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A Systematic Review of Tesla's Innovations Towards Environmental Sustainability

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ABSTRACT

This study assesses Tesla's innovations towards the reduction of the temperature in this century. It report seeks to investigate the company Tesla to assess its innovation for a sustainable environment, the effects fuel prices may have on the sale of its electric vehicles and the company's growth over the years.

This research provides insights into Tesla and its contributing factors towards environmental sustainability. It examines the Paris Agreement which was signed and adopted with the aim of reducing the rise in temperature; Tesla's approach to renewable resources and the effects of oil and gas prices on electric vehicles; and explores the innovation diffusion theories of Schumpeter and Rogers.

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CHAPTER ONE
INTRODUCTION

➢ *Research Proposal*

The automotive industry is a capital-intensive line of operation where the development of product and investment in fixed assets are through economies of scale (Liu & Meng, 2017). Tesla Inc. originally Tesla Motors, herein Tesla, was founded by Martin Eberhad and Marc Tarpenning in 2003 (Schreiber, 2023). This automotive company has had many successful years after Elon Musk became its Chief Executive Officer in 2004 (Zhou, 2023). BYD Co. Ltd, Tesla's biggest rival and a Chinese company, came very close to overtaking Tesla as the leader after delivering about 431,700 all-electric vehicles compared to Tesla's 435,000 (Krietzberg, 2023). Tesla initially fell short of expectations due to ongoing factory modifications (Krietzberg, 2023).

Paris Agreement ("legally binding international treaty on climate change" (United Nations, 2023)), enforced in 2016 was entered by almost 200 representatives in December 2015 with the goal of stopping the rise in world average temperature to far below 2 degrees Celsius over pre-industrial levels while limiting the increase to almost 2 degrees Celsius (United Nations, 2023). To maintain global warming to almost 2 degrees Celsius in this century, carbon dioxide emission must be reduced to almost 45% by the end of the decade (United Nations, 2023). Tesla's goal is to develop "zero-emission electric vehicles" which performs better than the fueled vehicles while pacing the adoption of sustainable transportation by creating attractive mass-market electric cars (Bilbeisi & Kesse, 2017). Being one of the most innovative manufacturers in its industry, Tesla shared all its copyrighted technology with other companies with the intention to support the development of electric vehicles which will foster growth in its industry, thus aiding to environmental sustainability (Liu & Meng, 2017).

With the movement to store and use renewable energy, storage systems were developed to meet increasing demands (Zhang, et al., 2019). The lithium batteries were identified to be the device with potential energy storage systems and desired qualities which includes environmental friendly properties (Zhang, et al., 2019). Tesla is the only electric car company that makes use of 18650 ternary lithium-ion batteries; it is also the only one in North America to use aluminum body for its vehicles (Liu & Zhan Meng, 2017).

The oil crisis in the 1970s prompted some automobile manufacturers to consider producing electric vehicles; however, this move was retracted due to the stability of the oil market in the 1980s (Kapustin & Grushevenko, 2020). The fluctuation in crude oil prices have a direct impact on fuel costs (Barbosa, et al., 2023). According to Tesla's team, driving a car for 15,000 miles per year will cost the owner around $7,000 in fuel, while driving an electric vehicle will cost only $600 (Bilbeisi & Kesse, 2017). However, David Rampson and Enrich Muehlegger (2023) advised that electric car cost savings vary per consumer.

➢ *Problem Statement / Rationale*

The daily operations of some oil and gas companies are the biggest contributors of greenhouse gas emissions while some companies uses hydroelectricity (Zakari, et al., 2022). Large amounts of CO2 gas emissions are also linked to fossil fuels consumption (Zakari, et al., 2022). Zakir, et al (2022) also published that to mitigate this, renewable energy sources should replace fossil fuels.

Oil and gas which are generated from fossil fuels takes years to form and generate. These non-renewable resources contribute to high CO2 gas emissions when being transformed by traditional burning from fossil fuels. Some Governments keep preparing and support burning of fossil fuels significantly more of what can be safely used; these Government were asked to reduce the fossil fuels production (United Nations Climate Change , 2021).

The Paris Agreement has been in charge of moderating the balance between oil and gas productions and quality of the environment (Zakari, et al., 2022). This Agreement has seen efforts to reduce CO2 emissions since it was signed in 2015 (Zakari, et al., 2022).

Zhang, et al., (2023) further published that when a company is faced with market and technological challenges and changes, it innovates in multiple ways simultaneously to accomplish a transition while their portfolio for innovation evolves. This research seeks to identify how Tesla's innovations that use renewal energy aids in the fight against climate change and adds to environmental sustainability.

➢ *Research Objectives*

The objectives of this research are as follows:

- To assess Tesla's focus on innovation for a sustainable environment.
- To evaluate the effects of oil and gas prices on the sale of Tesla's electric vehicles.
- To review Tesla's growth in the auto mobile industry over the years.

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➢ *Theory Overview*

This research explores Schumpeter's theory of innovation. In his theory, Schumpeter defined development and growth as a "historical process of structural changes" primarily powered by innovation (Śledzik, 2013). Innovation was divided into four types by Schumpeter, these are as follows:

- Introduction of a new product or an updated version of an existing product (Śledzik, 2013).
- Introduction of a new system or method of production that is yet to be tested by experience in the manufacturing branch (Śledzik, 2013).
- The establishment of a new market which was not entered into before (Śledzik, 2013).
- The acquisition of a new source of supply of unprocessed or semi processed materials (Śledzik, 2013).
- New structure in the industry, that is, the establishment or destruction of a monopolistic dominance (Śledzik, 2013).

It was published that creation or basic innovation has lower impact on an economy when compared to the distribution and replication process which has a much higher influence on an economy (Śledzik, 2013).

This theory's description of innovation "introduction of a new product or updated version of an existing product" is being used in this research from Tesla's innovations (Śledzik, 2013).

This study also explores Everett M. Rogers theory on Diffusion of innovation which was developed in 1962 (LaMorte, 2022). The diffusion of innovation theory was created to express how an idea, product or service develops momentum and spreads across a specific population or group of people over time (LaMorte, 2022).

