

A COMPARATIVE STUDY ON ELECTRIC VEHICLE AND PETROL VEHICLE

Submitted in partial fulfillment of the requirements for the award of

MASTER OF BUSINESS ADMINISTRATION

By

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**DEPARTMENT OF BUSINESS ADMINISTRATION
SCHOOL OF MANAGEMENT STUDIES**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

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SATHYABAMA

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SCHOOL OF MANAGEMENT STUDIES

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work of **JAYARAM K 42410099** who carried out the Project Training “**A COMPARATIVE STUDY ON ELECTRIC VEHICLE AND PETROL VEHICLE**” under my supervision from October 2023 to December 2023.

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ABSTRACT

The automotive industry is currently undergoing a significant transformation with the growing emphasis on sustainability and environmental responsibility. This comparative study examines the key differences and implications between electric vehicles (EVs) and traditional petrol vehicles, providing a comprehensive analysis of their respective technologies, environmental impact, performance, and economic considerations. The research approach includes a detailed review of existing literature, an analysis of real-world data, and expert interviews to establish a well-rounded understanding of the subject. This study aims to address the fundamental questions surrounding the adoption of electric vehicles as an eco-friendly alternative to traditional internal combustion engine vehicles. The study first delves into the technological disparities between electric and petrol vehicles, considering factors such as powertrain design, energy sources, charging infrastructure, and maintenance requirements. It also explores the environmental footprint of each vehicle type, evaluating their respective emissions, resource consumption, and long-term sustainability. Furthermore, the research scrutinizes the performance characteristics of electric vehicles, including acceleration, range, and overall driving experience, in comparison to petrol vehicles. Economic considerations, such as purchase price, operational costs, government incentives, and the total cost of ownership, are also analyzed. This study concludes by presenting a holistic view of the advantages and disadvantages of electric vehicles in comparison to petrol vehicles, emphasizing the environmental benefits of EVs and the evolving landscape of the automobile industry. By addressing the complex interplay of technology, sustainability, performance, and economics, this research seeks to provide valuable insights for policymakers, industry stakeholders, and consumers, aiding them in making informed decisions regarding the future of transportation and sustainability. Ultimately, this study anticipates the ongoing shift toward electric vehicles as a critical component of a more sustainable automotive landscape.

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CHAPTER 1

INTRODUCTION

1.1. INTRODUCTION

The global automotive landscape is undergoing a momentous transformation, driven by a growing awareness of environmental sustainability and the need to reduce our dependence on fossil fuels. In this era of innovation and change, the comparative study of petrol vehicles and electric vehicles (EVs) stands as a crucial endeavour, offering a comprehensive evaluation of two distinct paradigms that represent the past and future of transportation.

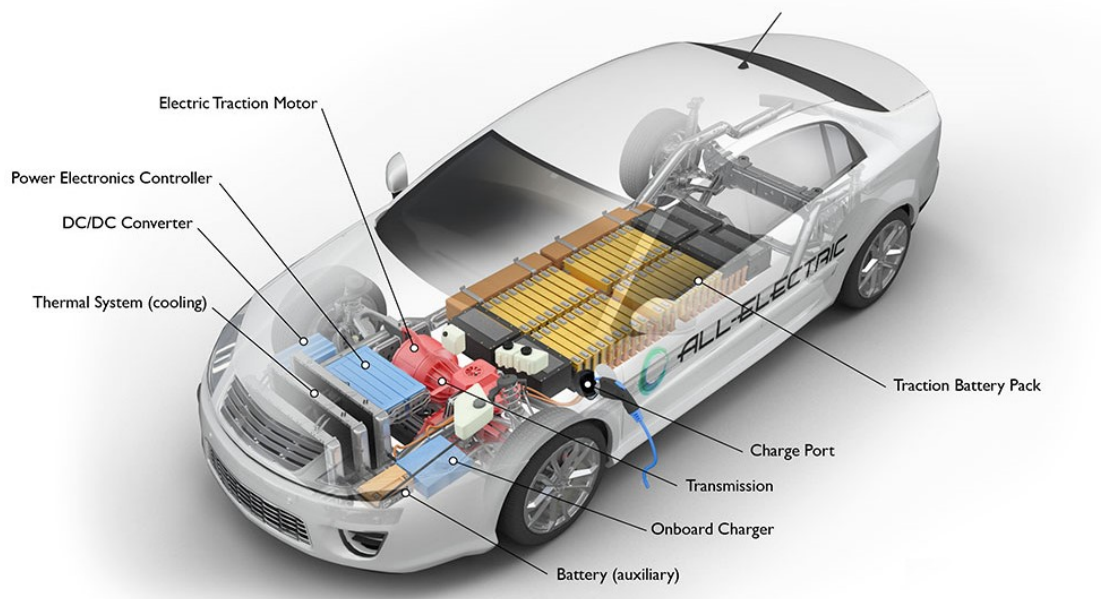
Petrol vehicles, with their internal combustion engines, have held a dominant position on the world's roads for over a century. These vehicles are known for their reliability, range, and the familiar growl of an engine running on gasoline. However, the environmental repercussions of petrol vehicles, including air pollution, greenhouse gas emissions, and the depletion of finite fossil fuel resources, have raised profound questions about their long-term sustainability.

In contrast, electric vehicles, powered by batteries and electric motors, have emerged as the vanguard of a cleaner, more sustainable transportation future. With zero tailpipe emissions, reduced dependence on fossil fuels, and the promise of renewable energy integration, electric vehicles offer a compelling alternative. Yet, they come with their own set of challenges, including range limitations, charging infrastructure development, and the need for more widespread adoption to realize their full potential.

This comprehensive comparative study seeks to illuminate the intricate dynamics that shape these two divergent transportation solutions. We will meticulously analyze and contrast petrol vehicles and electric vehicles across various dimensions, offering insights into the technological, environmental, economic, and practical aspects that influence the choices we make in our transportation needs.

ELECTRIC VEHICLE (4 WHEEL DRIVE)

An electric vehicle (EV) is a type of automobile that is powered by electricity stored in rechargeable batteries or other energy storage devices. Unlike traditional petrol or diesel vehicles, which rely on internal combustion engines, electric vehicles use electric motors for propulsion and do not have an exhaust system. The primary source of energy for electric vehicles is electricity, which can be obtained from a variety of sources, including power grids, renewable energy installations (such as solar or wind), or on-board generators (as in the case of plug-in hybrid electric vehicles).



In an era marked by an increasingly urgent need for environmental sustainability and energy efficiency, electric vehicles (EVs) have emerged as a groundbreaking and transformative force in the world of transportation. These innovative vehicles represent a significant departure from the traditional reliance on internal combustion engines, as they are powered by electricity stored in batteries and use electric motors for propulsion. EVs are at the forefront of a global shift towards cleaner, more sustainable mobility solutions, promising to revolutionize how we move while addressing critical environmental and energy challenges. Electric vehicles (EVs) are composed of several key components that work together to convert electrical energy into motion. These components distinguish EVs from

traditional internal combustion engine vehicles. Here are the primary components of an electric vehicle:

- **Electric Motor(s):** Electric vehicles are equipped with one or more electric motors that provide the necessary propulsion. These motors can be of various types, including AC (alternating current) or DC (direct current) motors. They convert electrical energy from the battery into mechanical energy to turn the wheels.
- **Battery Pack:** The battery pack is the heart of an electric vehicle and stores electrical energy in the form of chemical energy. Typically, lithium-ion batteries are used, but other battery technologies are under development. The capacity of the battery determines the range of the vehicle on a single charge.
- **Power Electronics:** Power electronics components, such as inverters and converters, are responsible for controlling the flow of electrical energy between the battery and the electric motor. They convert DC from the battery into AC for the motor and manage power distribution.
- **Charging Port:** Electric vehicles are equipped with a charging port that allows the vehicle's battery to be replenished with electricity. Different types of charging ports and connectors exist, including Level 1, Level 2, and DC fast charging options.
- **On-Board Charger:** The on-board charger is responsible for converting the incoming AC power from the charging station or power outlet into DC power to charge the battery. The charger's capacity and speed vary among different EV models.
- **Thermal Management System:** Electric vehicles require thermal management systems to regulate the temperature of the battery and other components. This system ensures that the battery operates within the optimal temperature range for efficiency and long run.
- **High-Voltage Wiring:** EVs use high-voltage wiring to transmit electricity from the battery to the motor and other components. This high voltage is necessary for power efficiency.
- **Regenerative Braking System:** Many electric vehicles feature a regenerative braking system, which captures kinetic energy during braking

and deceleration. This energy is converted back into electrical energy and used to recharge the battery.

- **Electric Vehicle Control Unit (EVCU):** The EVCU serves as the brain of the electric vehicle, managing various functions such as motor control, energy management, and overall vehicle operation.
- **Energy Management System (EMS):** The EMS optimizes the distribution and use of electrical energy, ensuring efficient operation and maintaining battery health.
- **Electric Vehicle Transmission:** Electric vehicles can have different types of transmissions, including single-speed transmissions or multi-speed transmissions, depending on the vehicle's design and motor characteristics.
- **Instrument Cluster and User Interface:** The instrument cluster and user interface provide information to the driver, including speed, battery state of charge, and range estimation. These components also allow drivers to control various vehicle functions.
- **Electric Vehicle Charging Infrastructure:** While not a part of the vehicle itself, charging infrastructure, including charging stations and connectors, plays a crucial role in enabling electric vehicle recharging.

ADVANTAGES OF ELECTRIC VEHICLE

- **LOWER RUNNING COSTS:**

Since you are not paying for petrol or diesel to keep your EV running, you save a lot of money on fuel. The cost to charge an electric vehicle compared to the price of petrol or diesel is substantially low. You can reduce the electricity cost further by utilising renewable energy sources such as solar.

- **LOW MAINTENANCE COSTS:**

Petrol or diesel-powered vehicles require regular maintenance since they have multiple moving parts. That's not the case with electric vehicles since they have comparatively lesser moving parts. This means that your electric car is likely to have lower maintenance costs in the long run.

- **TAX AND FINANCIAL BENEFITS:**

With India embracing the inclusion of EVs, the government offers several policies and incentives to encourage the usage of such vehicles.

For instance, the registration fees and road tax on purchasing EVs are lesser than ICE vehicles.

- **BETTER PERFORMANCE:**

In the past, EVs were seen as impractical. However, that has changed over the years, with manufacturers offering well-designed and good-looking EVs. Even the performance of EVs has changed for the better. Electric Vehicles are lighter in weight, and their acceleration is impeccable compared to fuel-powered vehicles.

- **ZERO TAILPIPE EMISSIONS:**

EVs emit zero tailpipe emissions, helping reduce the carbon footprint. You can further reduce your carbon footprint by utilising renewable energy to charge your EV.

- **EASY TO DRIVE AND QUIET:**

With lesser moving parts and uncomplicated controls, EVs are easy to drive. Also, you can plug such a vehicle into a public or home charging station when you want to charge it. They are also quiet, thereby reducing the sound levels that fuel-powered vehicles generate.

- **CONVENIENCE OF CHARGING AT HOME:**

There is no need to find the nearest petrol station to fill fuel. Charge your EV at home and get moving. With new-age charging technology, you can charge an EV quickly or even take advantage of battery swapping services to keep driving without worrying about the availability of conventional fuel.

- **NO FUEL, NO EMISSIONS**

One of the most significant advantages of EVs is their impact on our environment. Pure EVs have zero tailpipe emissions, which reduces air pollution. Since the electric motor of the EV operates on a closed circuit, it does not emit any harmful gases. Pure electric cars do not require petrol or diesel, which is excellent for the environment.

- **INCREASED RESALE VALUE**

As the demand for electric vehicles continues to grow, the resale value of EVs is expected to increase, making them a more attractive long-term investment.

- **REDUCED DEPENDENCE ON OIL**

Switching to electric vehicles reduces our dependence on oil, along with the related economic, political, and environmental consequences.

- **ENHANCED SAFETY FEATURES**

Electric vehicles often include cutting-edge safety features such as collision prevention systems and electronic stability control, lowering accident risks.

DISADVANTAGES OF ELECTRIC VEHICLE

- **LIMITED DRIVING RANGE**

Although battery technology is continuously advancing, electric vehicles still tend to have a shorter driving range compared to their traditional counterparts. This can cause range anxiety for some drivers, especially on long trips or in areas where charging stations are sparse.

- **CHARGING INFRASTRUCTURE**

The availability of charging stations can be limited, particularly in rural or remote regions. While the number of charging stations is steadily growing, it has yet to match the convenience and widespread availability of gas stations. Additionally, charging an EV typically takes longer than refueling a fossil fuel vehicle, which may be inconvenient for some drivers.

- **HIGH UPFRONT COST**

Electric vehicles usually come with a higher purchase price, primarily due to the cost of battery technology. However, potential savings from reduced running and maintenance costs can help offset the higher initial investment over time.

- **BATTERY LIFE AND DEGRADATION**

Over time, electric vehicle batteries can experience capacity degradation, which may lead to reduced driving range and performance. Battery replacements can be expensive, although it's expected that costs will decrease as technology continues to improve and economies of scale take effect.

- **LIMITED MODEL AVAILABILITY**

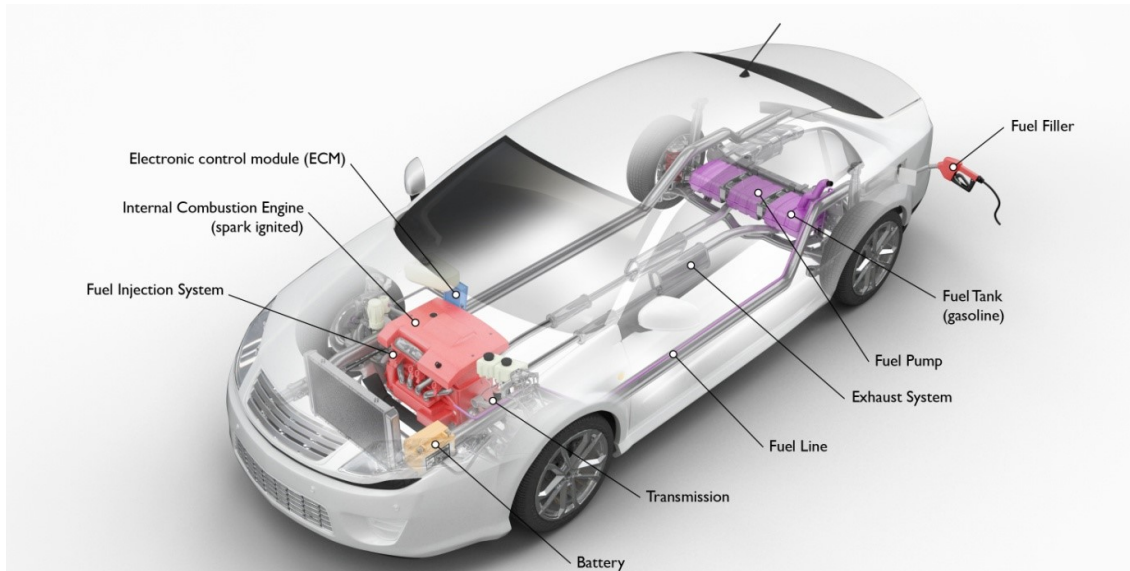
Despite the growing number of electric vehicle models available, the selection is still somewhat limited when compared to conventional vehicles. This can make it more challenging for potential buyers to find an EV that suits their specific needs, preferences, and budget.

