

# Critical Analysis of the Electric Vehicle Industry: Five forces and strategic action fields

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## Abstract

*Global warming and urban pollution have directed public policy towards sustainability and development of cleaner sources of energy. Electric vehicle industry provides a viable trajectory towards energy efficient transportation. From the standpoint of strategic management, we apply the five forces framework that outlines the dynamics in the electric vehicle industry and highlights the relative attractiveness of substitute products in terms of price and available infrastructure. In addition, the paper advances discussion of Porter's widely used Five forces model in strategic management by appropriating the concept of strategic action field that allows for the inclusion of human element. Finally, the paper bridges the gap for refinement and involvement of human element through the application of strategic action fields.*

**Keywords:** strategic management; five forces; electric vehicles; strategic action fields; climate change

## **Introduction**

The exponential development of technology and increasing consumer demand for cleaner energy sources have sparked the green energy revolution as a response to the concerns about global warming and urban pollution. The research of National Research Council (2006) indicates that the current climate change acceleration is ten times faster than an average ice-age-recovery warming. Government agencies and major corporations pursue efforts to significantly decrease carbon footprint, for instance, in 2019 UK parliament has passed the net zero greenhouse emissions 2050 target into law.

The transportation is one of the largest contributors of the rising greenhouse emissions accounting for 14% of the total greenhouse gas emissions in 2010 (United States Environmental Protection Agency, n.d.). Meanwhile the road transport that includes light and heavy-duty vehicles captures roughly 70% of the total transport emissions (Statista, 2017).

The primary energy source of the combustion engine vehicles consists of burning fossil fuels such as coal and petroleum that emit heat-trapping carbon dioxide (CO<sub>2</sub>). Whereas, electric vehicles, according to the USA's Department of Energy (n.d.), all directly produce zero emissions. Union of Concerned Scientists (2015) has found out that over the full life-cycle from manufacturing to disposal and accounting for power plant emissions the electric vehicles produce half the emissions when compared to gasoline powered vehicles.

Nevertheless, the adoption of the innovative technology to combat the climate change appears to be relatively slow. In fact, the proportion of electric vehicle sales to the total vehicle sales in 2019 was roughly 3% while the share of the electric vehicles of the global vehicle fleet was estimated at less than 1% in 2020 (Irlle, 2020; Statista, 2020).

In this paper, an introduction to the strategic management field is provided and the rationale behind Porter's Five Forces framework is discussed. To grasp the core components of the electric vehicle industry and the distribution of the economic value the largest electric vehicle producer in terms of market capital, Tesla, is analysed. Finally, we utilise the strategic action field to expand on the strategic management framework.

## **The Field of the Strategic Management**

An analysis of the rapidly expanding industry that transforms transportation requires an interdisciplinary lens. The field of strategic management is relatively young and elusive, drawing its identity and concepts from finance, psychology and social sciences including

economics, marketing and sociology, provides critical standpoint to assess the electric vehicle industry.

The field contains three main perspectives: resource-based, institutional and industry-based. Resource-based approach inspects how resources of a company at question influence its performance in a competitive market (**Collis & Montgomery, 1995**). The institutional approach primarily takes into account the execution of strategy and how an organization converts its goals into performance (**Mankins & Steele, 2005**). The industry-based perspective fits the task of finding the obstacles for mass adoption of zero emission vehicles as it observes the effectiveness of a company in a competitive environment that can be measured in terms of profits and value created for customers.

The Porter's five forces framework assists in analysing an industry and its performance in terms of profitability. Financial gains provide insights on the health and potential of the industry. For instance, low profitability might indicate underlying structural issues that hinder long-term development. In turn, low profitability may result not only into lower quality, less reliability and higher prices for customers, but also burden the society through expensive subsidies and potential bailouts. In fact, IATA (**2011**) report has shed light on more than a decade wide underperformance of the airline industry with the help of Porter's five forces model.