Adoption of a new product, service or idea is the process where some persons will choose to accept the innovation more than others (LaMorte, 2022). Everette Rogers explained that adoption of the innovation follows a curve because of the consistent distribution of innovativeness in the five adopter categories, that is "the innovators, early adopters, early majority, late majority and laggards" as well as conveying and sharing understanding within society (Noel, et al., 2019).

This theory is being used to identify how the world is adopting Tesla's electric vehicles which are aimed to decrease CO2 emissions.

➢ *Method of Analysis/ Scope of Work*

More than three quarter of the greenhouse gas emissions are from vehicles with internal combustion engines (Kim & Chung, 2023). The choice for purchasing an electric vehicle is negatively affected by the price, charging issues/ports and efficiency of energy while environmental understanding, technology and owner's reward have a positive impact on the decision (Brescia, et al., 2023).

A systematic approach to research will be taken to understand Tesla's operations toward a cleaner environment while assessing its growth over the years. Systematic approach is looking for and selecting the best evidence that exist for research by using a specified, planned, and consistent method (Juillion, 2019).

The initial step of the research was to select the topic which was done by exploring the published articles and journal using Emerald Insight, Google Scholar, and Research Gate among others. Journal papers and published findings from 2012 and later will be used to collect and combine information on Tesla.

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CHAPTER TWO
LITERATURE REVIEW

This literature review looks at past research to better understand the views, theories, and research done on the chosen topic. This review includes literature on innovations, greenhouse gas emissions, effect of oil and gas prices and Tesla's innovations in greater detail. The goal of this literature review is to give a better and broader understanding of the major terminology used throughout the research by presenting multiple points of view, depth, and ideas, as well as finding patterns and gaps in same.

- *Innovation*

Innovation is being introduced into each organization based on the mission, vision and corporate strategy (Kahn, 2018). Kuratko, et al. (2014) noted that while it is acknowledged that innovation is the approach which would lead to success, most firms find it difficult to apply and adopt to it. They went on to further explain that some businesses are disappointed at the return on investment towards the implementation of new innovations (Kuratko, et al., 2014).

Kahan (2018) explained that most firms are aware of innovation, but many still don't know how to put it into practice. Donald, et al. (2014) emphasize that some people would quit an organization because they are not receptive to change or the adoption of innovation, whilst others will use it as a chance to motivate and support innovation in order to boost a company's efficiency and profitability (Kuratko, et al., 2014).

Further, it was published by Kahn (2018) that innovation is divided into three parts, innovation as an outcome, process, and mindset. He explained that innovation as an outcome seeks to focus on the final product, which includes the process and initial mindset; innovation as a process examines how innovation should be organized and structured so that the outcome can be materialized and successful; and finally, innovation as a mindset is an organizational approach in which employees adopt a new culture of creativity to support innovation's thriving (Kahn, 2018).

Finally, Schumpeter innovation theory explained that innovation is critical to understand and explains economic progress with the "entrepreneur" being the primary inventor (Śledzik, 2013). He further stated that "Entrepreneurship is innovation and the actualization of innovation" (Śledzik, 2013). Ahmad, et al., (2023) recognized and published that when both innovation and economic growth are considered, a trade-off between revenue generation and environmental safety can be identified. They further published that technology and innovation are important for global growth and development as well as business survival; however, both frequently rely on heavy energy usage of fossil fuels which leads carbon dioxide emissions and pollution of the environment (Ahmad, et al., 2023).

- *Patent Sharing for Environmental Sustainability*

As noted in chapter 1, Tesla shares all its copyrighted technology with other companies with the intention to support the development of electric vehicles which will foster growth in its industry, thus aiding in environmental sustainability (Liu & Meng, 2017). This was seconded by Wang, et al., (2021) who published that Tesla is prepared to work with other companies in the industry to increase transparency, opportunity and "equity" in its supply chain and reduce CO2 emissions at each stage.

- *Tesla's Energy and Storage Devices*

Tesla which was electric vehicle company has evolved into an energy company that create storage devices to store their renewable energy (Matthews, et al., 2020). This was also published in Wang, et al., (2021) journal on sustainability which states that Tesla manufacture storage devices for the collection of their "clean energy" while also creating their electric vehicles. Tesla has created a simply and affordable storage device to store the excess solar energy to be used at another time (Matthews, et al., 2020).

- *Fossil Fuels and Paris Agreement*

The Paris Agreement, an international contract on climate change, was enforced with the goal to stop the rise in the world average temperature (United Nations, 2023). This Agreement was entered with the aim to limit the rise of the world's average temperature to below "2 to 1.5" degree Celsius "pre-industrial" times (United Nations, 2023). The Agreement was endorsed by over 195 parties who also recognizes that carbon dioxide emission must be reduced to decrease global warming (United Nations, 2023). The world leaders "stressed" on the importance to limiting the rise to "1.5" degree since the effects of global warming such as droughts, rainfall and heatwave can be severe (United Nations, 2023). This Agreement works on a "5-year cycle" of countries gradual aggressive climate response (United Nations, 2023). Thus far the Agreement motivated green alternatives within Countries and businesses throughout the world (United Nations, 2023).

Hyeonjoo Kim (2020) published that Fossil fuels consumption is over 80% globally with the demand for energy doubling from the 1970s to the 21st century. Globally, transportation carbon dioxide emission makes up "25%" of the total emissions in 2015 (Kim, 2020). The China development Network publish that supporting green development of vehicle consumption is required to lowering carbon emissions during the lifecycle of the vehicles while also supporting environmentally friendly practices (China Development Network, 2022). It was recognized that the most environmentally friendly vehicles are those that are fully electric and

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whose demand are on the rise (Maradin, et al., 2022). The demand for electric vehicles may be from the influence of increased fuel prices and carbon dioxide emissions (Kim, 2020).

Tesla, being the first automotive company to address the problem of using fossil fuels which leads to harmful emissions, has done so with the introduction of its electric vehicles to "outperform" fueled vehicles (Maradin, et al., 2022). Tesla believed that the future will be better the faster the world is able to move away its dependence on fossil fuels and move towards "zero emissions" (Wang, et al., 2021).