- **ENVIRONMENTAL IMPACT OF BATTERY PRODUCTION**

The production process for electric vehicle batteries can have negative environmental consequences, including habitat destruction, water pollution, and greenhouse gas emissions. However, efforts are being made to minimize these impacts through responsible sourcing of materials, recycling initiatives, and advancements in battery production technologies.

PETROL VEHICLE (4 WHEEL DRIVE)

A four-wheel-drive (4WD) petrol vehicle is a type of vehicle designed to provide power and traction to all four wheels simultaneously. This drivetrain configuration offers improved off-road capability and enhanced stability in challenging road conditions, making it a popular choice for various types of vehicles, including SUVs, trucks, and some passenger cars. A petrol vehicle, also known as a gasoline vehicle in certain regions, is a type of automobile powered by an internal combustion engine that runs on gasoline or petrol as its primary fuel source. These vehicles have played a pivotal role in modern transportation for over a century and continue to be one of the most prevalent forms of personal and commercial transportation worldwide.



Four-wheel drive (4WD) petrol vehicles represent a versatile and capable category of automobiles that have gained popularity for their ability to tackle a wide range of driving conditions. Whether it's traversing rugged off-road terrain, safely navigating slippery or snowy roads, or delivering enhanced stability and traction, 4WD petrol vehicles are designed to meet the demands of diverse driving environments.

- **Drivetrain Configuration:** A 4WD petrol vehicle has a drivetrain that delivers power to all four wheels, providing better traction on slippery or uneven terrain. In most cases, the system can be manually engaged by the driver,

although some modern vehicles feature automatic or electronically controlled 4WD systems.

- **Engine:** The heart of any petrol vehicle is the internal combustion engine. The choice of engine may vary from a smaller, fuel-efficient four-cylinder to a more powerful six-cylinder or eight-cylinder engine, depending on the vehicle's purpose and intended use.
- **Transmission:** A 4WD petrol vehicle typically features either an automatic transmission or a manual transmission, with some models offering a combination of both. Modern vehicles often come with multi-speed transmissions to optimize performance and fuel efficiency.
- **Transfer Case:** The transfer case is a crucial component in a 4WD system. It splits the engine's power and directs it to the front and rear axles. Drivers can typically choose between 2WD (two-wheel drive) and 4WD modes.
- **Axles and Differentials:** 4WD vehicles have axles at both the front and rear, each with differentials that allow the wheels on the same axle to rotate at different speeds when turning. This feature is essential for maneuverability and stability.
- **Four-Wheel-Drive Modes:** Many 4WD petrol vehicles offer different drive modes for various driving conditions. Common modes include 2WD (for regular road use), 4WD High (for added traction on slippery or unpaved roads), and 4WD Low (for extreme off-road conditions, such as rock crawling or deep mud).
- **Off-Roading Features:** To enhance off-road performance, 4WD vehicles may include features such as; Suspension systems designed for articulation and ground clearance, Skid plates to protect vital components under the vehicle, All-terrain or mud-terrain tires for better grip, Locking differentials to ensure equal wheel speed on each axle, enhancing traction.
- **Fuel System:** Being a petrol vehicle, it relies on an internal combustion engine that requires petrol fuel, which is typically stored in a fuel tank located near the rear of the vehicle.
- **Control System:** Modern 4WD systems may feature electronic control systems that allow drivers to switch between different drive modes with the push of a button or turn of a dial. These systems also include traction

control, stability control, and anti-lock braking systems to enhance safety and performance.

- **Utility and Purpose:** 4WD petrol vehicles come in various forms, from compact SUVs designed for everyday use to heavy-duty trucks built for off-road adventures, towing, and hauling. The choice of vehicle depends on the intended use and specific requirements of the driver.
- **Fuel Efficiency:** While 4WD systems offer improved traction and off-road capabilities, they may consume more fuel compared to 2WD vehicles due to the added weight and drivetrain components. Modern engineering and technology aim to improve fuel efficiency without compromising performance.

ADVANTAGES OF PETROL VEHICLE

- **POWER AND PERFORMANCE**

Petrol 4WD vehicles often provide strong and consistent power, making them well-suited for off-road driving, towing, and carrying heavy loads. They can deliver good acceleration and high-speed capabilities.

- **AVAILABILITY OF FUEL**

Petrol is widely available, making it easier to find fuel for your vehicle, especially in remote or less-developed areas where other fuel types may not be as accessible.

- **LOWER INITIAL COST**

In many cases, petrol 4WD vehicles tend to be less expensive than their diesel counterparts, making them a more affordable option for many consumers.

- **QUIETER OPERATION**

Petrol engines are generally quieter and produce less noise than diesel engines. This can lead to a more comfortable and enjoyable driving experience.

- **EASIER COLD STARTS**

Petrol engines tend to perform better in cold weather conditions compared to diesel engines, which can have difficulty starting in extremely cold temperatures.

- **LIGHTER WEIGHT**

Petrol engines and vehicles tend to be lighter than their diesel counterparts, which can lead to improved handling and agility.

- **LOWER MAINTENANCE COSTS**

Petrol engines often have lower maintenance costs compared to diesel or hybrid engines, as they require simpler technology and fewer maintenance needs.

- **NO RANGE ANXIETY**

Unlike electric 4WD vehicles, petrol 4WD vehicles don't suffer from range anxiety, as refueling can be done quickly at any petrol station.

- **PROVEN TECHNOLOGY**

Petrol engines have a well-established track record of reliability and performance in 4WD applications.

- **VERSATILITY**

Petrol 4WD vehicles are versatile and can handle a wide range of off-road driving conditions, from rocky terrain to muddy trails.

- **TOWING CAPACITY**

Petrol engines in 4WD vehicles can offer robust towing capabilities, making them suitable for towing trailers, campers, or other heavy loads on rugged terrains.

- **ENGINE OPTIONS**

There is a wide variety of petrol engines available for 4WD vehicles, allowing consumers to choose based on their specific needs, whether it's for daily commuting or extreme off-roading.

- **NO CHARGING INFRASTRUCTURE REQUIRED**

Petrol 4WD vehicles do not rely on a charging infrastructure, making them accessible to off-road enthusiasts in remote areas.

- **GLOBAL FUEL STANDARD**

Petrol quality and standards are fairly consistent worldwide, which can be advantageous for off-road adventurers who may travel internationally.

- **AVAILABILITY OF FUEL IN REMOTE AREAS**

In many remote or less-developed regions, petrol is more readily available compared to alternative fuels, ensuring you won't run out of fuel in challenging terrains.

DISADVANTAGES OF PETROL VEHICLE

- **LOWER TORQUE**

Petrol engines typically have lower low-end torque compared to diesel engines. This can affect their ability to provide the necessary low-speed power for crawling over challenging terrain or towing heavy loads off-road.

- **FUEL EFFICIENCY**

Petrol 4WD vehicles tend to have lower fuel efficiency compared to diesel-powered 4WDs. This can result in higher fuel costs, especially during extended off-road trips where refueling options may be limited.

- **REDUCED RANGE**

Due to lower fuel efficiency, petrol 4WD vehicles often have a shorter driving range compared to diesel counterparts. This can be a limitation in remote areas where refueling opportunities are scarce.

- **EMISSIONS**

Petrol engines typically produce higher levels of carbon dioxide (CO₂) emissions compared to diesel engines. This can make them less environmentally friendly, especially in terms of greenhouse gas emissions.

- **LIMITED LOW-END POWER**

Petrol engines may struggle with steep inclines or heavy mud because they have less low-end power and torque, which can lead to difficulties when navigating challenging off-road terrain.

- **RESALE VALUE**

Diesel 4WD vehicles often have better resale values compared to petrol counterparts because of their reputation for durability and fuel efficiency. This means that petrol 4WDs may depreciate faster.

- **LESS POPULAR IN SOME REGIONS**

In certain regions, diesel 4WD vehicles are more popular and more readily available, making it harder to find petrol options or parts and services for petrol engines.

- **LESS IDEAL FOR HEAVY TOWING**

Diesel 4WDs are generally better suited for heavy towing due to their higher torque. Petrol engines may struggle when towing large trailers or heavy loads off-road.

- **MAINTENANCE COSTS**

While petrol engines are often simpler to maintain, their performance may suffer if maintenance is neglected, particularly during heavy off-road use, leading to potentially higher maintenance costs.

- **ENVIRONMENTAL IMPACT**

In some cases, petrol 4WD vehicles may have a more significant environmental impact due to higher CO2 emissions, which can be a concern for environmentally conscious off-road enthusiasts.

1.2. PROBLEM STATEMENT

The automotive industry is currently undergoing a significant transition towards sustainable and environmentally friendly transportation options. This shift is primarily evident in the growing popularity of electric vehicles (EVs) as an alternative to traditional petrol vehicles (PVs). While EVs are gaining traction due to their potential environmental benefits and reduced reliance on fossil fuels, there exists a need for a comprehensive comparative study to evaluate and understand the overall performance, economic viability, environmental impact, and user acceptance of electric vehicles in comparison to petrol vehicles. This study aims to address key questions surrounding the adoption of EVs, including range limitations, charging infrastructure, total cost of ownership, environmental implications, and user perceptions. By conducting a thorough comparison of Electric vehicle and Petrol vehicle across various dimensions, this research seeks to provide valuable insights for consumers, policymakers, and industry stakeholders, contributing to the informed decision-making process in the ongoing transition towards a more sustainable transportation future.

1.3. SCOPE OF THE STUDY

The scope of a comparative study on electric vehicles (EVs) and petrol vehicles (PVs) can be extensive, covering various dimensions to provide a comprehensive analysis. Here's a suggested scope for such a study:

- **VEHICLE PERFORMANCE**

Acceleration, top speed, and overall driving performance. Range and energy efficiency. Comparison of maintenance requirements and costs.

- **ECONOMIC VIABILITY**

Initial purchase cost and total cost of ownership. Government incentives and subsidies. Charging infrastructure costs versus traditional refueling infrastructure.

- **ENVIRONMENTAL IMPACT**

Carbon emissions during manufacturing, usage, and disposal. Comparative life cycle analysis. Assessment of the environmental benefits of electric vehicles, considering the energy mix.

- **CHARGING INFRASTRUCTURE**

Availability and accessibility of charging stations. Charging time and convenience. Comparison of home charging and public charging options.

- **USER ACCEPTANCE AND PERCEPTION**

Consumer attitudes and perceptions toward EVs and PVs. Factors influencing the decision to adopt EVs or stick with PVs. Awareness and understanding of the environmental impact.

- **TECHNOLOGICAL ADVANCEMENTS**

Advances in battery technology. Innovations in petrol engine efficiency. Emerging technologies that may impact the performance and sustainability of both vehicle types.

1.4. OBJECTIVE OF THE STUDY

- Primary objective focuses on a comparative study on electric vehicle and petrol vehicle.
- To analyze the total cost of ownership, considering factors like fuel or electricity costs, maintenance expenses, and potential incentives for both types of vehicles.
- To examine the range limitations provided by electric vehicle and petrol vehicle.
- To conclude with the best mode of vehicle after a benchmark analysis.

1.5. NEED OF THE STUDY

- As the world faces increasing concerns about climate change and environmental degradation, there is a growing need to transition to cleaner and more sustainable transportation options. Electric vehicles (EVs) represent a potential solution to reduce the carbon footprint associated with traditional petroleum vehicles.
- It addresses the need to explore alternative energy sources and reduce dependence on finite fossil fuels. Electric vehicles, powered by electricity from renewable sources, offer a promising alternative to traditional vehicles relying on petroleum-based fuels.
- The automotive industry is undergoing rapid technological advancements in both electric and traditional vehicles. A comparative study helps in assessing the state of technology in each domain, considering factors such as energy efficiency, performance, and infrastructure development.
- With an increasing awareness of environmental issues, consumers are becoming more conscious of their choices. This study provides valuable insights for consumers, helping them make informed decisions based on factors such as cost, performance, environmental impact, and the availability of supporting infrastructure.
- The economic aspects of transitioning to electric vehicles, including manufacturing costs, operational expenses, and potential economic benefits, are crucial considerations for both policymakers and industry

stakeholders. This study contributes to a comprehensive understanding of the economic implications of adopting electric vehicles.

1.6. LIMITATIONS OF THE STUDY

- Electric vehicles, compared to traditional petroleum vehicles, have a shorter history in terms of widespread adoption. This limitation may restrict the availability of long-term data on aspects such as reliability, maintenance costs, and performance.
- Understanding consumer preferences and behaviors is crucial in evaluating the market dynamics. However, the study might be limited in capturing the complexity of consumer decision-making processes regarding vehicle choices.
- The study might not fully explore interdependencies between electric and traditional vehicles, such as advancements in hybrid technologies. Focusing solely on EVs and petroleum vehicles may overlook hybrid solutions.
- The field of electric vehicles is rapidly evolving with continuous advancements in technology. During the course of the study, new innovations or changes in technology may occur, potentially affecting the relevance of the findings.

CHAPTER 2

REVIEW OF LITERATURE

XIAOLI SUN, ZHENGGUO LI, XIAOLIN WANG AND CHENGJIANG LI (2019), thinks accelerated development of electric vehicles (EVs) as a means to reduce oil dependence and environmental pollution. It emphasizes the importance of EVs, particularly battery electric vehicles (BEVs), as solutions to energy and environmental challenges. The paper offers a comprehensive overview of technical advancements in the EV industry, focusing on key technologies related to batteries, charging infrastructure, electric motors and control. It also highlights emerging technologies and technical challenges, emphasizing the need for improved efficiency, reliability, and safety in future EV development.

EMILIA M. SZUMSKA AND RAFAŁ S. JURECKI (2021), thinks that anxiety-related concerns of electric vehicle (EV) users and potential buyers, with a primary focus on "range anxiety," which stems from the fear of the EV's battery depleting before reaching its destination. To address this issue, a study was conducted to examine the impact of specific factors on a battery's depth of discharge (DOD). The study used simulations to analyze how the driving cycle, ambient temperature, load, and initial battery charge affect energy consumption and DOD. The results confirmed that the choice of driving route had the most significant influence on energy consumption, highlighting how various operational conditions directly affect an EV's range. This information is crucial for understanding and mitigating range anxiety in EV users.

CHRISTODOULOS KATIS AND ATHANASIOS KARLIS (2023), described the growing trends in electric and hybrid vehicles, hydrogen cell vehicles, and self-driving cars. It emphasizes the need for continuous technological innovations and advancements in these areas. The review offers insights into potential technological innovations, applications, and operational considerations. These insights are aimed at ensuring the proper functioning of vehicle components and charging equipment and enhancing future road safety.