### **Five Forces Framework**

Michael Porter, a professor at Harvard University, a business strategist and industrial economist, has developed a strategic tool called Five Forces to scan and ultimately assess the long-term profitability of an industry in the competitive environment. The academic has derived ideas for the framework, which was first published in 1979 as *How competitive forces shape strategy*, from the theory of a firm and industrial organizations to address concerns of managers, stakeholders and governments on characteristics and structure of an industry that sets limits on the capabilities of firms (**Linstead et al., 2009**). The widely practiced model evaluates weaknesses and opportunities of a company's profit potential in term of five dimensions or categories in the external to the firm environment. The Porter's framework brings socio-political context into perspective unlike previous efficiency-based approaches advocated by planning school of thought (**Spender, 2014**). Five forces framework communicates and stimulates fruitful insights into the competitive nature of an enterprise and industry as a whole. By contrasting outputs of the framework, managers can look for the sweet spot in the web of opportunities and threats posed by outside of the firm actors such as suppliers, buyers, direct rivalry firms, substitute products and new

entrants to achieve above-average economic rents. Meanwhile the regulators interested in the development of the industry can identify the weaknesses and sufficient improvements.

Linstead (2009) considers Porter's framework as an industry analysis derived from neoclassical economics built on two implicit dimensions. First dimension connects suppliers, that transform raw materials into finished products, to buyers that are willing to exchange money for these items. In the case of electric car industry, the dimension entails such activities as acquisition of raw materials (nickel, cobalt, lithium) and technology (manufacturing robots, patents), manufacturing of intermediate components (lithium-ion batteries, engines) and finished goods (electric vehicles) as well as their ultimate distribution to end customers. The second dimension shows that the production chain can be comprised of different, separate companies that individually constitute only a proportion of the production process. In other words, a single vertically integrated firm can manage the entire production process.

### **Application of Five Forces Framework**

In the original paper Porter (1979) suggests analysing competitive environment in terms of five categories and determining their individual and collective influence on the profitability of the industry. The academic in 2008 article titled 'The five competitive forces that shape strategy' has stuck to the five categories briefly expanding on what they entail.

Dobbs (2014) acknowledged the inadequate use of the model due to the lack of procedural steps in the original model and further shallow reprints in the popular textbooks. As a best practice he recommended first discussing rivalry within the industry followed by buyers' and suppliers' bargaining power, then analysing threat coming from potential entrants and concluding with the most difficult concept to comprehend, substitutes.

Tesla is the focal company in the application of the framework since it has produced the lion's share of electric vehicles and has the highest market capitalisation among automotive companies of \$183 billion as of June 16 2020. The company has been producing fully electric vehicles and electric vehicle powertrain components since it was established in 2003.

#### *The Degree of Rivalry Among Electric Vehicle Producers: Medium*

The level of competition among electric vehicle manufacturers is medium as the industry has received dramatic support from government agencies across the world. Meanwhile the rampant development in technology and subsequent cost reduction has attracted companies from the traditional auto industry facing intensive rivalry in the mature industry. However, high

barriers to exit in the traditional sector imply significant capacity that never leaves the auto market. In fact, the auto industry is a vital sector in the United States contributing 3-3.5% to the overall US GDP and employing roughly 5% of the population (**Uzwyszyn, 2012**).

China, the largest electric vehicle market, and developed economies demand stricter regulation on the vehicles with internal combustion engine that improves the relative profitability of the electric vehicle industry. The incentives for electric vehicle industry differ across countries and regions, but the three main types are notable: direct, fiscal and fuel cost savings (**Mock & Yang, 2014**). In the US, the third largest electric vehicle market, the tax credit per vehicle ranges from \$2500 to \$7500 depending on the vehicle's weight and battery capacity. In China the policies are more aggressive and unorthodox both from the central and local government incentivising efficient transportation. China has restricted investments into manufacturing plants for vehicles with internal combustion engine, in addition to building fast charging infrastructure (**International Environmental Agency, 2019**). In 2017 UBS estimated that the cost of ownership of an electric vehicle could equal the cost of ownership of the traditional vehicle not accounting for any subsidies in 2018 for Europe, in 2023 for China and in 2025 for the US, if all the benefits pass to consumers.