It was published by Wang, et al (2022) who originally cited it from the Tesla's website that humanity will be better in the future if the dependency on fossil fuels can be reduced. Tesla's goal is to develop "zero-emission electric" vehicles concur with the Paris Agreement for reduction in greenhouse gas emission (Bilbeisi & Kesse, 2017). Wang, et al., (2021) published that Tesla's focus for 2018-2020 were on "batteries, photovoltaics, sustainability" and greenhouse gas emissions.

- *Environmental and Economic Trade off*

Najjid Ahmad et al., (2023) advised that environmentally friendly development is difficult to achieve in the early phases of growth and development in a business since human demands normally take precedence over environmental concerns. Omri (2020) produced research indicating that, while technological innovation is necessary for firm survival and economic success, it also poses environmental issues that are equally important for long-term growth and development**.** Hannah Ritchie (2020) published that the most effective way to combat climate change and greenhouse gas emissions is to understand the source of the emissions (Ritchie, 2020).

- *Oil and Gas Prices in the Automotive Industry*

Crude oil prices have significantly impacted a country's economic development internationally (Sun, et al., 2023). It was published that the fluctuations in the oil industry may have consequences on performance, demand, and supply in the automotive industry (Baur & Todorova, 2018). For supply, increase in oil prices may affect the production costs; while for demand, increase in oil prices can cause persons to drive less, or move towards electric vehicles (Baur & Todorova, 2018).

The rise in fuel prices has led to the increase in cost for travelling by motor vehicles thus influencing the population to seek cheaper means to travelling such as car/bus pooling and e- transport (Sun, et al., 2023). It was published that the impact of increased oil and gas prices are divided into two factors, that is the change in fuel prices can impact the population's travel behavior and secondly, it could affect the intention to purchase new vehicles (Sun, et al., 2023).

It was noted that fuel prices are rising while the cost for electric vehicle are reducing (Maradin, et al., 2022). Dirk G. Baur et al., (2018) recognizes that when oil price rises, the cost for maintaining and using fueled powered vehicles rises, causing the electric vehicles to be more attractive. However, when the fuel price reduces, the cost for maintaining the fueled powered vehicle reduces, making them more attractive (Baur & Todorova, 2018). Both impacts suggest that Tesla's prices are dependent on the combustion engine vehicles as an alternative (Baur & Todorova, 2018). Study conducted revealed that Tesla is exposed to the effects of oil and gas due to the replacement effect between fueled vehicles and electric vehicles (Baur & Todorova, 2018).

It has been reported that several variables, including changes in accessibility, technical advancement, and increasing environmental rules for greenhouse gas emissions, may have an impact on the relationship between the automobile sector and the oil market (Baur & Todorova, 2018). Changes in accessibility includes car sharing, which is increasing in populated areas, however this was recognized to have an increase in purchases and replacement of shared vehicles (Baur & Todorova, 2018).

- *Tesla Products for Environmental Sustainability*

Most of Tesla's innovation is because if its vertical integration and has led to its respect in the automotive industry due to its innovative nature (Maradin, et al., 2022) . This "tech giant" is not only in the automotive industry but also in the electric sector with the introduction of solar roofs and power walls (Maradin, et al., 2022). Tesla also went on to innovate their own clean energy by using solar energy to power their Powerwall and power pack batteries (Maradin, et al., 2022). This was also recognized by Wang, et., al (2021) who published that Tesla currently manufacture sustainable energy collecting and storage devices while also creating their electric vehicles (Wang, et al., 2021). The same green energy is sourced from Tesla owned, SolarCity, to power its batteries (Maradin, et al., 2022). An alternative to Tesla's clean energy is natural gas which is a cheaper alternative which reduces the dependence on crude oil; this poses a risk to Tesla's innovations (Matthews, et al., 2020).

Tesla also prioritize security provided by its vehicles, this is evidenced by the fact that its vehicles are considered the safest in the world (Maradin, et al., 2022). This was reported from the program conducted by the U.S. Government New Car assessment which tested the Tesla's model S, X and 3 (Maradin, et al., 2022).

Further, it was noted that Tesla's products are key for the environment due their green aspect, however the products are too expensive for most customers (Maradin, et al., 2022). Dario Maradin et al., (2022) explained that it's with affordability in mind that Tesla produced its Model 3 Sedan which is more affordable.

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This company is the only electric car company that makes use of 18650 ternary lithium-ion batteries; it is also the only one in North America to use an aluminum body (Liu & Zhan Meng, 2017). Tesla's goal with its batteries is to expedite the move from fossil fuels to an energy system that is environmentally friendly (Matthews, et al., 2020).

Tesla created and introduced its first fully electric vehicle, the Roadster in 2008 (Barbara A. Schreiber, 2023). Tesla encouraged other companies to start producing their own electric cars (Maradin, et al., 2022). This was seen in the Chevy volt which is hybrid and the Nissan Leaf which is fully electric (Maradin, et al., 2022)

Transportation Research Institute reflected that electric car cost "less than half" of the amount to operate than the fuel powered vehicles. It was also published that the average cost for operating an electric vehicle in the United States of America is almost $490 while the average cost for fueled vehicles is almost $1,120 (Maradin, et al., 2022). The Chinese population was willing to purchase electric and hybrid vehicles over fueled vehicles during the increase of fuel prices (Sun, et al., 2023).

Wang et, al (2021) published that the fast-charging stations which was invented in 2020 store "green energy" serves Tesla, and some of Nissan, BMW, and Hyundai customers. Tesla has a high standard charging interface, this is due to its supercharger charging interface technology and compatibility (Wang, et al., 2021). However it was published that it can take about "5" minutes to refuel a vehicle while it takes about "30" minutes to fully charge an electric vehicle at a fast-charging station, longer at a lower voltage charging station, thus impacting the purchaser intention for a new electric vehicle (Sun, et al., 2023).