M. SATYENDRA KUMAR , SHRIPAD T. REVANKAR (2017), says EV system comprises energy storage devices like batteries, fuel cells, and ultra-capacitors, along with electric propulsion and various engineering technologies. The primary goal of EVs is to offer a commercially viable range, efficient performance, safety, and reliability at a competitive price compared to internal combustion vehicles. The paper also highlights the use of permanent magnet brushless DC motors due to their advantages, and it provides an overview of EV technology, key strategies, and energy management systems. Additionally, it touches upon the commercial aspects and benefits of EVs.

NIC LUTSEY AND MICHAEL NICHOLAS (2019), this research evaluates the costs of battery electric vehicles (BEVs) from 2020 to 2030, utilizing data available up to 2018. It also examines when BEVs are expected to achieve price parity with conventional gasoline vehicles in the U.S. light-duty vehicle market for representative car types, including cars, crossovers, and SUVs.

ALAN JENN, KATALIN SPRINGEL, AND ANAND R. GOPAL (2018), describes the importance of transitioning to electric vehicles (EVs) to reduce energy use and emissions in the United States. It assesses the impact of various incentives provided by government and other entities on EV adoption. The study reveals that every \$1,000 offered as a rebate or tax credit boosts EV sales by 2.6%. Access to HOV lanes also significantly encourages EV adoption, resulting in a 4.7% increase for every 100 vehicles with HOV lane access per hour. The paper introduces a new factor, consumer knowledge of EVs and incentives, to explain regional differences in incentive effectiveness, highlighting the importance of raising consumer awareness for successful EV incentive programs.

SWARAJ RAVINDRA JAPE , ARCHANA THOSAR (2017), study on electric vehicles are becoming a compelling alternative to traditional internal combustion engine vehicles due to their high energy efficiency, low maintenance costs, and eco-friendly operation. Advancements in technology have addressed many traditional drawbacks of electric vehicles, making them more suitable for modern transportation needs. The electric motor is a crucial component that powers these

vehicles. This paper compares various types of electric motors for electric vehicle applications, considering specific parameters to help select the right motor type.

LEI WANG, XIANG WANG, WENXIAN YANG (2019), describes the growing electric vehicle market and the need to recycle Lithium-Ion batteries, a common power source for these vehicles. It emphasizes the urgency of recycling to reduce environmental pollution and support sustainable electric vehicle development. The paper presents a model that considers carbon emissions for simulating electric vehicle battery recycling, taking into account various strategies for handling used batteries. The study also highlights the importance of developing cost-effective recycling technology to further reduce recycling costs for electric vehicle manufacturers.

SCOTT HARDMAN, KELLY L. FLEMING, EESHA KHARE, AND MAHMOUD M. RAMADAN (2021), they describes buyers of electric vehicles tend to be male, high-income, well-educated homeowners with multiple vehicles and home charging access. Electric vehicle model options are expanding, but many are luxury vehicles or SUVs with higher costs. Incentives for electric vehicles often lack equity, are received after purchase, and can favor higher-income buyers. Additionally, electric vehicle charging infrastructure is not evenly distributed, and there is a need for more affordable charging options in lower-income residential areas.

IQBAL HUSAIN (2020), describes the transition to electric road transport technologies, emphasizing the need for electric traction drive systems to offer improved performance and capabilities, including fuel efficiency, extended range, and fast charging options. The US Department of Energy, in collaboration with the automotive industry, has set technical targets for light-duty electric vehicles for 2025 to accelerate their mass-market adoption.

TIANJIE ZOU, DAVID GERADA (2022), defines the increasing demand for higher power density in electric vehicle (EV) drive systems is driving innovations in traction motor design. Hairpin windings, known for reduced losses and improved heat dissipation, have become popular for EV motors. It presents a detailed

approach to designing hairpin winding layouts, exploring various aspects like pin connections, special jumpers, transposition, terminal positions, phase shift, and more. It also addresses the challenge of layout options with increased slot numbers. The advantages of this motor are compared to a more traditional design. Finally, a stator prototype with the proposed hairpin winding is created to validate its manufacturability.

ANDREA CREDO, MARCO VILLANI, GIUSEPPE FABRI (2023), describes the performance requirements for electric motors in meeting the acceleration and maximum speed needs of electric vehicles. It begins with a simplified vehicle model, aiming to minimize motor torque and input power. Synchronous reluctance motors are evaluated in two case studies: a high-performance vehicle and a city car. The motor's flux weakening capabilities play a crucial role in these scenarios, as they can affect motor sizing and design. The article emphasizes that for high-performance requirements, advanced design procedures can help meet the goals even with the motor's limitations. In the case of the city car, modifications to the motor stack length and windings are considered, with a prototype tested to confirm simulation results.

REZA RAZI, MAJID MEHRASA, KHALED HAJAR (2022), describes the concept of smart charging for electric vehicles in parking lots, which has received less attention compared to other scenarios with more vehicles than charging points. In parking lots, the charging duration is typically temporary, and modular converters are used to reduce costs. It introduces a modified algorithm to connect each vehicle to the appropriate charging point while achieving specific objectives. The effectiveness of this approach is assessed through simulations.

SANDIP HAZRA AND JANARDHAN K. REDDY (2021), describes the emergence of electric vehicles (EVs) and the unique noise, vibration, and harshness (NVH) challenges they bring. Unlike internal combustion engine (ICE) vehicles, EVs lack combustion and exhaust noise, but they still have NVH concerns related to motor and battery cooling. They addresses various noise issues in EVs, categorizing them into five groups: motor, wind, road, auxiliary, and other noises. The impact of powertrain mount architecture on load transfer and

crash performance, highlighting the need for a balanced approach to NVH, durability, and crash requirements in EV design.

MIRCEA POPESCU, LINO DI LEONARDO (2023), it focuses on the design of a 200 kW/ 370 Nm induction machine for electric vehicle traction systems. The goal is to improve induction machine technology for mass production, making it a rare earth-free solution for EVs. The design incorporates suitable materials, rotor die-casting, hairpin stator winding, and specific cooling systems. The performance of the machine is evaluated using analytical and numerical methods across its entire speed range.

VINCENT M. MACHARIA, VIJAY K. GARG, DINESH KUMAR (2023), they describe increasing global awareness of climate change and the need for net-zero emissions. It highlights the challenges in the transportation sector, particularly in reducing greenhouse gas emissions and the dwindling fossil fuel reserves. Electric vehicles (EVs) are presented as a promising solution to replace internal combustion engines (ICE) in the near future. The article reviews various components and technologies employed in EVs to enhance motion efficiency and optimize energy management.

NING DING, K. PRASAD AND T.T. LIE (2019), they both explores electric vehicles (EVs) as a solution to reduce the greenhouse effect. It particularly focuses on plug-in hybrid electric vehicles (PHEVs) and how they offer competitive driving range and fuel economy compared to internal combustion engine vehicles. The importance of optimized control strategies and energy management systems (EMS) in enhancing PHEV efficiency. It also discusses battery and supercapacitor technology as potential means to increase PHEV energy capacity.

GEORGE CRABTREE (2019), says the adoption of electric vehicles (EVs) is set to revolutionize various aspects of transportation, impacting fuel usage, carbon emissions, costs, maintenance, and driving habits. Initially driven by the need to decarbonize transportation in response to the climate crisis, the focus may soon shift to economics, as EVs are expected to become more affordable and higher-performing than gasoline cars.

JULIO A. SANGUESA, VICENTE TORRES-SANZ, PIEDAD GARRID, FRANCISCO J. MARTINEZ AND JOHANN M. MARQUEZ-BARJA (2021), that discusses the growing popularity of Electric Vehicles (EVs) due to price reductions and environmental awareness. It provides insights into the worldwide market for EVs and their future prospects. The evolution of battery technologies, with a focus on Lithium-ion batteries, and explores the various standards for EV charging. Additionally, it covers power control and battery energy management methods.

JIANWEI XING, BENJAMIN LEARD, SHANJUN LI (2021), says the emissions reductions resulting from the adoption of electric vehicles (EVs) by identifying the vehicles that would have been purchased if EVs were not available. The research utilizes a discrete choice model of new vehicle demand and simulations to estimate counterfactual sales without EV subsidies.

JOHN B. HEYWOOD (2018), thinks that internal combustion engines, whether spark-ignition (SI) or compression-ignition (CI), serve the purpose of converting chemical energy from fuel into mechanical power. Unlike external combustion engines, internal combustion engines burn fuel within the engine itself. The working fluids are the fuel-air mixture before combustion and the burned products after combustion. The energy transfer that generates power happens directly between these working fluids and the engine's mechanical components.

OMOJOLA AWOGBEMI, DARAMY VANDI VON KALLON, EMMANUEL IDOKO ONUH AND VICTOR SUNDAY AIGBODION (2021), describes that biofuels, derived from renewable sources, are seen as a cost-effective, safe, and environmentally friendly alternative to fossil-based fuels. This work explores the classification, production, and application of biofuels, with a focus on their use in internal combustion engines (ICE). Biofuels are categorized based on physical state, technology maturity, feedstock generation, and product generation.

O P LOPATIN (2020), says that chemical transformations of hydrocarbon fuel-air mixtures under non-isothermal conditions is challenging due to the complexity of the chemical mechanisms involved. This complexity necessitates considering numerous elementary stages between the mixture's individual components, along

with higher-order nonlinearities in the system and issues related to "stiffness" caused by the sensitivity of reaction rates to temperature.

AIMAN ALBATAYNEH, MOHAMMAD N. ASSAF, DARIUSZ ALTERMAN, MUSTAFA JARADAT (2020), says that overall energy efficiency of electric vehicles (EVs) compared to internal combustion engine vehicles (ICEVs). The research finds that the efficiency of power plants used to generate electricity for EVs plays a significant role in determining the overall efficiency.

Lai Yang, Biying Yu, Bo Yang, Hao Chen, Gabriel Malima, Yi-Ming Wei (2020), thinks the environmental impact of electric vehicles (EVs) in China using a life cycle assessment (LCA). It compares carbon dioxide (CO₂) and air pollutant emissions across the entire life cycle, including production, use, and end-of-life, for three types of passenger vehicles: internal combustion engine vehicles (ICEV), plug-in hybrid electric vehicles (PHEV), and battery electric vehicles (BEV).

ISABELLA BURCH AND JOCK GILCHRIST (2018), describes the lack of political will to ban internal combustion engine (ICE) vehicles and the absence of a comprehensive database documenting global efforts to transition to electric vehicles. The first version of the survey was well-received in 2018 and has since been updated to include the increasing number of countries, cities, and companies committing to electrified vehicle fleets.

SITI NURUL AKMAL YUSOF, NOR AZWADI CHE SIDIK, YUTAKA ASAKO (2020), describes that nano-sized particles dispersed in a liquid medium, has gained attention for its ability to enhance heat transfer and energy efficiency in various engineering applications. In the automotive industry, adding nano-fluid to diesel/biodiesel as an additive for internal combustion engines (ICE) has become an appealing approach to improve combustion efficiency and reduce emissions. Numerous studies have shown that nanoparticles added to diesel/biodiesel fuel can enhance engine combustion characteristics.

L. ATHANASOPOULOU, H. BIKASA, P. STAVROPOULOS (2018), they efforts to reduce carbon dioxide (CO₂) emissions from the automotive sector focus on manufacturing and use phases. Battery Electric Vehicles (BEVs) are considered a promising technology due to their lower emissions compared to conventional Internal Combustion Engine Vehicles (ICEVs) during use. This study introduces a Well-to-Wheel framework to compare the air pollution contributions of ICEVs and BEVs, covering the entire energy production process.

XINYU LIU, KRISHNA REDDI, AMGAD ELGOWAINY, HENNING LOHSE-BUSCH, MICHAEL WANG, NEHA RUSTAGI (2019), says hydrogen fuel cell electric vehicles (HFCEVs) operate more efficiently than gasoline internal combustion engine vehicles (ICEVs) and produce zero tailpipe emissions. However, the production, transportation, and refueling of hydrogen can be more energy-intensive and emissions-heavy. A well-to-wheels (WTW) analysis compared a Toyota Mirai HFCEV to a Mazda 3 ICEV using different fuel consumption data sources.

SAAD S. ALRWASHDEH, ALAA M. AL-FALAHAT,, TALIB K. MURTADHA (2022), Internal Combustion Engines (ICE) play a crucial role in converting fuel's chemical energy into thermal energy through combustion, which is then transformed into kinetic energy for various modes of transportation. While ICE efficiency is currently in an intermediate range, improvements are continually sought. Turbochargers, which increase engine pressure, are used to enhance ICE efficiency.

XI WANG, BAI-GANG SUN, QING-HE LUO (2019), Turbocharged hydrogen engine focused on energy and exergy distribution. The energy loss during fuel conversion primarily includes exhaust energy, cooling medium (coolant and oil) energy, intercooler energy, and uncounted energy, while effective work accounts for a proportion ranging from 25.7% to 35.1%. Results indicate that all types of energies increase with engine speeds but are insensitive to loads. The turbocharger can boost brake thermal efficiency, with a potential increase of up to 4.8%.

QUENTIN MAL, GABRIEL STAFFELBACH, OLIVIER VERMOREL, ANTONY MISDARIIS, FREDERIC RAVET, THIERRY POINSOT (2019), thinks the use of pre-chamber ignition systems to enhance the ignition of lean mixtures in internal combustion engines. By employing large eddy simulation and reduced chemistry modeling, the research analyzes the flow dynamics, cooling effects, and ignition sequences. It is found that in this case, a few flame kernels exit the pre-chamber, allowing hot products to penetrate the main chamber, mix with fresh reactants, and initiate combustion, transitioning from distributed reaction to flamelet propagation. This technology holds promise for improving fuel efficiency and reducing emissions in engines operating on lean mixtures.

AN EXPOSITORY COMPARISON OF ELECTRIC VEHICLES AND INTERNAL COMBUSTION ENGINE VEHICLES IN AFRICA - OMOWUNMI MARY LONGE (2022), Internal combustion engine vehicles are predominant in global transportation, but environmental concerns have spurred interest in electromobility (e-mobility) as a green and sustainable alternative. In Africa, several obstacles hinder the adoption of e-mobility, such as high import duties, expensive electric vehicles, inadequate government policies, limited charging infrastructure, and a lack of subsidies. To enable a successful transition to green mobility in Africa, it's crucial for governments, businesses, and academic institutions to collaborate and implement suitable strategies.

A. GOWTHAM RAJAN, A.BHARATH NITHISH, S.RAMPRAKAASH, K.VITHYASAGAR (2021), thinks the thermal analysis of a conventional uncoated diesel piston made of aluminum silicon alloy and a piston crown coated with a two-layer thermal barrier coating (TBC) using Air Plasma spraying. The goal is to maintain the required temperature in the combustion chamber, reducing heat loss to the piston and enabling the combustion of unburnt gases to reduce exhaust pollution. The results are expected to show improved thermal efficiency for the coated piston at full load but an increase in nitrogen oxide emissions.