Auto makers compete by making a number of sequential choices about quantity and price. First, a company chooses its capacity by building sizable manufacturing plants. This choice is often set for longer time periods, given time lags in a vehicle delivery and a construction of the necessary infrastructure. For instance, Tesla has built a factory for the production of electric batteries at an approximate cost of \$5 billion raising additional funds from investors. Meanwhile, Volkswagen in 2019 has announced €1.2 billion facility redevelopment to support an electric production of 300,000 vehicles per year since 2021 (**Frangoul, 2019**). Second, a business allocates capacity among the range of models. Changes in assortment on existing factories can be made with higher frequency. Third, the companies set prices for each model taking into account the willingness of consumers to purchase the product, supply chain and market dynamics.

When setting capacity, electric vehicle manufacturers are faced with individual incentives to make aggressive choices. Some are related to costs: acquiring more infrastructure potentially leads to higher savings such that operating larger manufacturing plant reduces marginal costs per vehicle, in particular, reducing the cost of a battery pack and powertrain. Others are related to traditional risks in a cyclical auto industry: positive returns of spare capacity in periods of high demand are substantial and fully accrue to managers, while the potential losses in periods of low

demand are constrained by an equity stake. As the industry matures the electric vehicle producing companies could end up acquiring too much capacity and operating too many production facilities that cover only their marginal costs of operation without significant benefits to the stakeholders limiting innovation, quality and efficiency potential.

*The Bargaining Power of Buyers: High*

The bargaining power of buyers is a moderately limiting force on the industry profitability. The consumers have shifted their preferences and many consider purchasing an electric vehicle: in the US the share of respondents is 10-30%, in Europe 40-60% and in China over 70% (**Baik et al., 2019**). However, Caruana et al. (**2016**) cited consumer attitude and habits studies, which indicated that while around 30 per cent of consumers had concern for the environment, barely 5 per cent translated the intention into an action. Overall, a high purchase price, the lack of range of an electric vehicle and time-consuming re-charging make the electric vehicle ownership relatively less attractive to internal combustion engine vehicles.

*The Bargaining Power of Suppliers: Medium*

Scale and in-house production of batteries are highly important to reduce the total production cost and to make an attractive offering. Outsourcing constrains the acquisition of expertise and increases pressure on an electric vehicle manufacturer. In case of Tesla, the corporation produces lithium batteries in-house that comprise a third of the vehicle production cost. Munro & Associates have rated efficiency of Tesla battery much higher than of Samsung SDI (BMW i3 electric car supplier) and LG Chem (Chevrolet Bolt supplier).

In 2014 van der Steen et al. conducted a research of E-mobility strategy in eight European countries outlining shallow longer-term government strategic approach, in particular, insufficient charging infrastructure. Nevertheless, Tesla has found a solution by building its own web of charging stations that has further differentiated it from competitors. In addition, a group of traditional auto makers among which is Ford and Daimler have agreed to partner and build a set of stations to cover Europe in accordance with their long-term production plans. Furthermore, McKinsey and Company (**2017**) optimistically projected global charging station deployments to grow from around 2 million in 2016 to over 12 million in 2020.

The key raw materials that enable electric vehicle production and rapid growth of the industry are cobalt and lithium. Companies have signed long-term lithium supply agreements as the extraction process struggles keeping up with an increasing demand. Tesla has four known suppliers of

the mineral. Ganfeng, one of the largest producers of lithium hydroxide in the world, announced in 2018 September that it had an agreement with Tesla to supply the EV maker with 20% of its annual production until 2021, that could also be extended by three years. The second supplier Kidman Resources is a developmental stage company from Australia that is not yet profitable but has a fixed price three-year agreement with two three-year extension options. Two other companies are Pure Energy minerals located roughly 200 miles away from Tesla's Giga Nevada factory, and Sonora Lithium Project in Mexico.

Azevedo et al. (2018) estimated that more than 65 percent of global production of cobalt concentrated in the Democratic Republic of the Congo (DRC). In 2020 Tesla has secured 6000 tonnes of cobalt annually from Glencore that produces approximately 4% of cobalt mining globally. The cobalt mining might constrain further expansion of electric vehicle industry as China controls around 70% of the refined cobalt and the poor governance structure in DRC threatens the viability of stable supply of the mineral.