- *Tesla's Performance*

Dario Maradin et al., (2022) recognized that Tesla's presence in the auto and electric sectors has led to the transformation of both the industries. Tesla was the most valued vehicle brand as at June 2023, it was within the fifteen most valuable brand overall in 2022 and led in the sales for Electric vehicle that same year (Carlier, 2023). This company's growth from 2021 to 2022 was remarkable with almost 52% increase in revenue from 2021, this represent almost USD $ 81.6 billion (Carlier, 2023). Tesla has already surpassed its 2022 total of almost 1,314,000 new vehicles with approximately 1,324,000 in the third quarter of 2023 (Carter, 2023).

- *Conclusion*

This literature review revealed that many organizations still don't know what innovation is and how to adopt and implement it. Kahn (2018) revealed that innovation, once managed properly can lead to growth.

Omri (2020) and Ahmad et al., (2023) recognizes that both economic success and environmental stability are important (Omri, 2020), (Ahmad, et al., 2023). Sun et al., (2023) and Dario et al., (2022) have recognized that the cost for fuel may influence the population's mode of transportation.

Tesla started their focus on "solar energy, auto driving and energy storage" since 2015, the same year with the Paris Agreement (Wang, et al., 2021). Tesla produces their own clean renewable energy and storage devices for the said energy to be used when ready (Matthews, et al., 2020), (Wang, et al., 2021). Tesla started their focus on "solar energy, auto driving and energy storage" since 2015, the same year with the Paris Agreement (Wang, et al., 2021). Liu & Meng (2017) and Wang, et al., (2021) recognized and published that Tesla shares it copyrighted technology with other companies with the intention to support development of more electric vehicles which contribute to environmental sustainability.

Over the years there has been numerous literatures on Tesla and its contribution to environmental sustainability. This literature revealed that Tesla's goal is aligned with the Paris Agreement as it believes the faster the world move away on their dependency of the fossil fuels the chances are better for humanity (Wang, et al., 2021). However, the price for electric vehicles and fuel continues to impact the decision to purchase these vehicles; Sun, et al., (2023) and Dario et al., (2022) have recognized that the cost for fuel may influence the population's mode of transportation.

It was also revealed that Tesla not only produces vehicles but also their own green energy, power wall and power pack batteries (Maradin, et al., 2022). Tesla has seen growth over the years while being considered the most valued vehicle brand in 2023 (Carlier, 2023).

Further, it was discovered that the general operating cost of an electric vehicle is cheaper than that of a fueled vehicle. It was also revealed that people in the denser cities choose to share vehicles.

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CHAPTER THREE
METHODOLOGY

➢ *Introduction*

In this chapter, the researcher presents the secondary findings on Tesla's use of innovation to infiltrate the market for sustainable environment. Tesla is the first company to accomplish the successful introduction of the Electric Vehicle in the world; this was accomplished through its operation in an environment that demanded innovation which developed to being disruptive (Liu & Meng, 2017). Electric vehicles assist in the reduction of greenhouse gas. This chapter explores the methodology and the approach used in the research as outlined in chapter 1.

➢ *Philosophical Position*

The Pragmatism method was used in this study's philosophical standpoint. This method takes multiple forms but emphasize on practical application as the main requirement in identifying meaning, facts, and value (Thesarus.com, 2019). It follows a practical approach using several perspectives to assist with collection and interpretation of data (Saunders, et al., 2009).

➢ *The Research Approach*

This research did not seek to test any existing theories, instead all information was gathered, group and analyze to determine any pattern, gaps and theories. Thus, the inductive approach was taken. Inductive approach seeks to develop a theory by observation from all the information gathered (Streefkerk, 2023).

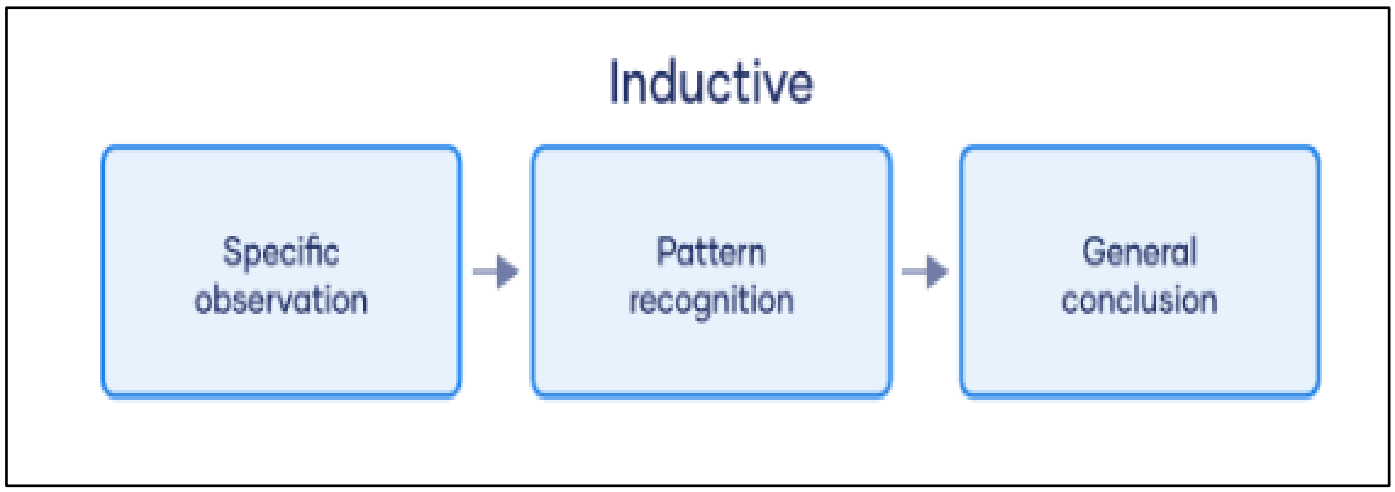

Fig 1 The Steps When Conducting an Inductive Approach. (Streefkerk, 2023)

For the literature review, the articles were gathered, the information needed was extracted while noting the author(s), date of publication, name, and title of the articles. The data gathered was grouped according to their subject matter. The compiled information was then analyzed for patterns, gaps and differences from which the conclusion was completed.