G. J., HOWEY D., CONTESTABILE M., CLAGUE R., BRANDON N. P. (2019), it compares Battery Electric Vehicles (BEV) to Hydrogen Fuel Cell Electric Vehicles (FCEV) and Hydrogen Fuel Cell Plug-In Hybrid Vehicles (FCHEV) in terms of

technology, infrastructure, and lifecycle cost over 100,000 miles, assuming a common vehicle platform. The study suggests that by 2030, FCEVs could achieve cost parity with conventional gasoline vehicles, but both BEVs and FCHEVs have lower lifecycle costs.

MANISHKUMAR VARMA, HOSHIAR MAL, RAJESH PAHURKAR, RAMAKANT SWAIN (2020), the environmental concerns related to global warming, ozone depletion, and greenhouse gas emissions. It explores various alternative approaches to reduce pollution, including nuclear energy, renewable energy sources like wind and solar power, and increasing the efficiency of fossil fuel plants while capturing and storing carbon dioxide emissions. The study also examines the potential of electric vehicles (EVs) and other green propulsion technologies to reduce emissions and emphasizes the growing support for EVs worldwide.

SEBASTIAN GRZESIAK AND ADAM SULICH (2022), the European Union has taken significant steps to support the electric automotive sector, with a declaration in Glasgow leading to a ban on the sale of combustion engine cars from 2035. It focuses on the impact of this change in the Czech Republic, Germany, and Poland. It aims to compare car engines at multiple levels and answer whether electric vehicles are less harmful to the environment. It compares vehicles of the same make, class, and type with petrol, diesel, hybrid, and electric engines, considering their environmental impact.

S. MEKHILEF, R. SAIDUR, A. SAFARI (2021), thinks fuel cells offer a promising way to generate electricity and heat through the electrochemical reaction of oxygen and hydrogen, particularly in areas without access to the grid or with high wiring costs. They find applications in secure energy needs like uninterruptible power supplies, power generation stations, and distributed systems. It compares the techno-economic aspects of hydrogen fuel cell vehicles (FCV) and internal combustion engine vehicles (ICEV).

CHENGXIANG ZHUGE, CHUNFU SHAO AND XIA LI (2019), a comparative study conducted in Beijing, China, investigates the differences between

conventional vehicles (CVs), battery electric vehicles (BEVs), and plug-in hybrid electric vehicles (PHEVs) in terms of maximum acceptable diverting time to a refueling station, maximum acceptable waiting time at a refueling station, refueling preferences, and desired electric driving ranges. The preferred driving ranges for BEVs and PHEVs are around 50 km, suggesting a preference for shorter charging times. They discuss how these empirical findings can inform the planning of refueling and charging stations.

TROY R. HAWKINS, BHAWNA SINGH, GUILLAUME MAJEAU-BETTEZ, AND ANDERS HAMMER STROMMAN (2019), it evaluates the environmental impact of electric vehicles (EVs) compared to conventional vehicles, considering both the use phase and vehicle production. When powered by the current European electricity mix and assuming a 150,000 km lifetime, EVs can reduce global warming potential by 10% to 24% compared to conventional diesel or gasoline vehicles. To improve the environmental profile of EVs, efforts should focus on reducing supply chain impacts and promoting cleaner electricity sources.

MEDHAT ELKELAWY, HAGAR ALM-ELDIN BASTAWISSI, MOHAMMED OSAMA ELSAMADONY, AHMED MOHAMMED ELBANNA, AHMED M. S. M. SAFWAT (2022), the transportation sector is a major contributor to global carbon emissions and air quality problems, especially in cities. Hybrid electric vehicles (HEVs), known for their success in reducing hydrocarbon usage, are seen as a bridge between fully electric cars and internal combustion engines. It compares a conventional gasoline car's fuel consumption and emissions to a complete HEV system under various battery charging rates.

KHALID S. MOHAMMAD, AQEEL S. JABER (2022), it emphasizes the importance of transitioning to electric vehicles (EVs) to reduce environmental pollution. It focuses on the selection of the most suitable electric motor for EVs, considering factors like efficiency, dynamic response, starting torque, and cost. It compares various types of electric motors used in EVs and presents the results for consideration.

SHREY VERMA , GAURAV DWIVEDI A, PUNEET VERMA (2021), they explores the transition to electric vehicles (EVs) as a means to reduce greenhouse gas emissions, air pollution, and improve overall comfort. It compares various life cycle assessment (LCA) and life cycle cost (LCC) analyses of EVs and conventional fossil fuel-powered vehicles. The findings indicate that EV adoption reduces greenhouse gas emissions but increases human toxicity due to materials and energy used in powertrain and battery production.

IOAN-SORIN SORLEI, NICU BIZON, PHATIPHAT THOUNTHONG, MIHAI VARLAM, ELENA CARCADEA, MIHAI CULCER, MARIANA ILIESCU AND MIRCEA RACEANU (2020), in electric fuel cell vehicles, which combine fuel cell systems with hybrid energy storage, such as batteries and ultra capacitors, to meet dynamic power demands. It discusses the latest vehicle topologies and DC/DC converters used in these systems, providing valuable information for researchers and developers. The study also delves into energy management strategies, comparing different approaches in terms of energy efficiency, hydrogen consumption, and subsystem degradation.

EVANTHIA A. NANAKI, CHRISTOPHER J. KORONEOS (2020), it compares the economic and environmental aspects of conventional, hybrid, and electric vehicles available in the Greek market. It considers both the production and utilization stages of these vehicles and explores three electricity generation scenarios (high, medium, and low carbon). The results indicate that hybrid and electric cars offer environmental advantages over conventional vehicles. In a carbon-free electricity generation scenario, electric cars significantly reduce greenhouse gas and air pollution emissions compared to conventional cars.

FAYCAL-SIDDIKOU BOUREIMA, MAARTEN MESSAGI , JULIEN MATHEYS, VINCENT WYNEN, NELE SERGEANT, JOERI VAN MIERLO, MARC DE VOS , BERNARD DE CAEVEL (2019), describes environmental comparison of electric, hybrid, LPG (liquefied petroleum gas), and gasoline passenger vehicles using a Life Cycle Assessment (LCA) approach. It employs a range-based modeling system, considering variations in weight, fuel consumption, and emissions within the family car category. LPG hybrid and battery electric vehicles have significantly

lower greenhouse gas emissions, with the battery electric vehicle scoring highest in terms of human health and air acidification impact.

KAMIL CAGATAY BAYINDIR, MEHMET ALI GOZUKUCUK, AHMET TEKE (2021), explains about hybrid electrical vehicles (HEVs) as an alternative to traditional fuel-based vehicles, driven by concerns about limited fuel resources, global warming, and exhaust emissions. It provides an overview of HEVs, focusing on hybrid configurations, energy management strategies, and electronic control units. The advantages and disadvantages of each configuration are discussed, along with a classification of existing powertrain control techniques for HEVs.

ALI EMADI, YOUNG JOO LEE, KAUSHIK RAJASHEKARA (2018), it compares the life cycle greenhouse gas (GHG) emissions of electric vehicles (EVs) and conventional internal combustion engine vehicles (ICEVs) in Indian conditions. It reveals that ICEVs have about 40% less embodied equivalent carbon emissions compared to EVs. The vehicle emission factor, which normalizes emissions based on vehicle life in kilometers, shows lower values for ICEVs, with the highest for petrol variants. EVs have higher emission values, primarily due to factors like the battery component, the Indian generation mix, and energy-intensive manufacturing techniques.

ELENA CARCADEA (2018), says the development of environmentally friendly vehicles, including electric, hybrid electric, and plug-in hybrid electric vehicles, to meet emission reduction and fuel economy demands. The role of power electronics as an enabling technology in these vehicles and provides an overview of current trends, future strategies, and the function of power electronic subsystems.

SESHA GOPAL SELVAKUMAR (2021), the need for alternative energy sources in automobiles due to the depletion of fossil fuels, high prices, and pollution. Electric, hybrid, and fuel-cell vehicles as solutions, with a focus on the different types of electric vehicles (AEVs, PHEVs, HEVs, and FCEVs). It explores the downsides of using electric vehicles and provides insights into the future of electric vehicle technology.

DANIEL DE WOLF AND YVES SMEERS (2023), describes the need for alternative energy infrastructure, particularly for hydrogen (for fuel cell electric vehicles) and electricity (for battery electric vehicles), due to the ban on fossil fuel vehicles in European cities. It compares the advantages and constraints of both propulsion modes, hydrogen's autonomy and fast recharging and electricity's affordability and wide grid availability.

DANIELLE RODRIGUES DE MORAES, LAENE OLIVEIRA SOARES, VANESSA DE ALMEIDA GUIMARAES, KATIA FERREIRA DE OLIVEIRA, LUIS HERNANDEZ CALLEJO, GISELE MARIA RIBEIRO VIEIRA, RONNEY ARISMEL MANCEBO BOLOY (2021), describes the environmental impact of Solid Oxide Fuel Cell Electric Vehicles (SOFCEV), specifically by examining different fuel options. It evaluates equivalent carbon dioxide emissions and energy-ecological efficiency. The thermodynamic analysis suggests that ethanol and biomethane have a minor environmental impact compared to gasoline and glycerine. Biofuel-fueled SOFCEV performs similarly to gasoline-powered vehicles and meets future emissions standards. Among the fuels analyzed, biomethane-fueled SOFCEV demonstrates the best energy and environmental performance.

CHAPTER 3

RESEARCH METHODOLOGY

3.1. METHODOLOGY

Research methodology is mainly needed for the purpose of framing the research process and the designs and tools that are to be used for the project purpose. A comparative study on electric vehicles (EVs) and petrol vehicles involves examining various aspects to understand the advantages, disadvantages, and overall performance of each type of vehicle. Collect opinions and experiences from users of both electric and petrol vehicles through surveys. Understand their satisfaction, concerns, and preferences. Evaluate the existing infrastructure for both types of vehicles. Consider the availability and accessibility of charging stations for electric vehicles and petrol stations for traditional vehicles.

3.2. RESEARCH DESIGN

Qualitative Research Design

Qualitative research involves gathering and examining non-numerical data, which includes observational data, focus group transcripts, and interview transcripts. These types of data are frequently utilized to investigate detailed subjects or gain perspective on the experiences of individuals or groups.

3.3 SAMPLING TECHNIQUE:

Probability sampling

Every person in the population has an equal chance of getting chosen when using probability sampling. Since it yields the most representative samples, this kind of sampling is frequently employed in research investigations. Cluster sampling is selected under probability sampling.

Cluster sampling

It is a method, in which the participant groups are chosen from the population.

3.4. SOURCES OF DATA:

A place where data is generated or stored is called a data source. There are two categories of data sources, primary and secondary data. A combination of primary and secondary data is used for research purposes.

- **Primary data sources**

Primary data are those from which fresh information is initially gathered. A variety of methods, including surveys, interviews, focus groups, experiments, and observations, can be used to gather primary data. A questionnaire is being used to collect primary data for the research purposes.

- **Secondary data sources**

Secondary data are those that include information that has previously been gathered by another party. A range of sources, including government data, industry reports, scholarly publications, news articles, and online articles, can be used to gather secondary data.

3.5. STRUCTURE OF QUESTIONNAIRE:

Questionnaire was divided into two sections. First part was designed to know the general information about users of electric car and petrol car and the second part contained the respondent's opinions about the comparative study on electric vehicle and petrol vehicle.

- Basic Introduction
- Personal Details
- Research related Questions
- Perception Questions
- Likert Scaling Questions
- Suggestion Question.

3.6. SAMPLE SIZE:

The sample size for this research project is 143.

3.7. SAMPLE DESIGN:

The process of choosing a subset of a population to represent the entire population is known as sample design. It is an essential stage in any research project since it can greatly affect the validity and dependability of the findings. Probability sampling and non-probability sampling are the two categories of sample design. Cluster sampling under probability sampling is being utilized in the study.

3.8. SAMPLING

- Sampling Design : Probability Sampling
- Sampling Techniques : Cluster Sampling
- Sample Unit : Users
- Sample Size : 143 Respondents.

3.9. PERIOD OF STUDY:

The period of the study is to determine the research process is carried out for 3 months.

3.10. AREA OF THE STUDY:

The targeted people are the users of electric vehicle and petrol vehicle.

3.11. HYPOTHESIS:

HYPOTHESIS 1

- H0: There is no significant association between age group and the factors influencing the choice of an electric car based on environmental concerns
- H1: There is a significant association between age group and the factors influencing the choice of an electric car based on environmental concerns

HYPOTHESIS 2

- H0: There is no significant difference between the average range of electric cars and the annual spending on petrol car

- H1: There is a significant difference between the average range of electric cars and the annual spending on petrol car.

3.12. TOOLS FOR ANALYSIS:

A questionnaire was created to get the response from the sample required to achieve the research objective. Following are the tools used for data analysis.

3.13. PERCENTAGE ANALYSIS:

Analyzing data by representing it as a percentage of a total is known as percentage analysis. It is an effective tool for comparing many data points and discovering similarities. When it is essential to know how many of the participants gave a specific answer, percentage analysis is appropriate.

3.14. ANALYTICAL TOOLS:

SPSS tool is used to test hypothesis

- **CHI-SQUARE**

The chi-square test is a statistical analysis tool used to determine whether there is a significant relationship between two categorical variables. It is a non-parametric test, meaning it does not make any assumptions about the underlying distribution of the data. The chi-square test is based on the comparison of observed frequencies to expected frequencies. The observed frequencies are the actual counts of the data, while the expected frequencies are the counts we would expect to see if there were no relationship between the two variables.

- **CORRELATION**

Correlation is a statistical technique that shows how strongly two variables are related to each other or the degree of association between the two. For example, if we have the weight and height data of taller and shorter people, with the correlation between them, we can find out how these two variables are related.

CHAPTER 4

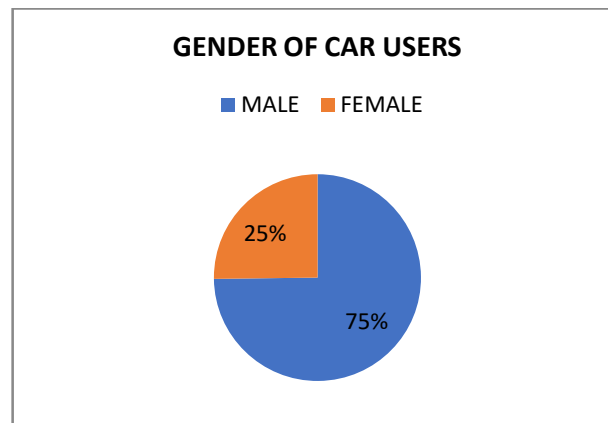
DATA ANALYSIS AND INTERPRETATION

4.1. PERCENTAGE ANALYSIS

4.1.1. GENDER OF CAR USERS

S.NO.	GENDER OF CAR USERS	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	MALE	107	75%
2	FEMALE	36	25%
Total		143	100%

4.1.1. CHART



INTERPRETATION

75% of respondents were given by the male users and 25% were given by female users.

