarter 2018

Source: Exhibit adapted from Statista. 2018. "Number of Tesla vehicles delivered worldwide from 3rd quarter 2015 to 3rd quarter 2018 (in units)". Accessed November 2018. https://www.statista.com/statistics/502208/tesla-quarterly-vehicle-deliveries/

Roadster

Model S

Model X

Model 3

Exhibit 2: Tesla vehicle models

Source: Exhibit reproduced from Tesla website. Accessed October, 2018. https://www.tesla.com/

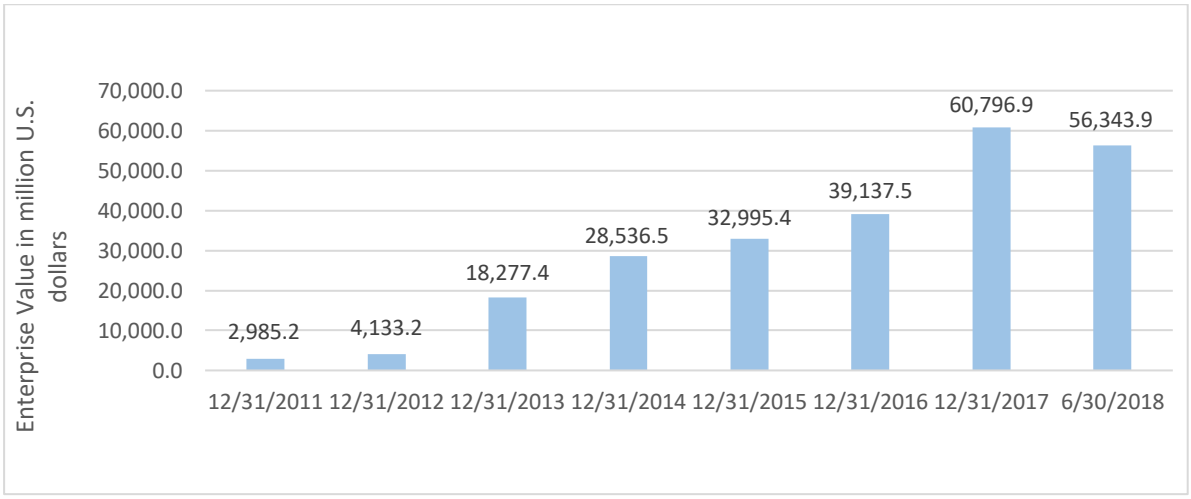


Exhibit 3: Historical data on Tesla Enterprise Value

Source: Exhibit adapted from YCharts. 2018. "Tesla Inc Enterprise Value". Accessed November 2018. https://ycharts.com/companies/TSLA/enterprise_value

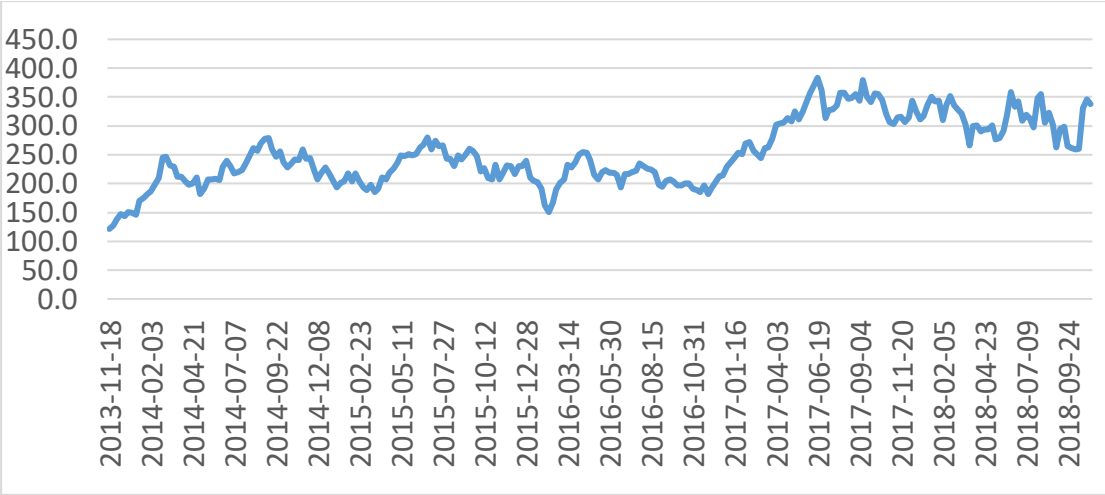


Exhibit 4: Tesla stock price performance

Source: Exhibit adapted from Nasdaq. 2018. "Tesla, Inc. Common Stock (TSLA) Quote & Summary Data". Accessed November 2018. https://www.nasdaq.com/symbol/tsla