The information gathered was then displayed using both qualitative and quantitative methods thereby using mixed methods research. This method allows the researcher to gain the benefits from both the qualitative and quantitative study.

The qualitative approach was used to assess Tesla and its focus on innovation for a sustainable environment. This method involved the use of words to express ideas, opinions and feelings on the topic (Streefkerk, 2023).

The quantitative approach was used to evaluate the effects of oil and gas prices on the sale of Tesla's electric cars and review Tesla's growth in the auto mobile industry over the years. This research approach method uses data and graphs to report findings on the topic (Streefkerk, 2023).

➢ *The Research Method*

Systematic review was employed when conducting this research. A systemic review is a form of analysis that involves repeatedly searching and finding information on the topic to generate your report (Turney, 2023). This type of review responds to a clearly stated research question and directly specifies the methods used to reach the conclusion (Turney, 2023). All articles used were published from 2012 to 2023 to allow recent and updated information. Total of 58 articles and websites were used to gather information to complete this research.

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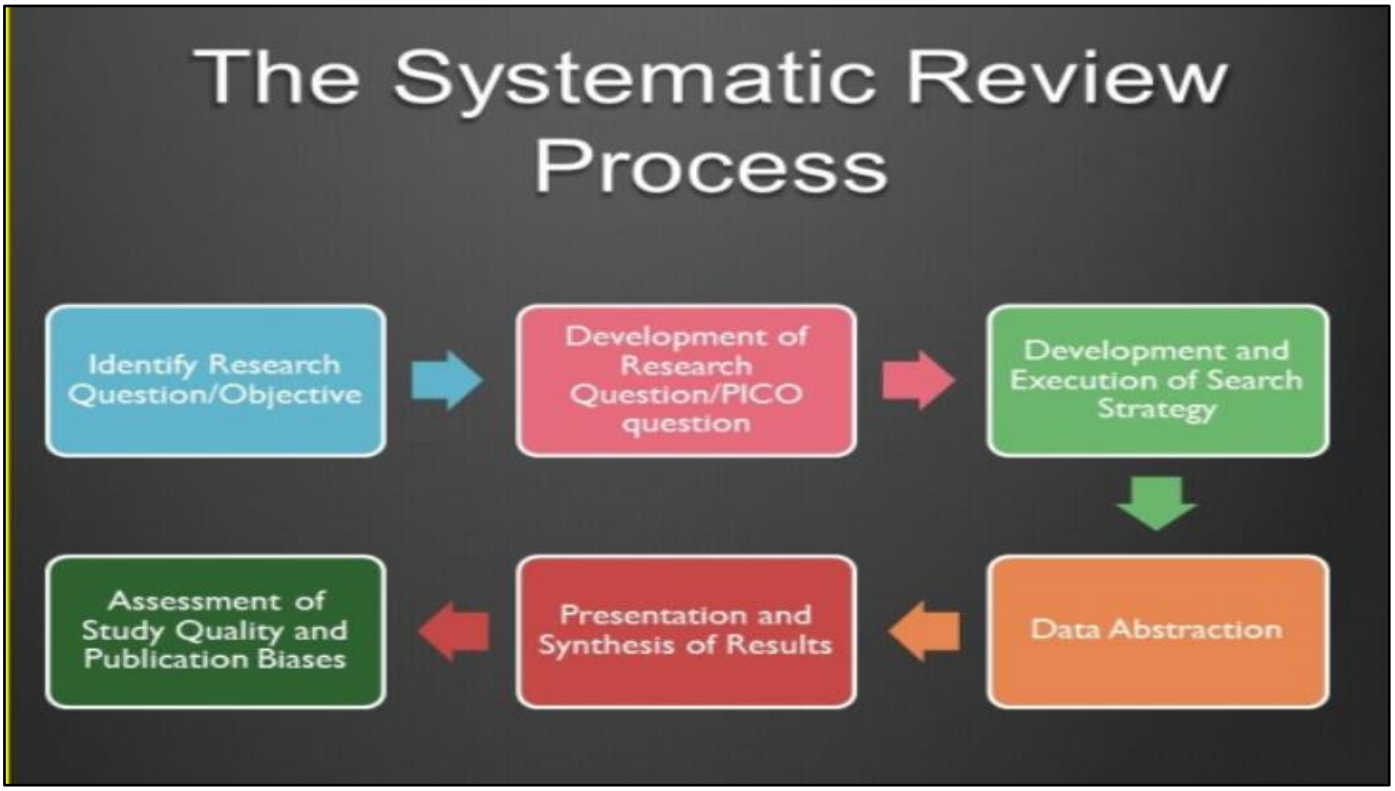

Fig 2 Steps for Systematic Review (Duong, 2016)

➢ *Data Collection*

All information collected for this report are secondary data from published journals. These data were initially gathered for other purposes by other individuals who publish and make them available to researchers and other parties (Indeed Editorial Team , 2023). Secondary information includes both qualitative and quantitative data (Saunders, et al., 2009).

The secondary data were collected based on the themes what were used to develop the topic for Tesla with reference to its Electric vehicles, batteries, and subsequent innovations. Additionally, data on the Paris Agreement, the impact of oil and gas on the sale of electric vehicles, and some basic information on innovation and how organizations respond to it were gathered and presented.

Finally, after gathering information from the relevant articles, a thematic assessment was conducted on the data obtained which resulted in the presentation of the findings in the table below.

➢ *Presentation of Key Findings*

Several articles were used to conduct a systematic review on Tesla and its innovation towards a sustainable environment. The effects of oil and gas prices were also reviewed to understand how increase and decrease of its prices influence the decision to purchase an electric vehicle.

Table 1 Presenting Themes, Findings and Sources of Information Gathered.