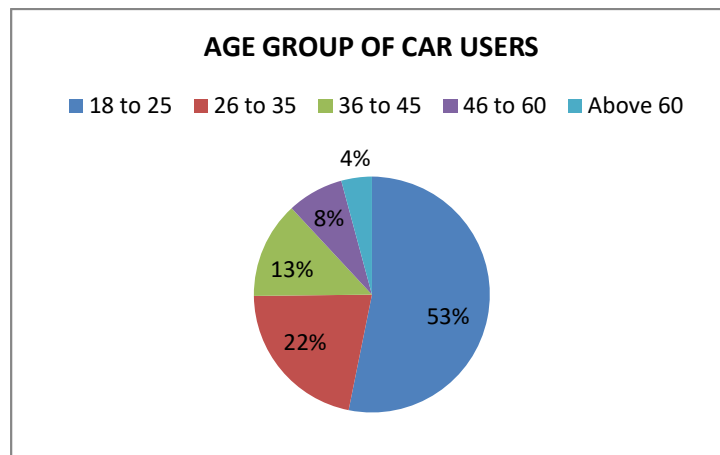
INFERENCE

Majority i.e., 75% of the response were given by male users.

4.1.2. AGE GROUP OF CAR USERS

S.NO	AGE GROUP OF CAR USERS	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	18 to 25	76	53%
2	26 to 35	31	22%
3	36 to 45	19	13%
4	46 to 60	11	8%
5	Above 60	6	4%
Total		143	100%

4.1.2. CHART



INTERPRETATION

The respondents; 53% of users were between the age group of 18 to 24, 22% of the users were between the age group of 26 to 35, 13% of the users were between the age group of 36 to 45, and 8%% of the users were between the age group of 46 to 60, 4% of users were above 60 years.

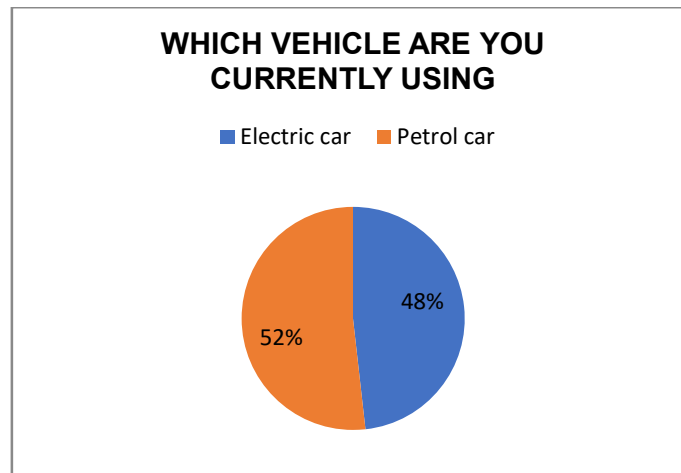
INFERENCE

Most responses, i.e., 53% were given by users in the age group of 18 to 24.

4.1.3. WHICH VEHICLE ARE YOU CURRENTLY USING

S.NO	WHICH VEHICLE ARE YOU CURRENTLY USING	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Electric car	69	48%
2	Petrol car	74	52%
Total		143	100%

4.1.3. CHART



INTERPRETATION

The respondents, 52% of users are currently using Electric car, 48% of the users are currently using Petrol car.

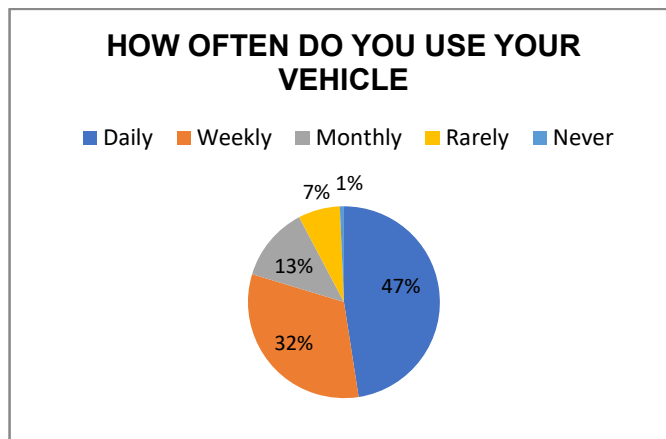
INFERENCE

Most responses, i.e., 52% are given by users by petrol car.

4.1.4. HOW OFTEN DO YOU USE YOUR VEHICLE

S.NO.	HOW OFTEN DO YOU USE YOUR VEHICLE	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Daily	68	47%
2	Weekly	46	32%
3	Monthly	18	13%
4	Rarely	10	7%
5	Never	1	1%
Total		143	100%

4.1.4. CHART



INTERPRETATION

According to the users response, 47% are daily using, 32% are weekly using, 13% are monthly users, 7% are rarely users, and 1% are often using vehicle.

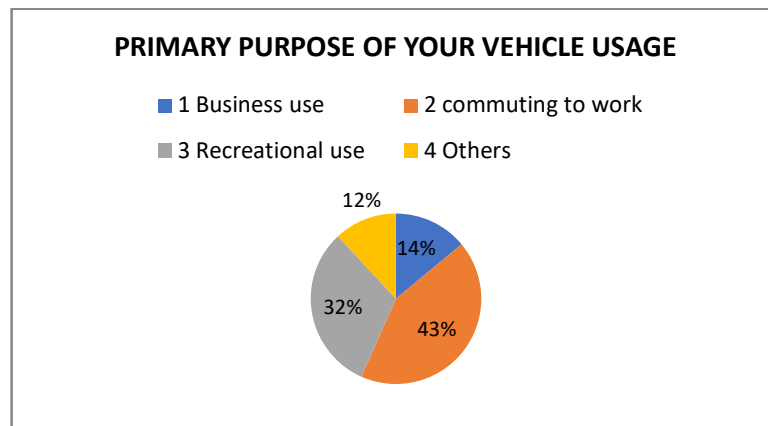
INFERENCE

Most responses, i.e., 47% users are daily using both electric and petrol car.

4.1.5. PRIMARY PURPOSE OF YOUR VEHICLE USAGE

S.NO.	PRIMARY PURPOSE OF YOUR VEHICLE USAGE	NO.OF.RESPONENT	PERCENTAGE ANALYSIS
1	Business use	20	14%
2	commuting to work	61	42%
3	Recreational use	45	32%
4	Others	17	12%
Total		143	100%

4.1.5. CHART



INTERPRETATION

According to the users response, 47% are using business use, 32% are using commuting to work, 13% are using recreational use, 14% are others and they using for primary purpose.

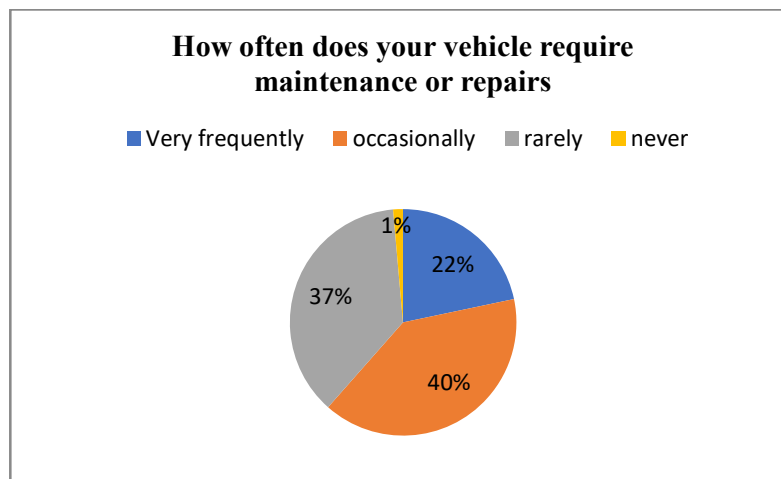
INFERENCE

Most responses, i.e., 43% users are business use for both electric and petrol car.

4.1.6. HOW OFTEN DOES YOUR VEHICLE REQUIRE MAINTENANCE OR REPAIRS

S.NO.	How often does your vehicle require maintenance or repairs	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Very frequently	31	22%
2	occasionally	57	40%
3	rarely	53	40%
4	never	2	1%
Total		143	100%

4.1.6. CHART



INTERPRETATION

According to the users response, 40% occurs for very frequently, 37% occurs for occasionally, 13% occurs for rarely, 1% are never and often require for maintenance or repairs.

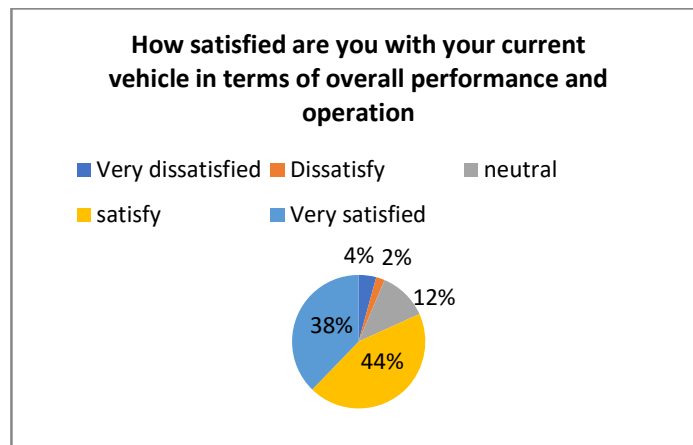
INFERENCE

Most responses, i.e., 40% users are very frequently their vehicle require maintenance or repairs for both electric and petrol car.

4.1.7. HOW SATISFIED ARE YOU WITH YOUR CURRENT VEHICLE IN TERMS OF OVERALL PERFORMANCE AND OPERATION

S.NO.	How satisfied are you with your current vehicle in terms of overall performance and operation	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Very dissatisfied	6	4%
2	Dissatisfy	3	2%
3	neutral	17	12%
4	satisfy	63	44%
5	Very satisfied	54	38%
Total		143	100%

4.1.7. CHART



INTERPRETATION

According to the response, users feel that. Usage of current vehicle in terms of overall performance and operation is 4% are very dissatisfied, 2% are dissatisfy, 12% are neutral, 44% are satisfy and 38% are very satisfied.

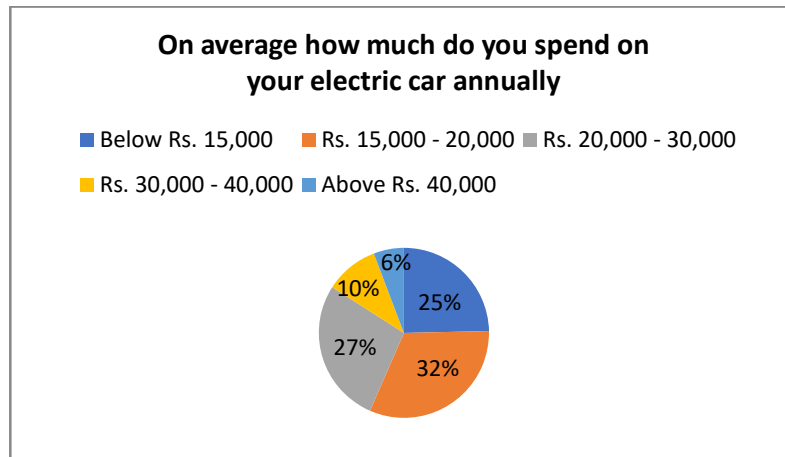
INFERENCE

Most responses, i.e., 44% users are satisfied their current vehicle in terms of overall performance and operation for both electric and petrol car.

4.1.8. ON AVERAGE HOW MUCH DO YOU SPEND ON YOUR ELECTRIC CAR ANNUALLY

S.NO	On average how much do you spend on your electric car annually	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Below Rs. 15,000	17	25%
2	Rs. 15,000 - 20,000	22	32%
3	Rs. 20,000 - 30,000	19	27%
4	Rs. 30,000 - 40,000	7	10%
5	Above Rs. 40,000	4	6%
Total		69	100%

4.1.8. CHART



INTERPRETATION

According to the users response 25% is below Rs. 15,000, 32% is Rs. 15,000 – Rs. 20,000, 27% is Rs. 20,000 – Rs. 30,000, 10% is Rs. 30,000 – Rs. 40,000 and 6% is above Rs. 40,000 are spend for their electric car.

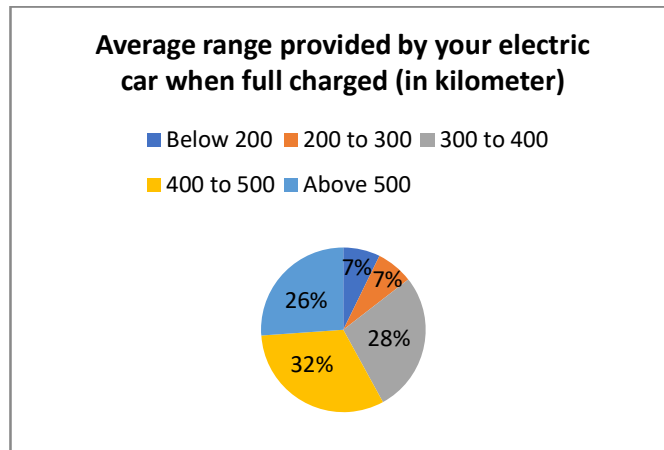
INFERENCE

Most responses, i.e., 32% users are averagely spent below Rs. 15,000 for their electric car.

4.1.9. AVERAGE RANGE PROVIDED BY YOUR ELECTRIC CAR WHEN FULL CHARGED (IN KILOMETER)

S.NO.	Average range provided by your electric car when full charged (in kilometer)	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Below 200	5	7%
2	200 to 300	5	7%
3	300 to 400	19	28%
4	400 to 500	22	32%
5	Above 500	18	26%
Total		69	100%

4.1.9. CHART



INTERPRETATION

According to the users response 42% is below 200, 32% is 200 to 300, 12% is 300 to 400, 7% is 400 to 500 and 6% is above 500 are average range provided by electric car is fully charged.

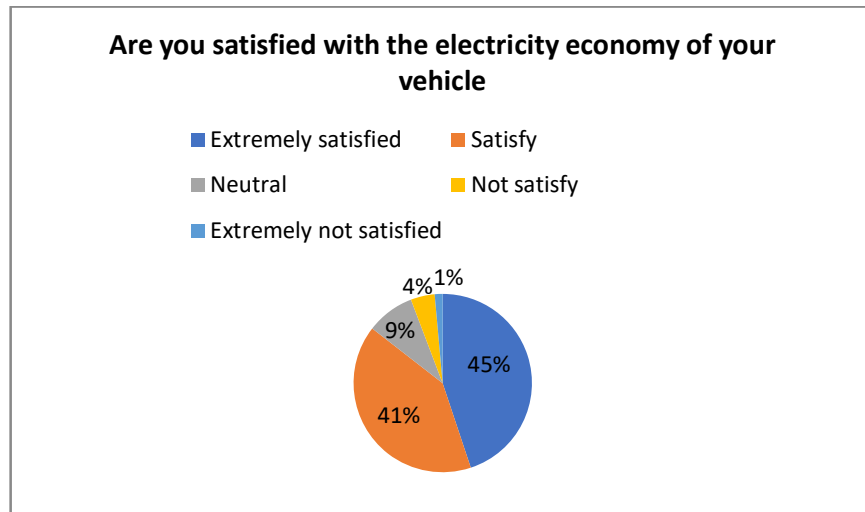
INFERENCE

Most responses, i.e., 32% users have average range is 400 to 500 given by electric car is fully charged.