#### *The Threat of New Entrants: Medium*

In case of the electric vehicle industry, large capital investments, large spending on research and development, experience in the industry, economies of scale are required to enable the efficient manufacturing. In addition, the industry is not likely to become profitable in a short period of time that makes it difficult to raise funds as initial sunk costs are quite significant. The cheapest vehicle of Tesla, Model 3, costs 35000\$ but it is unlikely to bring profits for the company. UBS (2017) has estimated that in addition to Model 3 being profitable only if consumers would spend more than \$41,000. Besides, Chevrolet Bolt was also destroying value for investors, losing \$7000 EBIT per car in 2017.

The threat from new manufacturers entering the market is low. An electric vehicle manufacturer founded in 2009, Rivian, has yet to deliver an electric vehicle despite raising around \$4 bn in investments. In addition, Lucid Motors, Byton and Faraday Futures have received substantial funding but are also struggling to deliver an electric vehicle for the end consumers.

Nevertheless, the established automakers have resources and expertise to develop infrastructure for producing electric vehicles. In a time period from April 2019 to April 2020 BMW has achieved 7% market share selling models 530e/Le, i3 and 330e. Meanwhile, Volkswagen has delivered only around 3500 less cars than Tesla in April 2020 and has started production of its ID.3 series in 2019 with expected volume of 300000 cars per year since 2021 (Pontes, 2020).



### *Power of Substitutes: High*

A substitute product is the one that consumers see as essentially the same to another product. An availability of cheaper and more efficient substitute products for the electric vehicles erodes profit potential for the industry. Cost conscious consumers could reduce their carbon footprint rather than purchasing Tesla's vehicles, by switching to substantially cheaper substitutes such as public transport, bicycles or not traveling at all. For consumers willing to purchase a vehicle, in general, close substitutes in terms of in the traditional automotive market are plentiful.

### **Application of Five Forces: Summary**

The power of substitute products and bargaining power of buyers are the most significant obstacles to the profitability of the electric vehicle industry. In particular, the relatively small range of electric vehicles, insufficient number of charging stations, relatively long time of charging and high price are likely to shift a consumer to a public transport or a car with internal combustion engine.

The traditional auto makers have a competitive advantage over start-up companies entering the industry as it requires intensive capital and learning curve to produce in the rapidly growing industry of electric vehicles. In fact, Volkswagen and BMW are traditional auto companies that have much better time allocating capacity than companies such as Faraday Futures and Byton. In the long-term the existing capacity in the traditional vehicle industry will likely translate into higher competition leading to constrained profits and opportunity for innovation.

Regulatory effort in Europe, the US and China promotes the adoption of electric vehicles. The latter country has implemented unorthodox policies shifting the power away from internal combustion engine vehicles, but its influence extends to the supply of necessary for production raw minerals such as cobalt. International co-operation and long-term infrastructure projects could further improve the production effectiveness and cost of an electric vehicle.

### **Limitations of the Five Forces Framework**

The industry, the unit of analysis of the Porter's framework, provides a foundation to assess drivers and processes of the firm in the competitive environment, in particular, the pressure coming from suppliers and customers. Porter (1980) defines an industry as "the group of firms producing products that are close substitutes for each other". However, in case of Tesla and electric car industry, the conflict lies much deeper as reshaping the traditional car industry would require massive investments,



re-education of workers and phasing out or retooling of the existing infrastructure.

The underlying microeconomic industry structure and concepts such as barriers to entry and exit, substitutes and profit margins provide are unlikely to be disputed by academics and provide a basis for an overview of the firm's environment. However, Coyne and Subramaniam (1996) state that underlying assumptions of Five Forces are unrealistic: five categories are unrelated, participants have nearly perfect information on the industry, interactions are fast, while the competitive advantage can be exercised by erecting barriers and building structural advantage. In the current era of rapid technological advances and transformation of boundaries, Porter's all implicit assumptions are unlikely to hold. In addition, the framework does not analyse specific characteristics, past encounters, future projection and power dynamics that are significant influences on an enterprise, strategy creation and its adoption.