Themes	Findings	Sources
Innovation	Innovation is being introduced into an organization through its mission, vision and strategy.	(Kahn, 2018)
	Schumpeter innovation theory explained that innovation is critical to understand and explains economic progress with the "entrepreneur" being the primary inventor.	(Śledzik, 2013)
Patent sharing for environmental sustainability	Tesla shares all its copyrighted technology with other companies with the intention to support the development of electric vehicles which will foster growth in its industry, thus aiding in environmental sustainability.	(Liu & Meng, 2017).
	Tesla is prepared to work with other companies in the industry to increase transparency, opportunity and "equity"	(Wang, et al., 2021)

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	in its supply chain and decrease CO2 emissions at each level.	
Tesla's energy and storage devices	Tesla, which is an electric vehicle company has evolved into an energy company that create storage devices to store their renewable energy. Tesla manufactures storage devices for the collection of their "clean energy" while also creating their electric vehicles. Tesla has created a simple and affordable storage device to store the excess solar energy to be used at another time.	(Matthews, et al., 2020). (Wang, et al., 2021) (Matthews, et al., 2020)
Fossils fuels and Paris Agreement	This Agreement was entered with the aim to limit the rise of the world's average temperature to below 2 to 1.5 degree Celsius "pre-industrial" times. The Agreement was endorsed by over 195 parties who also recognize that carbon dioxide emission must be reduced to decrease global warming. The effects of global warming can be severe such as prolonged droughts, excessive rainfall and heatwaves. Fossils fuels consumption is over 80% and has been on the rise while transportation emission makes up over 20% of the total greenhouse gas emission as at 2015. Green development of vehicle consumption is required to lower carbon emissions during the lifecycle of the vehicles while also supporting environmentally friendly practices. Tesla believed that the future will be better the faster the world is able to move away its dependence on fossil fuels and move towards "zero emissions". Tesla's focus for 2018-2020 were on "batteries, photovoltaics, sustainability" and greenhouse gas emissions	(United Nations, 2023). (United Nations, 2023). (United Nations, 2023). (Kim, 2020). (China Development Network, 2022). (Wang, et al., 2021) (Wang, et al., 2021)
Environmental and Economic trade-off	Trade off can be identified between revenue generation and environmental safety. While technological innovation is necessary for firm survival and economic success, it also poses environmental issues that are equally important for long-term growth and development. The most effective way to combat climate change and greenhouse gas emissions is to understand the source of the emissions.	(Ahmad, et al., 2023) (Omri, 2020) (Ritchie, 2020).
Oil and gas prices in the automotive industry	The fluctuations in the oil industry may have consequences on performance, demand, and supply in the automotive industry. Increase in oil and gas prices may affect the production cost for a vehicle while the same increase may cause the population to travel less by fueled powered vehicles.	(Baur & Todorova, 2018). (Baur & Todorova, 2018).

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	When oil price rises, the cost for maintaining and using fueled powered vehicles rises, causing the electric vehicles to be more attractive.	(Baur & Todorova, 2018).
	When the oil price reduces, the cost for maintaining the fueled powered vehicle reduces, making them more attractive.	(Baur & Todorova, 2018).
	Tesla is exposed to the effects of oil and gas due to the replacement effect between fueled vehicles and electric vehicles.	(Baur & Todorova, 2018).
Tesla products for environmental stability	The most environmentally friendly vehicles are the fully electric types introduced by Tesla.	(Maradin, et al., 2022)
	Tesla created and introduced its first fully electric vehicle, the Roadster in 2008.	(Barbara A. Schreiber, 2023)
	Tesla also introduced its own solar roofs and power walls.	(Liu & Meng, 2017)
	An alternative to Tesla's clean energy is natural gas which is a cheaper alternative that reduces the dependence on crude oil; this poses a risk to Tesla's innovations.	(Matthews, et al., 2020).
	Tesla's products are key for the environment due to their green aspect, however the products are too expensive for most customers.	(Maradin, et al., 2022)
	This company is the only electric car company that makes use of the 18650 ternary lithium-ion batteries; it is also the only one in North America to use an aluminum body.	(Liu & Zhan Meng, 2017).
	Tesla's goal with its batteries is to expedite the move from fossil fuels to an energy system that is environmentally friendly.	(Matthews, et al., 2020).
	The average cost for operating an electric vehicle in the United States of America is almost $490 while the average cost for fueled vehicles is almost $1,120.	(Maradin, et al., 2022).
	The fast-charging stations which were invented in 2020 store "green energy" and serves Tesla, and some of Nissan, BMW and Hyundai customers.	(Wang, et al., 2021)
Tesla Performance	Tesla was the most valued vehicle brand as at June 2023, within the fifteen most valuable brand overall in 2022 and lead in the sales for Electric vehicle that same year.	(Carlier, 2023)
	This company's growth from 2022 to 2023 was remarkable with almost 52% increase in revenue from 2022.	(Carlier, 2023)
	Tesla has already surpassed its 2022 total of almost 1,314,000 new vehicles with approximately 1,324,000 in the third quarter of 2023	(Carlier, 2023)

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CHAPTER FOUR
DISCUSSION, CONCLUSION AND RECOMMENDATION

➢ *Introduction*

Business innovation is the process by which a company introduces a method, product or service in its sector or industry through improvements or completely changing the product or service (Indeed Editorial Team, 2022). These improvements can be to increase product or service efficiency from market demands or simply to increase market share. (Indeed Editorial Team, 2022). This chapter interprets and discusses the findings on Tesla and its innovative products which were presented in the preceding chapter.

➢ *Findings and Discussion*

The current study suggests that Tesla adopt innovations in its Electric vehicles and batteries. While this was not directly related to market demands, Tesla recognizes the need to reduce greenhouse gas emissions. From there, Tesla created and introduced its first fully electric vehicle, the Roadster in 2008 (Barbara A. Schreiber, 2023). This introduction of the Roadster can be linked to Schumpeter's theory of innovation which includes the introduction of new products. Additionally, it is aligned to Donald et al, (2014) publication which explains that some companies will adopt innovation to boost a company's profitability and efficiency.

The world recognized that the greenhouse gas emission needs to be reduced and as such, the Paris Agreement was adopted in 2015 and enforced in 2016, eight (8) years after Tesla introduced its first Electric Car (United Nations, 2023).