4.1.10. ARE YOU SATISFIED WITH THE ELECTRICITY ECONOMY OF YOUR VEHICLE

S.NO.	Are you satisfied with the electricity economy of your vehicle	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Extremely satisfied	31	45%
2	Satisfy	28	41%
3	Neutral	6	9%
4	Not satisfy	3	4%
5	Extremely not satisfied	1	1%
Total		69	100%

4.1.10. CHART



INTERPRETATION

According to the users response 45% feel extremely satisfied, 41% feel satisfy, 9% feel neutral, 4% are not satisfy and 1% are extremely not satisfy for electricity economy for their electric car.

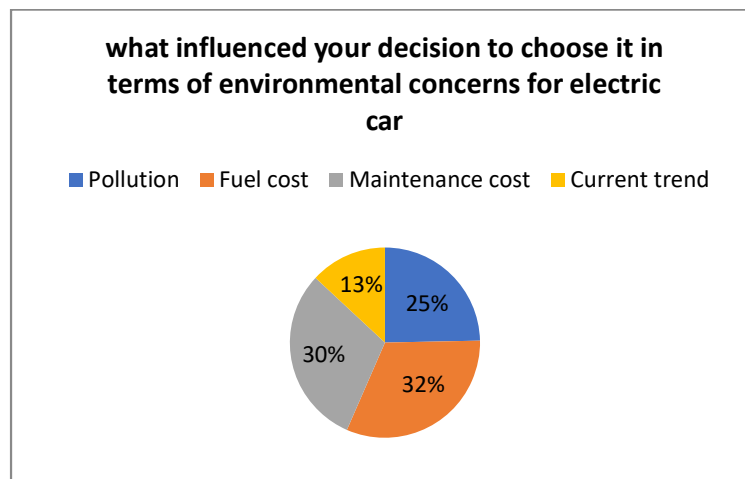
INFERENCE

Most responses, i.e., 45% users are extremely satisfied for electricity economy for their electric car.

4.1.11. WHAT INFLUENCED YOUR DECISION TO CHOOSE IT IN TERMS OF ENVIRONMENTAL CONCERNS FOR ELECTRIC CAR

S.NO	what influenced your decision to choose it in terms of environmental concerns	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Pollution	17	25%
2	Fuel cost	22	32%
3	Maintenance cost	21	30%
4	Current trend	9	13%
Total		69	100%

4.1.11. CHART



INTERPRETATION

According to the users response 25% are chosen for pollution, 32% are chosen for fuel cost, 30% are chosen for maintenance cost, 13% are chosen for current trend in terms of environmental concerns.

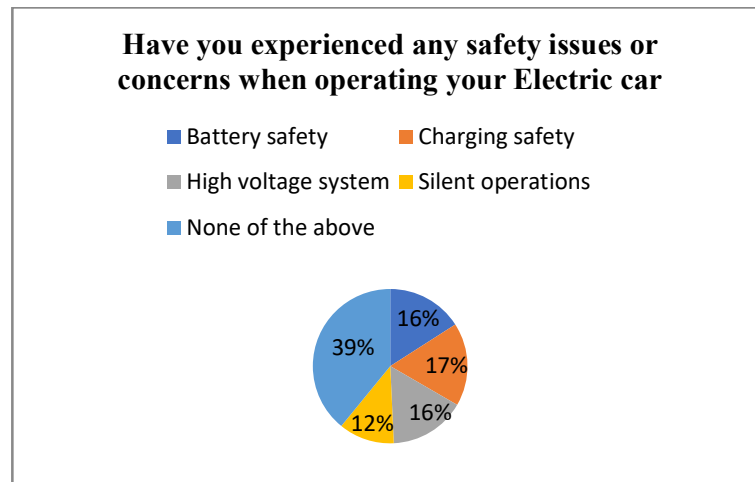
INFERENCE

Most responses, i.e., 32% users are chosen for fuel cost in electric car.

4.1.12. HAVE YOU EXPERIENCED ANY SAFETY ISSUES OR CONCERNS WHEN OPERATING YOUR ELECTRIC CAR

S.NO	Have you experienced any safety issues or concerns when operating your Electric car	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Battery safety	11	16%
2	Charging safety	12	17%
3	High voltage system	11	16%
4	Silent operations	8	12%
5	None of the above	27	39%
Total		69	100%

4.1.12. CHART



INTERPRETATION

According to the users response 16% are experienced battery safety, 17% are experienced charging safety, 12% are experienced high voltage system, 39% are experienced silent operations, and 10% are none of the above have experienced in safety issues in electric car.

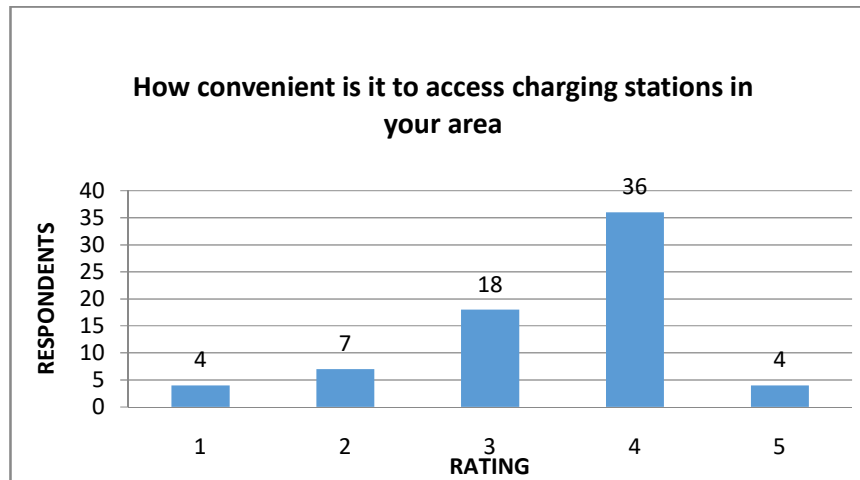
INFERENCE

Most responses, i.e., 39% users are experienced silent operations in safety concerns for their electric car.

4.1.13. HOW CONVENIENT IS IT TO ACCESS CHARGING STATIONS IN YOUR AREA

S.NO.	How convenient is it to access charging stations in your area	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	1	4	6%
2	2	7	10%
3	3	18	26%
4	4	36	52%
5	5	4	6%
Total		69	100%

4.1.13. CHART



INTERPRETATION

According to the users response 6% are rated in 1 for very inconvenient, 10% are rated in 2, 26% are rated in 3, 52% are rated in 4, and 6% are rated in 5 for very convenient to access charging stations in their areas.

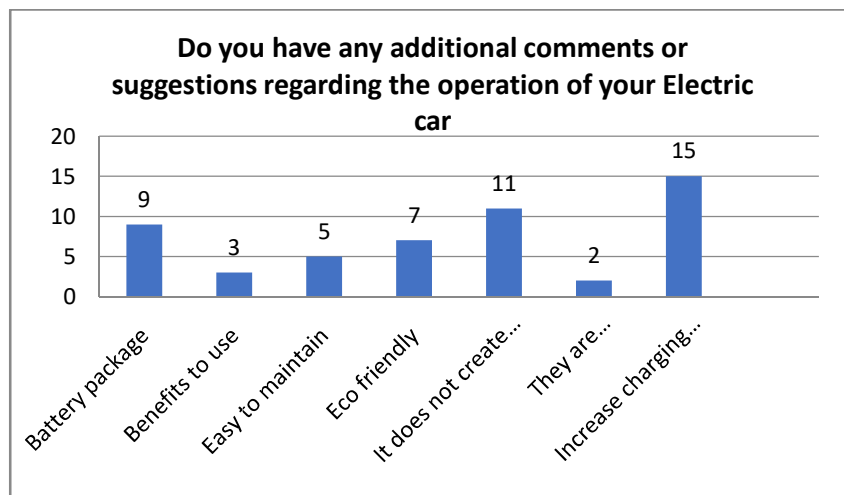
INERENCE

Most responses, i.e., 52% users are convenient to access charging stations in their areas.

4.1.14. DO YOU HAVE ANY ADDITIONAL COMMENTS OR SUGGESTIONS REGARDING THE OPERATION OF YOUR ELECTRIC CAR

S.NO.	Do you have any additional comments or suggestions regarding the operation of your Electric car	NO.OF.RESPONDENT S	PERCENTAGE ANALYSIS
1	Battery package	9	17%
2	Benefits to use	3	6%
3	Easy to maintain	5	10%
4	Eco friendly	7	13%
5	It does not create any noise pollution	11	21%
6	They are pollution less	2	4%
7	Increase charging stations	15	29%
Total		52	100%

4.1.14. CHART



INTERPRETATION

According to the users response 17% are comment battery package, 6% are comment benefits to use, 10% are easy to maintain, 13% are comment eco friendly, 21% are comment does not create noise pollution, 4% are comment pollution less, and 29% are comment to increase charging stations.

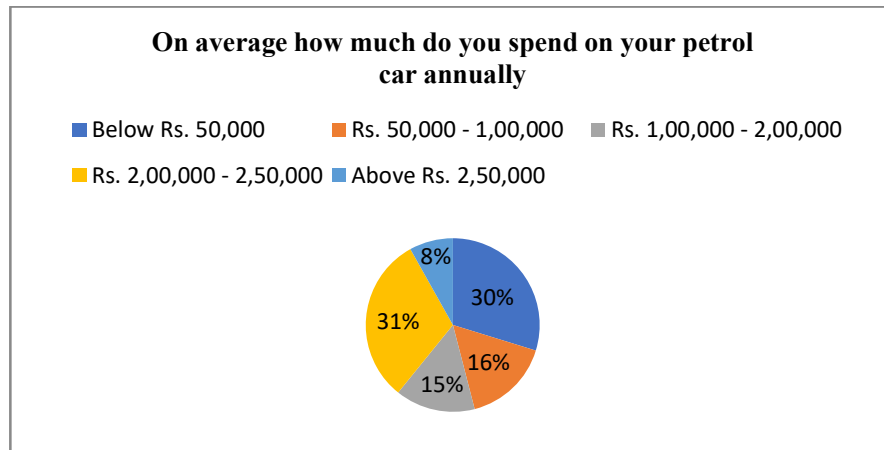
INFERENCE

Most responses, i.e., 29% are users are comment to increase the charging stations.

4.1.15. ON AVERAGE HOW MUCH DO YOU SPEND ON YOUR PETROL CAR ANNUALLY

S.NO.	On average how much do you spend on your petrol car annually	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Below Rs. 50,000	22	30%
2	Rs. 50,000 - 1,00,000	12	16%
3	Rs. 1,00,000 - 2,00,000	11	15%
4	Rs. 2,00,000 - 2,50,000	23	31%
5	Above Rs. 2,50,000	6	8%
Total		74	100%

4.1.15. CHART



INTERPRETATION

According to the users response 30% is below Rs. 50,000, 16% is Rs. 50,000 – Rs. 1,00,000, 15% is Rs. 1,00,000 – Rs. 2,50,000, 31% is Rs. 2,00,000 – Rs. 2,50,000 and 8% is above Rs. 2,50,000 are spend for their petrol car.

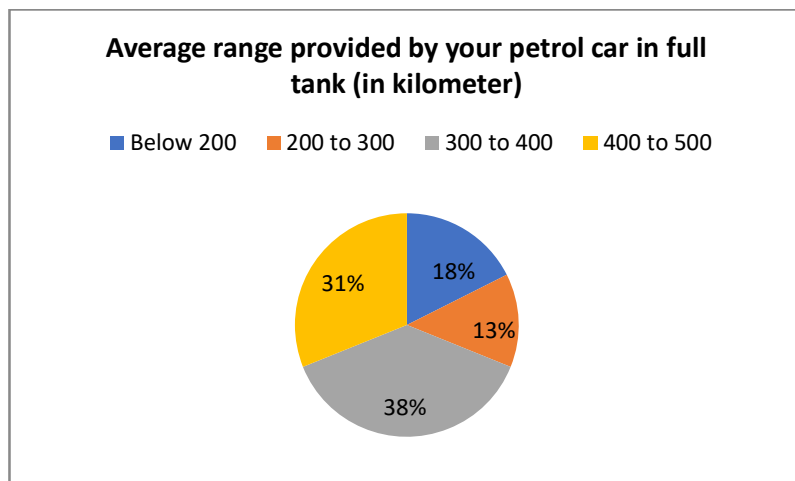
INFERENCE

Most responses, i.e., 31% users are averagely spent below Rs. 2,00,000 – Rs.2,50,000 for their petrol car.

4.1.16. AVERAGE RANGE PROVIDED BY YOUR PETROL CAR IN FULL TANK (IN KILOMETER)

S.NO.	Average range provided by your petrol car in full tank (in kilometer)	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Below 200	13	18%
2	200 to 300	10	13%
3	300 to 400	28	38%
4	400 to 500	23	31%
Total		74	100%

4.1.16. CHART



INTERPRETATION

According to the users response 18% is below 200, 13% is 200 to 300, 38% is 300 to 400, 31% is 400 to 500 are average range provided by petrol car is tank full.

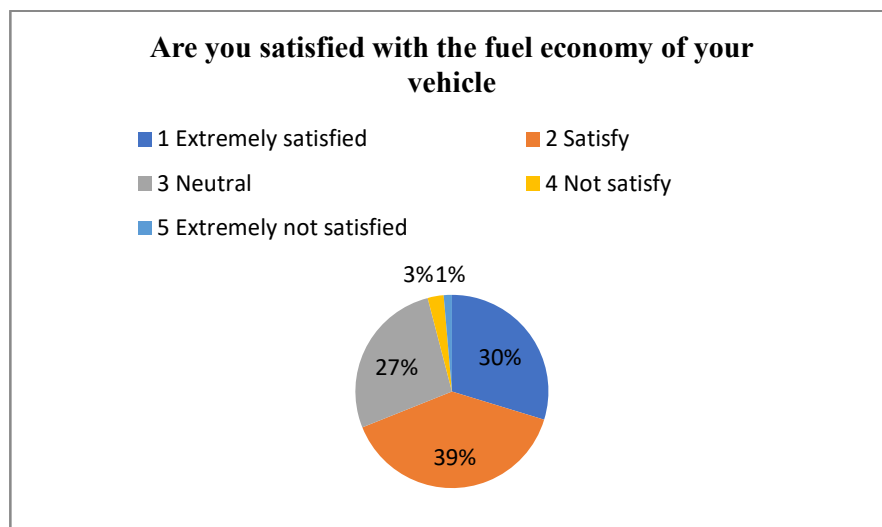
INFERENCE

Most responses, i.e., 38% users have average range is 300 to 400 given by petrol car is full tank.