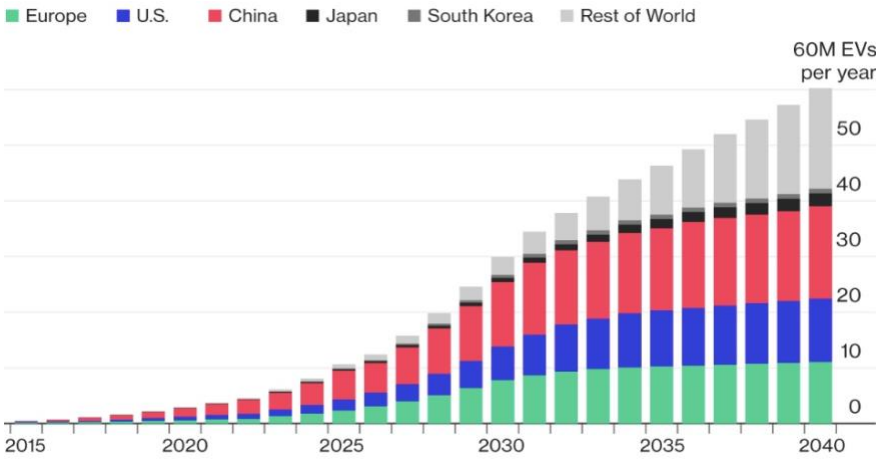


Exhibit 5: Expected stock of electric vehicles in different regions

Source: Exhibit reproduced from McKerracher et al. 2018

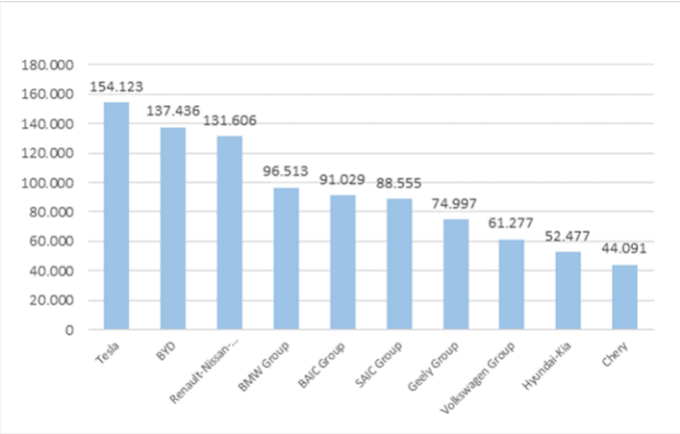


Exhibit 6: World´s Top 10 Plug-In Automotive Groups in 2018

Source: Exhibit reproduced from Kane, Mark. 2018.

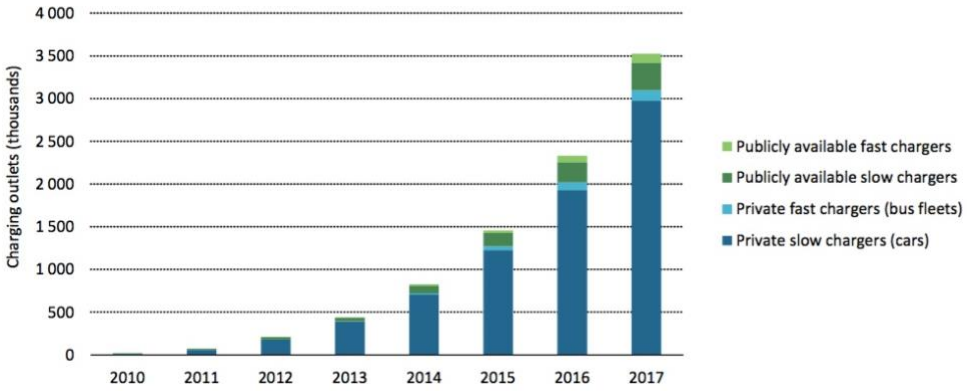
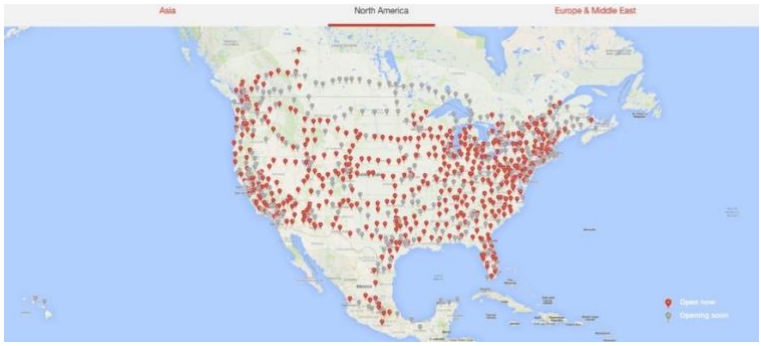