### **Strategic Action Fields**

Fligstein and McAdam (2011) have developed a general theory of fields to consider collective social life in a context of change and stability, generally practiced within the field of sociology. Strategic action field takes into account individuals, organisations and institutions that together constitute the meso-level social order. These actors maintain a common set of knowledge, positions and hierarchies, in addition to defining legitimate and acceptable behaviour. The competition for obtaining the best position drives the actors while social skill is the method of achieving it. Overall, the theory primarily considers the web of interrelations between actors and how they fit in relation to one another in terms of social, political and economic life.

The electric vehicle industry and its development since its inception can be characterized as a strategic action field constituted by a diverse range of actors: manufacturers of various sizes, sectors and interests, who are involved in the delivery of zero emission vehicles. These companies compete with one another for position, power and resources in the field that is subsidised to a large degree in the leading economies and additionally benefits from support of socially conscious consumers. This field is located alongside traditional car industry and a range of public infrastructure fields that are producing significant positive externalities such as renewable energy plants.

Public goods are primarily dependent on relationship with the state field and state actors that may in different ways influence the inner workings of a field, mediating and disrupting relationships by altering policies and shifting the balance of power by reallocating resources, sometimes establishing and managing markets.

In the electric vehicle industry inside the US Tesla enjoys substantial benefits as an incumbent, in particular, due to being able to dictate the common understanding to the collective. The advantageous position can be attributed to the radical shift in the domain of transport, from internal combustion engine to the one powered by rechargeable batteries. Tesla was the first large company to focus on the electric vehicle industry, hence allowing it to frame the public collective perception of what is a zero emission vehicle.

Governance units have a substantial economic influence in reducing the cost of Tesla's products. Loans and subsidy programs from the American government have largely influenced the evolution of the defined field and the development of Tesla as one of the leaders. Department of energy of the USA and California Alternative energy and advanced transportation financing authority has supported Tesla and conserved the development of the field maintaining the prevailing order. For instance, Department of Energy has granted \$465 million in 2009 as Tesla satisfies the goals outlined by the department in reducing greenhouse effect and petroleum reduction.

The business structure of the successful start-up has allowed Tesla to negate significant costs related to inflexible wages that occur in the traditional car industry limiting the restructuring potential of companies. The first-mover advantage has brought the tremendous amount of power to the corporation by cutting the middlemen in form of dealerships and service centres. Tesla was able to control the secondary market of electric vehicles by having the access to the software of the vehicle and controlling the charging infrastructure. Effectively, the company constrains the repair shops from transforming broken vehicles by having the power to label the car as broken and deter from using an official supercharging network.

The development of the social sustainability concept and popularity of environmental, social and governance investments among investors have largely aided electric vehicle industry and Tesla, in particular. For instance, Tesla has experienced difficulties with following the production plan, but nonetheless getting support from businesses community. High-grade corporations such as Walmart and Pepsi have made reservations that cost US\$5,000 per vehicle despite the high cost (\$150,000-\$180,000) of the semi-truck and Tesla's inconsistent production plan.

## Conclusion

Porter's Five Forces framework provides structure to evaluate the primary drivers of the electric vehicle industry.

The industry-based perspective brings forth the profitability obstacles within the industry as well as provides a general overview of the socio-political trends in the competitive environment. In particular, the largest profitability threat comes from the substitute products: public transport. Meanwhile, raw material (cobalt and lithium) miners and refiners involved in the production of electric vehicle have potential to gain higher share in the power battle as growing demand might outstrip the available supply due to the bottlenecks in the supply chain and bad governance practices.

Furthermore, the government support which takes the form of direct subsidies and regulation of carbon emissions is the most significant driver of the development of the industry.

The general theory of strategic action fields proposed by Fligstein and McAdam (2011) enhances the understanding of the social context and provides an analysis of the area between micro and macro levels that lacks in the Porter's model. The example of Tesla shows that large part of the firm's profit potential depends on the ability to understand cultural context and maintain social connection with public, businesses and government. In particular, communication with public and alignment with the governmental goals of sustainability has a large impact on Tesla's performance and role in the field associated with sustainable vehicles. Finally, the first mover advantage lets the company to benefit from the rapidly developing competitive environment.

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Pavel graduated from the University of Manchester and currently works as a data scientist at Nielsen IQ. Currently, they contributing to various open-source and code/projects which are available at <https://github.com/Pfed-prog> and <https://github.com/dspytdao>.

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