4.1.17. ARE YOU SATISFIED WITH THE FUEL ECONOMY OF YOUR VEHICLE

S.NO.	Are you satisfied with the fuel economy of your vehicle	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Extremely satisfied	22	30%
2	Satisfy	29	39%
3	Neutral	20	27%
4	Not satisfy	2	3%
5	Extremely not satisfied	1	1%
Total		74	100%

4.1.17. CHART



INTERPRETATION

According to the users response 30% feel extremely satisfied, 39% feel satisfy, 27% feel neutral, 3% are not satisfy and 1% are extremely not satisfy for fuel economy for their petrol car.

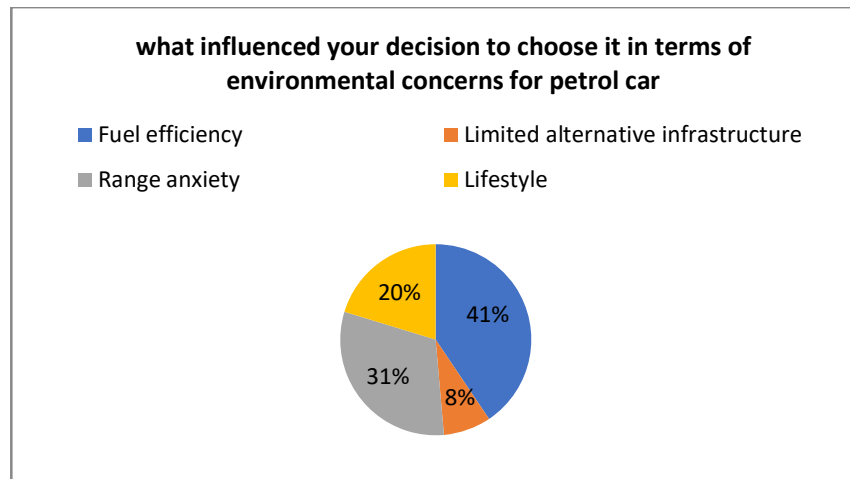
INFERENCE

Most responses, i.e., 45% users are extremely satisfied for fuel economy for their petrol car.

4.1.18. WHAT INFLUENCED YOUR DECISION TO CHOOSE IT IN TERMS OF ENVIRONMENTAL CONCERNS FOR PETROL CAR

S.NO.	what influenced your decision to choose it in terms of environmental concerns for petrol car	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Fuel efficiency	30	41%
2	Limited alternative infrastructure	6	8%
3	Range anxiety	23	31%
4	Lifestyle	15	20%
Total		74	100%

4.1.18. CHART



INTERPRETATION

According to the users response 41% are chosen for fuel efficiency, 8% are chosen for limited alternative infrastructure, 31% are chosen for range anxiety, 20% are chosen for lifestyle in terms of environmental concerns.

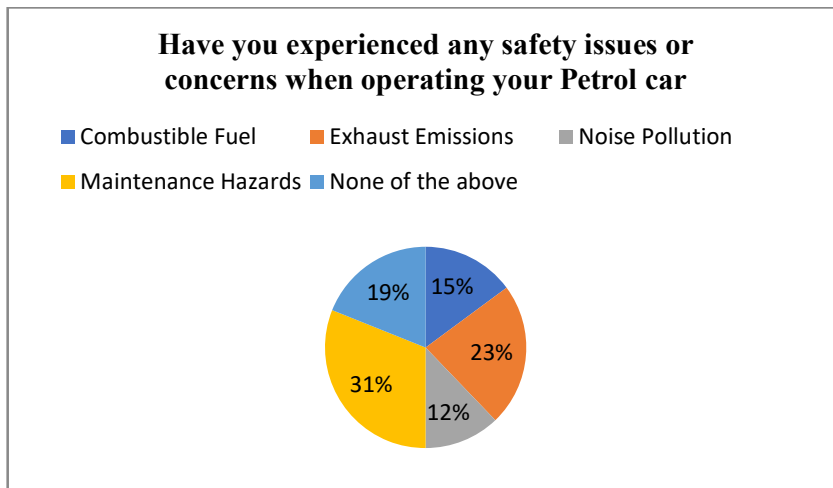
INFERENCE

Most responses, i.e., 41% users are chosen for fuel efficiency in petrol car.

4.1.19. HAVE YOU EXPERIENCED ANY SAFETY ISSUES OR CONCERNS WHEN OPERATING YOUR PETROL CAR

S.NO.	Have you experienced any safety issues or concerns when operating your Petrol car	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	Combustible Fuel	11	15%
2	Exhaust Emissions	17	23%
3	Noise Pollution	9	12%
4	Maintenance Hazards	23	31%
5	None of the above	14	19%
Total		74	100%

4.1.19. CHART



INTERPRETATION

According to the users response 15% are experienced combustible fuel, 23% are experienced exhaust emissions, 31% are experienced noise pollution, 19% are experienced maintenance hazards, and 19% are none of the above have experienced in safety issues in petrol car.

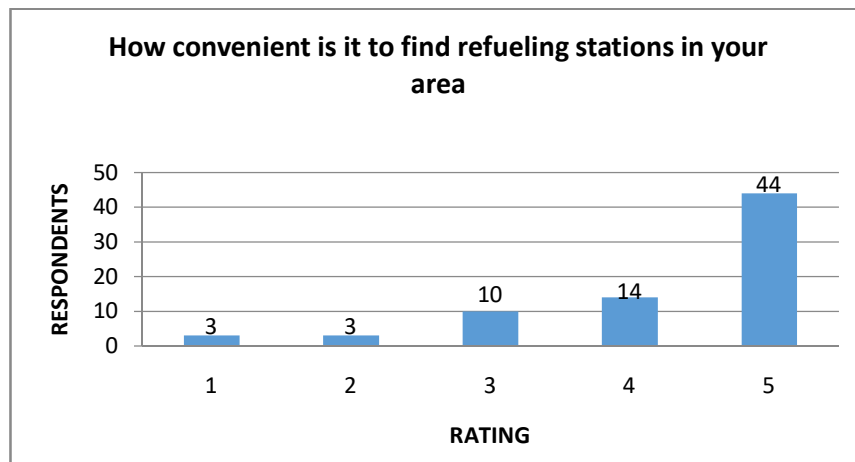
INFERENCE

Most responses, i.e., 31% users are experienced noise pollution in safety concerns for their petrol car.

4.1.20. HOW CONVENIENT IS IT TO FIND REFUELING STATIONS IN YOUR AREA

S.NO.	How convenient is it to find refueling stations in your area	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	1	3	4%
2	2	3	4%
3	3	10	14%
4	4	14	19%
5	5	44	59%
Total		74	100%

4.1.20. CHART



INTERPRETATION

According to the users response 4% are rated in 1 for very inconvenient, 4% are rated in 2, 14% are rated in 3, 19% are rated in 4, and 59% are rated in 5 for very convenient to access refuel stations in their areas.

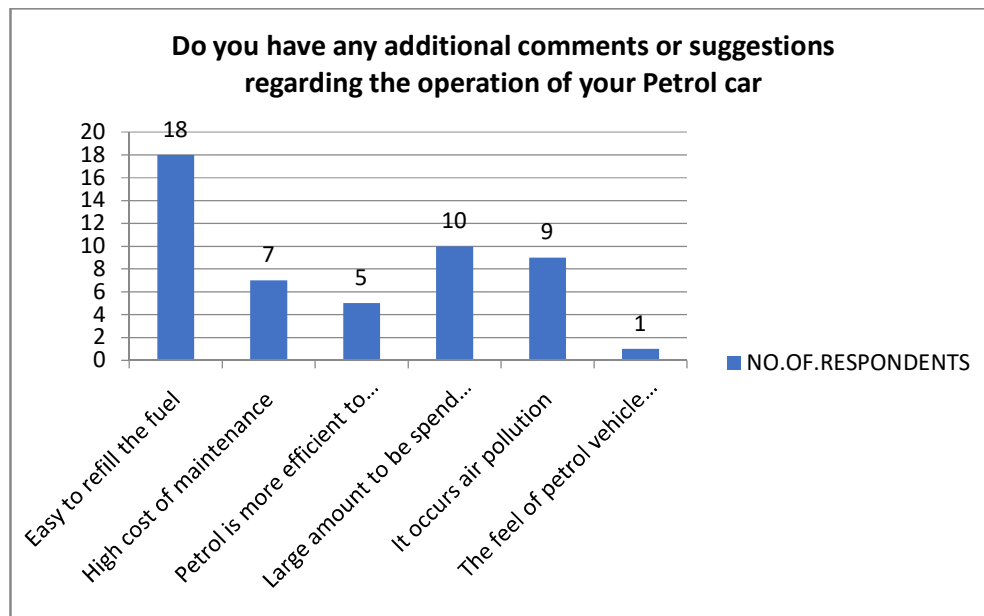
INERENCE

Most responses, i.e., 59% users are convenient to access refuelling stations in their areas.

4.1.21. DO YOU HAVE ANY ADDITIONAL COMMENTS OR SUGGESTIONS REGARDING THE OPERATION OF YOUR PETROL CAR

S.NO.	Do you have any additional comments or suggestions regarding the operation of your Petrol car	NO.OF.RESPONDENT S	PERCENTAGE ANALYSIS
1	Easy to refill the fuel	18	36%
2	High cost of maintenance	7	14%
3	Petrol is more efficient to use	5	10%
4	Large amount to be spend for petrol	10	20%
5	It occurs air pollution	9	18%
6	The feel of petrol vehicle can't be change by electric vehicle	1	2%
Total		50	100%

4.1.21. CHART



INTERPRETATION

According to the users response 36% are comment easy to refill the fuel, 14% are comment high cost of maintenance, 10% are petrol is more efficient to use, 20% are comment large amount to be spend for petrol, 18% are comment it occurs air pollution, and 2% are comment the feel of petrol vehicle can't be change by electric vehicle.

INFERENCE

Most responses, i.e., 36% are given easy to refill the fuel.

4.2. CHI SQUARE

HYPOTHESIS 1

- H0: There is no significant association between age group and the factors influencing the choice of an electric car based on environmental concerns
- H1: There is a significant association between age group and the factors influencing the choice of an electric car based on environmental concerns.

4.2.1. SIGNIFICANT ASSOCIATION BETWEEN AGE GROUP AND FACTORS INFLUENCING THE CHOICE OF AN ELECTRIC CAR BASED ON ENVIRONMENT CONCERNS

			If you own an electric car, what influenced your decision to choose it in terms of environmental concerns				Total
			Current trend	Fuel cost	Maintenance cost	Pollution	
AGE GROUP YOU BELONG TO	18 to 25	Count	2	11	10	5	28
		Expected Count	3.7	8.9	8.5	6.9	28.0
	26 to 35	Count	2	4	7	6	19
		Expected Count	2.5	6.1	5.8	4.7	19.0
	36 to 45	Count	3	4	2	2	11
		Expected Count	1.4	3.5	3.3	2.7	11.0
	46 to 60	Count	1	1	2	2	6
		Expected Count	.8	1.9	1.8	1.5	6.0
	Above 60	Count	1	2	0	2	5
		Expected Count	.7	1.6	1.5	1.2	5.0
	Total	Count	9	22	21	17	69
		Expected Count	9.0	22.0	21.0	17.0	69.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2- sided)
Pearson Chi-Square	8.919 ^a	12	.710
Likelihood Ratio	10.307	12	.589
N of Valid Cases	69		

a. 15 cells (75.0%) have expected count less than 5. The minimum expected count is .65.

INTERPRETATION

The p value is 0.710 which is greater than the significance value (0.05). Hence null hypothesis (H₀) is accepted and alternate hypothesis (H₁) is rejected.

INFERENCE

There is no significant association between age group and the factors influencing the choice of an electric car based on environmental concerns.

4.3. CORRELATION

HYPOTHESIS 2

- H0: There is no significant difference between the average range of electric cars and the annual spending on petrol cars
- H1: There is a significant difference between the average range of electric cars and the annual spending on petrol cars

4.3.1. DIFFERENCE BETWEEN THE AVERAGE RANGE OF ELECTRIC CARS AND THE ANNUAL SPENDING ON PETROL CARS

Correlations

		Average range provided by your electric car when full charged (in kilometer)	On average how much do you spend on your petrol car annually
Average range provided by your electric car when full charged (in kilometer)	Pearson Correlation	1	.927
	Sig. (2-tailed)		.001
	N	69	74
On average how much do you spend on your petrol car annually	Pearson Correlation	.927	1
	Sig. (2-tailed)	.001	
	N	69	74

INTERPRETATION

The p value is 0.927 is rounded to 1. "1" represents positive correlation. Hence null hypothesis (H0) is rejected and alternate hypothesis is accepted. Therefore, it has significant difference between the average range of electric cars and the annual spending on petrol cars.

CHAPTER 5

FINDINGS, SUGGESTIONS AND CONCLUSION

5.1. FINDINGS

- Majority i.e., 75% of the response were given by male users.
- Most responses, i.e., 53% were given by users in the age group of 18 to 24.
- Most responses, i.e., 52% are given by users by petrol car.
- Most responses, i.e., 47% users are daily using both electric and petrol car.
- Most responses, i.e., 43% users are business use for both electric and petrol car.
- Most responses, i.e., 40% users are very frequently their vehicle require maintenance or repairs for both electric and petrol car.
- Most responses, i.e., 44% users are satisfied their current vehicle in terms of overall performance and operation for both electric and petrol car.
- Most responses, i.e., 32% users are averagely spent below Rs. 15,000 for their electric car.
- Most responses, i.e., 32% users have average range is 400 to 500 given by electric car is fully charged.
- Most responses, i.e., 45% users are extremely satisfied for electricity economy for their electric car.
- Most responses, i.e., 32% users are chosen for fuel cost in electric car.
- Most responses, i.e., 39% users are experienced silent operations in safety concerns for their electric car.
- Most responses, i.e., 52% users are convenient to access charging stations in their areas.
- Most responses, i.e., 29% are users are comment to increase the charging stations.
- Most responses, i.e., 31% users are averagely spent below Rs. 2,00,000 – Rs.2,50,000 for their petrol car.
- Most responses, i.e., 38% users have average range is 300 to 400 given by petrol car is full tank.

- Most responses, i.e., 45% users are extremely satisfied for fuel economy for their petrol car.
- Most responses, i.e., 41% users are chosen for fuel efficiency in petrol car.
- Most responses, i.e., 31% users are experienced noise pollution in safety concerns for their petrol car.
- Most responses, i.e., 59% users are convenient to access refuelling stations in their areas.
- Most responses, i.e., 36% are given easy to refill the fuel.

CHI SQUARE TEST

There is no significant association between age group and the factors influencing the choice of an electric car based on environmental concerns.

CORRELATION

There is significant difference between the average range of electric cars and the annual spending on petrol cars.