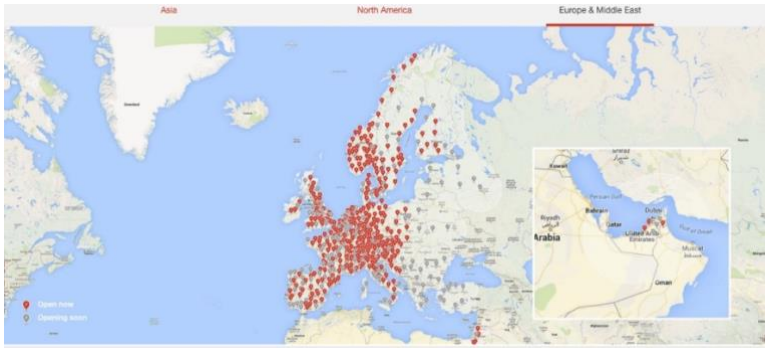
Exhibit 7: Public and private charging stations available worldwide

Source: Exhibit reproduced from Bunsen et al. 2018

North America



Europe



Asia

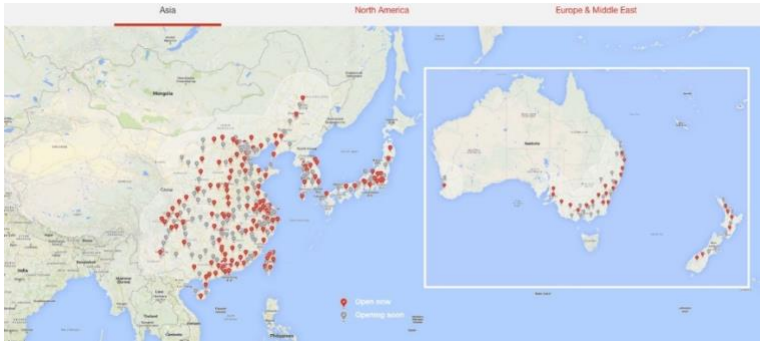


Exhibit 8: Tesla Superchargers Network

Source: Exhibit reproduced from Tesla 2018c.

Exhibit 9: Tesla Value proposition

Source: Exhibit reproduced from Tesla website, accessed in October 2018

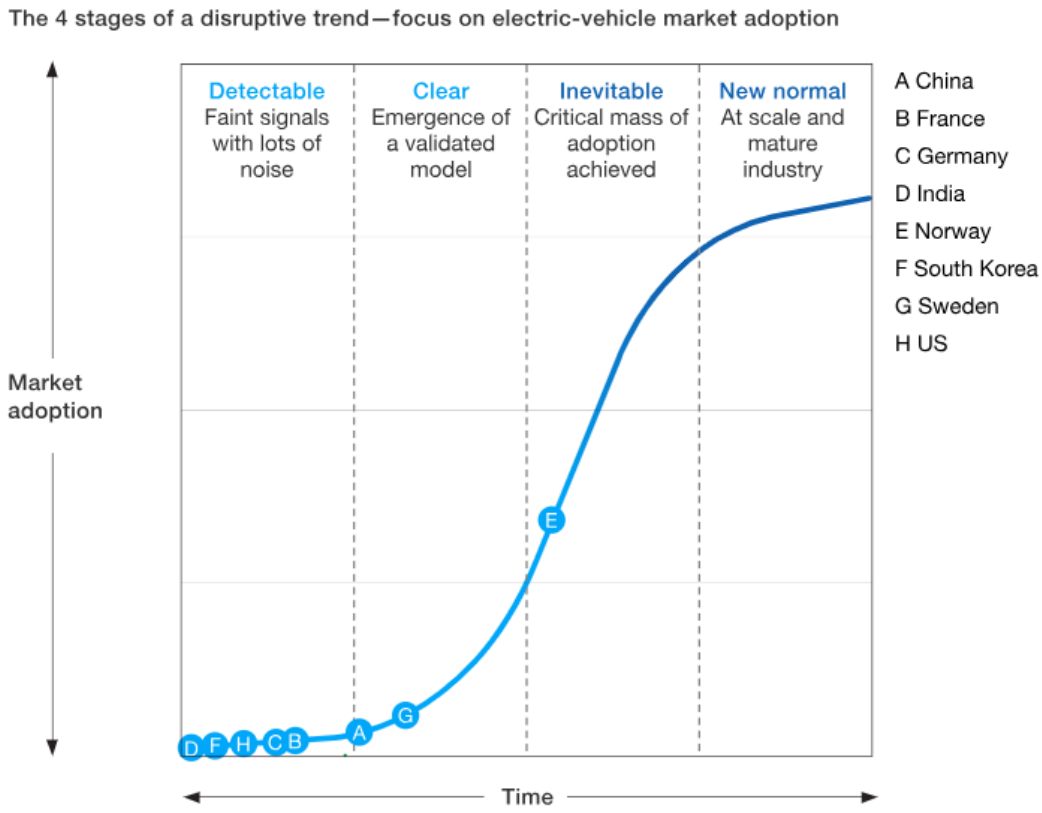


Exhibit 10: Electric Vehicles adoption curve

Source: Hertzke, Patrick, Nicolai Muller, Stephanie Schenk, and Ting Wu. 2018. "The global electric-vehicle market is amped up and on the rise". Accessed November 2018. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-global-electric-vehicle-market-is-amped-up-and-on-the-rise