Additionally, it is recognized that both economic success and environmental stability are important in an organization and this can often lead to a tradeoff (Omri, 2020), (Ahmad, et al., 2023). Some businesses can incrementally introduce green innovations for environmental sustainability rather than not having any green policies since the effects of increased temperature can be severe, these include prolonged droughts, rainfall and heat wave as published by the United Nations (2023). More companies gradually introducing and adopting green innovation can be linked to Everett Rogers theory on the adoption of innovation in an organization, thereby following the "S-Curve" which caters for the "the innovators, early adopters, early majority, late majority and laggards" (Noel, et al., 2019).

It is to be noted that other manufacturers are following Tesla's lead on innovation and have started to create and introduce their own partially and fully electric vehicles such as Chevy Volt which was created by General Motors and the Leaf by Nissan (Maradin, et al., 2022). Additionally, Tesla's sharing of its copyright and patents allows for car manufacturing companies to start creating their own electric vehicles which will aide in the reduction of greenhouse gas emissions. Introduction of electric vehicles by companies aligns well with Schumpeter's theory which explained that innovation includes the introduction of new products or services, for this interpretation, the product is electric vehicles.

Further, it was expected that the rise in oil and gas prices would have boosted the sale of electric vehicles, instead as published by Baur & Todorova (2018) it led to car sharing /pooling or commutating by public transportation than purchasing electric vehicles. The expectation was due to the published article by Maradin, et al., (2022) which explained that the average cost for operating an electric vehicle in the United States of America is almost $490 while the average cost for fueled vehicles is almost $1,120. It should be noted that the cost for electric products as mentioned by Maradin, et al., (2022) may be a discouragement to purchasing electric vehicle.

The gradual adoption of electric vehicles can be linked to Rogers's 1962 theory on diffusion of innovation; the world is the market, and those who own electric vehicles are considered "the innovators' and "early adopters" while the momentum continues to build for the rest of world to adopt to electric vehicles.

Indeed, electric vehicles lead to savings from fuel, what was not considered was the cost for the electric cars, time to charge and available port for charging its batteries. While Tesla created its fast charging station in 2020, with super charging interface, findings reveals that an electric vehicle requires roughly 30 minutes to fully recharge at the fast charging station and as compared to approximately 5 minutes to refuel a standard automobile (Wang, et al., 2021), (Sun, et al., 2023). These factors are contributing to the discouragement of purchasing and electric vehicle which will have a positive impact on the environment.

Tesla recorded almost $81,500 million United States Dollars in revenue for the year 2022 as reflected in figure 4 (Carlier, 2023).

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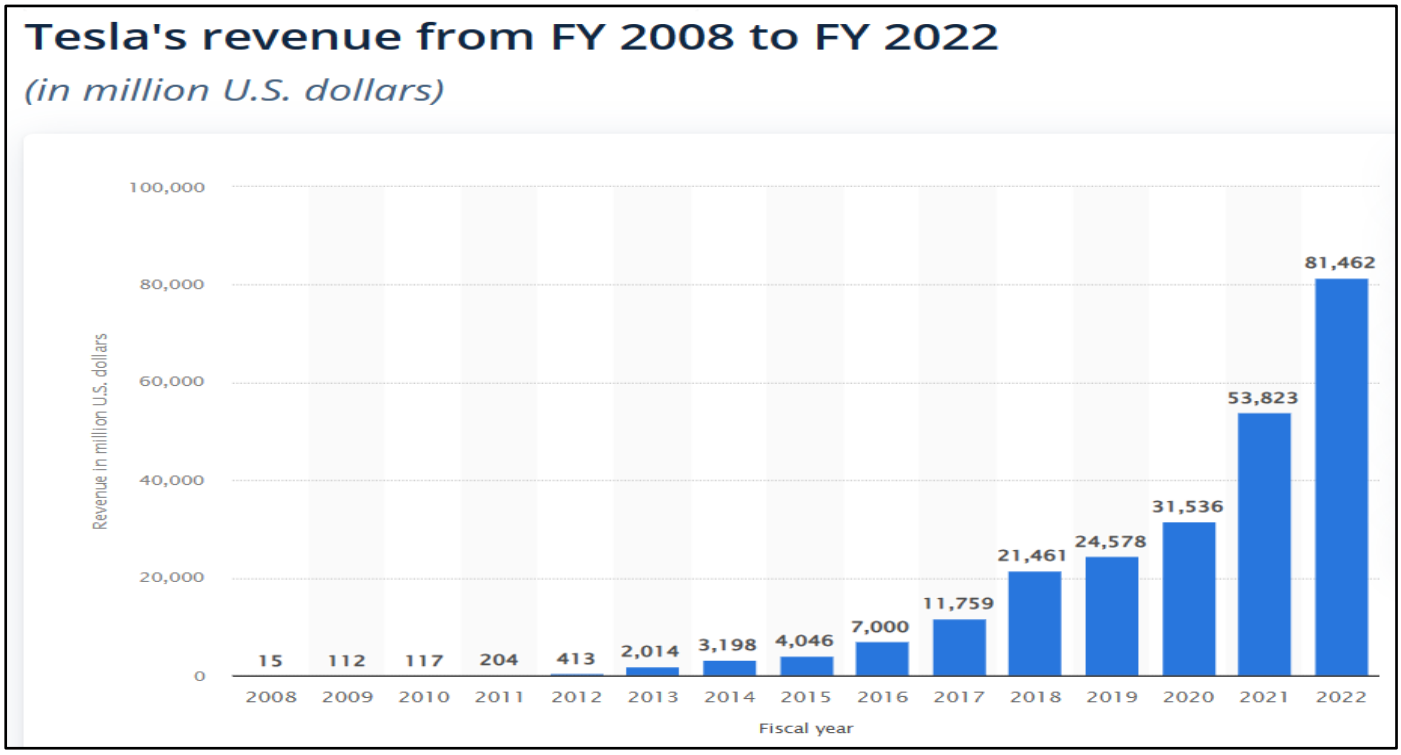

Fig 3 Tesla's Growing Revenue Over its Financial Years. (Carlier, 2023)

➢ *Unique Findings*

Kahan (2018) explained that most firms, while being aware of innovation, still don't know how to implement it. Evidently, Tesla is one of the firms that adopt innovation as outcome, mindset and process. Tesla's innovations not only open new markets but also aid in environmental sustainability. Its goal was to create "zero emission electric vehicles" that perform better than fueled vehicles. The goal was accomplished from its electric vehicles, power wall which stores clean renewable energy gathered from the solar, storage devices and also its charging stations with compatible interfaces which allows for other manufacturers' vehicles to be charged also (Tesla , 2023) (Wang, et al., 2021). Additionally, Liu and Meng (2017) explained that Tesla shares its copyrighted technology with other manufacturers. These findings show that Tesla's goal for environmental sustainability extends to other companies.

The creation of new markets through innovation is align with Schumpeter theory of innovation. Roger's diffusion of innovation can be used to track the market's adoption of Tesla's innovation.

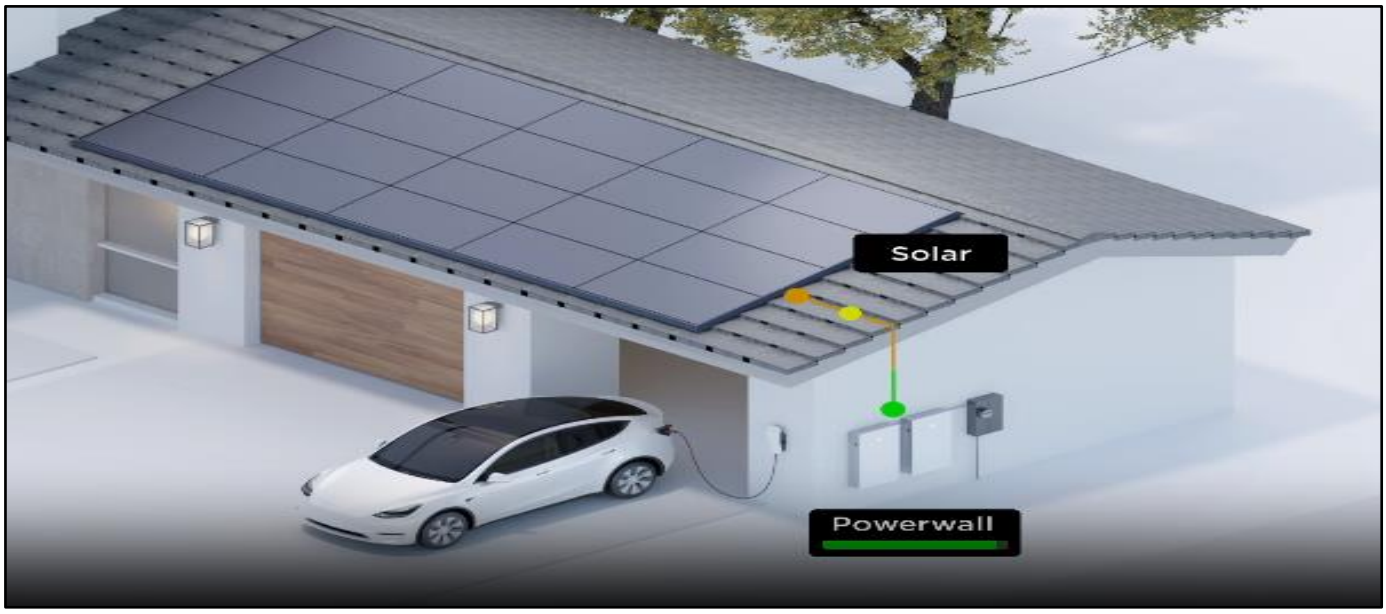

Fig 4 Present in the Picture is an Electric Vehicle Being Charged with Renewable Energy Generated from the Solar Panel and Stored in the Power Wall. (Tesla , 2023)

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➢ *Strengths of the Research*

The researcher gained a wider understanding while conducting the research on innovation, the Paris Agreement, fossil fuels, Tesla's innovation, and effects of oil and gas prices on electric vehicles.

➢ *Limitations of the Research*

This inductive study was conducted from secondary research only. This means that the only major limitation is the articles used could have been altered as a result of the initial researcher biasness. Due to time constraints and phases to conduct the research, the study had to be completed with the initial reports and journals found with limited time to seek more credible publications.

➢ *Conclusion*

The study has shown that Tesla's focus on innovation has expanded over the years from their roadster introduced in 2008 to its Models 3, Model S, Model X and Model Y in recent years. Tesla's electric vehicles contributed to a cleaner environment through zero emissions, its solar panels which convert energy and store in its Power wall, same energy being used to charge the electric vehicles.

The second major findings were the effects of oil and gas prices on the sale of Tesla's vehicles. While the results did not directly lead to the increase in sales of electric vehicles, its increase or decrease has not affected Tesla's growth and revenue earnings. This study also explored Tesla's growth over the years. While more companies seek to adopt the innovation of electric vehicles (competitors), it never affected Tesla's progress. Tesla reflected almost $30,000 million United States dollars increase for its financial year 2022 with the total revenue of approximately $81,000 million United States dollars compared to 2021-year end revenue of almost $54,000 million United States dollars (Carlier, 2023).

This research was conducted to assess Tesla's focus innovation for a sustainable environment, evaluate the effects of oil and gas prices on the sale of Tesla's electric cars and review Tesla's growth in the auto mobile industry over the years.

➢ *Recommendations:*

➢ *Recommendation for Tesla are as Follows:*

- Expand operations to other countries such as Guyana who is on the on the track to becoming the "Dubai of South America" with its blooming economy and growth potential. Expansion of operations may be through finding an authorized dealer in the said country and then exporting directly. This will increase the market share for Tesla which will lead to more electric vehicles being used, which will add to the reduction of CO2 emissions.

- Create more affordable electric vehicles for the market so that they can be afforded by a larger market segment. While it was noted that Tesla is creating cheaper vehicles such as its Sedan as explained by Maradin, et al., (2022), more can be done to ensure the world can afford and use electric vehicles. That means they will now have to target the people at the bottom of the pyramid which is most of the world's population.

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