5.2. SUGGESTION AND RECOMMENDATION

- Clearly define the operational parameters you will be assessing. This could include factors such as range, fueling infrastructure, maintenance requirements, and adaptability to different operational environments.
- If focus on fleet operations. Assess how EVs and PVs perform when integrated into corporate or municipal fleets. Consider factors like total cost of ownership, fueling logistics, and maintenance expenses.
- Evaluate the impact of charging infrastructure on the operational efficiency of electric vehicles. Consider the convenience and accessibility of charging stations, especially in the operational areas of interest.
- Conduct a comprehensive total cost of ownership analysis, incorporating not only the initial purchase price but also ongoing operational costs, maintenance expenses, and potential incentives for both electric and petrol vehicles.
- Evaluate the performance metrics of both vehicle types, including acceleration, top speed, and handling. Understand how these factors impact operational efficiency and user satisfaction.
- Compare the maintenance requirements of EVs and PVs. Assess the frequency of maintenance tasks, downtime for repairs, and the associated costs. Consider the impact on operational continuity.
- Consider the driver experience and training required for operating both EVs and PVs. Evaluate any additional training needs for electric vehicles, especially regarding charging protocols and battery management.
- Extend the environmental impact assessment to the operational phase. Consider factors such as emissions during vehicle operation, noise pollution, and the overall ecological footprint of both electric and petrol vehicles.
- Assess the long-term operational sustainability of both vehicle types. Consider the availability and cost of spare parts, the ease of upgrading technologies, and the potential for extending the operational life of each vehicle.

5.3. CONCLUSION

EVs generally have a lower environmental impact compared to PVs, especially in terms of greenhouse gas emissions. The study emphasizes the importance of transitioning to electric vehicles to mitigate climate change and reduce air pollution.

Electric vehicles demonstrate higher energy efficiency in terms of converting energy from the source to vehicle movement. This is attributed to the efficiency of electric motors compared to internal combustion engines in petrol vehicles.

The comparative analysis reveals shifting market dynamics, with a growing consumer interest in electric vehicles. As environmental consciousness rises and EV technology matures, automakers need to adapt their strategies to meet evolving consumer preferences and regulatory requirements.

Electric vehicles represent a focal point for innovation within the automobile industry. The study emphasizes the importance of continued research and development in battery technology, energy storage, and electric drivetrains to enhance the performance and appeal of Electric vehicle.

The automobile industry must address the electric vehicle technology, including battery innovations, increased range, and improved charging infrastructure. These advancements are likely to enhance the appeal of Electric vehicle in the future.

Consumer perceptions and understanding play a pivotal role in the adoption of electric vehicles. The automobile industry must invest in educating consumers about the benefits of EVs, dispelling myths, and addressing concerns related to range anxiety and charging infrastructure.

REFERENCES

- Xiaoli Sun, Zhengguo Li, Xiaolin Wang and Chengjiang Li (2019), 'Technology Development of Electric Vehicles' – Energies vol: 13
- Emilia M. Szumska and Rafał S. Jurecki (2021), 'Parameters Influencing on Electric Vehicle Range' – Energies vol: 14
- Christodoulos Katis and Athanasios Karlis (2023), 'Evolution of Equipment in Electromobility and Autonomous Driving Regarding Safety Issues' - Energies vol: 16
- M. Satyendra Kumar , Shripad T. Revankar (2017), 'Development scheme and key technology of an electric vehicle' -Renewable and sustainable reviews vol: 70 pp- 1266-1285
- Nic Lutsey and Michael Nicholas (2019), 'Update on electric vehicle costs in the United States through 2030' - International council on clean transportation
- Alan Jenn, Katalin Springel, and Anand R. Gopal (2018), 'Effectiveness of electric vehicle incentives in the United States'
- Swaraj Ravindra Jape , Archana Thosar (2017), 'COMPARISON OF ELECTRIC MOTORS FOR ELECTRIC VEHICLE APPLICATION' - International Journal of Research in Engineering and Technology vol: 6
- Lei Wang , Xiang Wang, Wenxian Yang (2019), 'Optimal design of electric vehicle battery recycling network - from the perspective of electric vehicle manufacturers'
- Scott Hardman, Kelly L. Fleming, Eesha Khare, and Mahmoud M. Ramadan (2021), 'A perspective on equity in the transition to electric vehicle' – MIT science policy review vol: 2 pp- 46
- Iqbal Husain (2020), 'Electric Drive Technology Trends, Challenges, and Opportunities for Future Electric Vehicles'
- Tianjie Zou, David Gerada (2022), 'A Comprehensive Design Guideline of Hairpin Windings for High Power Density Electric Vehicle Traction Motors'
- Andrea Credo , Marco Villani , Giuseppe Fabri (2023) 'Adoption of the Synchronous Reluctance Motor in electric vehicles' iee transactions on transportation electrification vol: 9

- Reza Razi, Majid Mehrasa, Khaled Hajar (2022), 'Predictive smart charging of plug-in electric vehicles for parking fleet scenario with modular converters' - CIRED workshop on E-mobility and power distribution systems- pp 371
- Sandip Hazra and Janardhan K. Reddy (2021), 'An Aspect of Noise, Vibration, and Harshness Issues in Electric Vehicles' vol: 6
- Mircea Popescu, Lino Di Leonardo (2023) 'Design of Induction Motors With Flat Wires and Copper Rotor for E-Vehicles Traction System' - IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, VOL.: 59
- Vincent M. Macharia, Vijay K. Garg, Dinesh Kumar (2023), 'A review of electric vehicle technology' - IET Electrical Systems in Transportation
- Ning Ding, K. Prasad and T.T. Lie (2019), 'The electric vehicle: a review' - Int. J. Electric and Hybrid Vehicles, Vol. 9
- George Crabtree (2019), 'The coming electric vehicle transformation' – science vol: 366
- Julio A. Sanguesa 1, Vicente Torres-Sanz, Piedad Garrid, Francisco J. Martinez and Johann M. Marquez-Barja (2021), 'A Review on Electric Vehicles: Technologies and Challenges'- smart cities pp: 373
- Jianwei Xing, Benjamin Leard, Shanjun Li (2021), 'what does an electric vehicle replace'
- John B. Heywood (2018), 'internal combustion engine fundamentals'
- Omojola Awogbemi, Daramy Vandi Von Kallon, Emmanuel Idoko Onuh and Victor Sunday Aigbodion (2021), 'An Overview of the Classification, Production and Utilization of Biofuels for Internal Combustion Engine Applications' – Energies vol: 14
- O P Lopatin (2020), 'Investigation of alternative fuel oxidation kinetics in an internal combustion engine' - IOP Conference Series: Materials Science and Engineering
- Aiman Albatayneh, Mohammad N. Assaf, Dariusz Alterman , Mustafa Jaradat (2020), 'Comparison of the Overall Energy Efficiency for Internal Combustion Engine Vehicles and Electric Vehicles' - Environmental and Climate Technologies - vol. 24, pp. 669–680

- Lai Yang, Biying Yu, Bo Yang, Hao Chen, Gabriel Malima, Yi-Ming Wei (2020), 'Life cycle environmental assessment of electric and internal combustion engine vehicles in China' - Journal of Cleaner Production pp: 285
- Isabella Burch and Jock Gilchrist (2018), 'Survey of Global Activity to Phase Out Internal Combustion Engine Vehicles'
- Siti Nurul Akmal Yusof, Nor Azwadi Che Sidik, Yutaka Asako (2020), 'A comprehensive review of the influences of nanoparticles as a fuel additive in an internal combustion engine' - Nanotechnology Reviews vol: 9 pp: 1326–1349
- L. Athanasopoulou, H. Bikasa, P. Stavropoulos (2018), 'Comparative Well-to-Wheel Emissions Assessment of Internal Combustion Engine and Battery Electric Vehicles' – sciencedirect vol: 78 pp:25-30
- Xinyu Liu, Krishna Reddi, Amgad Elgowainy, Henning Lohse-Busch, Michael Wang, Neha Rustagi (2019), 'Comparison of Well-to-Wheels Energy Use and Emissions of a Hydrogen Fuel Cell Electric Vehicle Relative to a Conventional Gasoline-powered Internal Combustion Engine Vehicle'
- Saad S. Alrwashdeh, Alaa M. Al-falahat,, Talib K. Murtadha (2022), 'Effect of Turbocharger Compression Ratio on Performance of the Spark-Ignition Internal Combustion Engine' - Emerging Science Journal, vol: 6 pp: 482
- Xi Wang, Bai-gang Sun, Qing-he Luo (2019), 'Energy and exergy analysis of a turbocharged hydrogen internal combustion engine' – International journal of hydrogen energy, vol: 44
- Quentin Mal, Gabriel Staffelbach, Olivier Vermorel, Antony Misdariis, Frederic Ravet, Thierry Poinot (2019), 'Large Eddy Simulation of Pre-Chamber Ignition in an Internal Combustion Engine' – HAL open science
- Omowunmi Mary Longe (2022), 'An Expository Comparison of Electric Vehicles and Internal Combustion Engine Vehicles in Africa' – IEEE PES/IAS PowerAfrica
- A.Gowtham Rajan, A.Bharath Nithish, S.Ramprakaash, K.Vithyasagar (2021), 'Analysis of Performance characteristics of an Internal Combustion

Engine with Thermal barrier coated piston’ - International Journal of Emerging Trends in Engineering Research vol: 9

- G. J., Howey D., Contestabile M., Clague R., Brandon N. P. (2019), ‘Comparative analysis of battery electric, hydrogen fuel cell and hybrid vehicles in a future sustainable road transport system’ – Energy policy
- Dr. Manishkumar Varma, Hoshier Mal, Dr. Rajesh Paturkar, Ramakant Swain (2020), ‘Comparative analysis of green house gases emission in conventional vehicles and electric vehicles’ - international Journal of Advanced Science and Technology vol: 29, pp. 689-695
- Sebastian Grzesiak and Adam Sulich (2022), ‘Car Engines Comparative Analysis: Sustainable Approach’ – Energies vol: 15
- S. Mekhilef, R. Saidur, A. Safari (2021), ‘Comparative study of different fuel cell technologies’ - Renewable and Sustainable Energy Reviews vol: 16 pp: 981-989
- Chengxiang Zhuge, Chunfu Shao and Xia Li (2019), ‘A Comparative Study of En Route Refuelling Behaviours of Conventional and Electric Vehicles in Beijing, China’ – Sustainability
- Troy R. Hawkins, Bhawna Singh, Guillaume Majeau-Bettez, and Anders Hammer Stromman (2019), ‘Comparative Environmental Life Cycle Assessment of Conventional and Electric Vehicles’ - Journal of Industrial Ecology vol: 17
- Medhat Elkelawy, Hagar Alm-Eldin Bastawissi, Mohammed Osama Elsamadony, Ahmed Mohammed Elbanna, Ahmed M. S. M. Safwat (2022), ‘Effect of Battery Charging Rates for Electric Hybrid Vehicle on Fuel Consumption and Emissions Behaviors in different Road Conditions: A Comparative Study with Conventional Car’ - Journal of Engineering Research vol: 6
- Khalid S. Mohammad, Aqeel S. Jaber (2022), ‘Comparison of electric motors used in electric vehicle propulsion system’ - Indonesian Journal of Electrical Engineering and Computer Science vol: 27, pp: 11-19
- Shrey Verma , Gaurav Dwivedi a, Puneet Verma (2021), ‘Life cycle assessment of electric vehicles in comparison to combustion engine vehicles’ - Materials Today: Proceedings

- Ioan-Sorin Sorlei, Nicu Bizon, Phatiphat Thounthong, Mihai Varlam, Elena Carcadea, Mihai Culcer, Mariana Iliescu and Mircea Raceanu (2020), 'Fuel Cell Electric Vehicles—A Brief Review of Current Topologies and Energy Management Strategies' – Energies vol: 14
- Evanthia A. Nanaki, Christopher J. Koroneos (2020), 'Comparative economic and environmental analysis of conventional, hybrid and electric vehicles' - Journal of Cleaner Production vol: 53
- Faycal-Siddikou Boureima, Maarten Messagi , Julien Matheys, Vincent Wynen, Nele Sergeant, Joeri Van Mierlo, Marc De Vos , Bernard De Caemel (2019), 'Comparative LCA of electric, hybrid, LPG and gasoline cars in Belgian context' - World Electric Vehicle Journal vol: 3
- Kamil cagatay Bayindir, Mehmet Ali Gozukucuk, Ahmet Teke (2021), 'A comprehensive overview of hybrid electric vehicle: Powertrain configurations, powertrain control techniques and electronic control units' - Energy Conversion and Management vol: 52
- Jani Das (2021), 'Comparative life cycle GHG emission analysis of conventional and electric vehicles in India' – Environment, Development and Sustainability
- Ali Emadi, Young Joo Lee, Kaushik Rajashekara (2018), 'Power Electronics and Motor Drives in Electric, Hybrid Electric, and Plug-In Hybrid Electric Vehicles' - IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 55
- Sesha Gopal selvakumar (2021), 'Electric and hybrid vehicles: A comprehensive overview' – IEEE 2nd international conference on electrical power and energy systems
- Daniel De wolf and Yves Smeers (2023), 'Comparison of Battery Electric Vehicles and Fuel Cell Vehicles' – World electric vehicle journal
- Danielle Rodrigues de Moraes, Laene Oliveira Soares, Vanessa de Almeida Guimaraes, Katia Ferreira de Oliveira, Luis Hernandez Callejo, Gisele Maria Ribeiro Vieira, Ronney Arismel Mancebo Boloy (2021), 'Energy ecological efficiency of the fuel cell electric vehicle powered by different biofuels' - Clean Technologies and Environmental Policy.

ANNEXURE I – QUESTIONNAIRE

1) Name

2) Gender

- Male
- Female

3) AGE GROUP YOU BELONG TO

- 18 to 20
- 21 to 35
- 36 to 45
- 46 to 60
- Above 60

4) Which vehicle are you currently using

- Electric car
- Petrol car

5) How often do you use your vehicle

- Daily
- Weekly
- Monthly
- Rarely
- Never

6) What is the primary purpose of your vehicle usage

- Commuting to work
- Recreational use
- Business use
- Others...

7) How often does your vehicle require maintenance or repairs

- Very frequently
- Occasionally
- Rarely

- Never

8) How satisfied are you with your current vehicle in terms of overall performance and operation

- Very dissatisfied
- Dissatisfy
- Neutral
- Satisfy
- Very satisfied

9) On average how much do you spend on your electric car annually

- Below Rs. 15,000
- Rs. 15,000 - 20,000
- Rs. 20,000 - 30,000
- Rs. 30,000 - 40,000
- Above Rs. 40,000

10) Average range provided by your electric car when full charged (in kilometer)

- Below 200
- 200 to 300
- 300 to 400
- 400 to 500
- Above 500

11) Are you satisfied with the electricity economy of your vehicle

- Extremely satisfied
- Satisfy
- Neutral
- Not satisfy
- Extremely not satisfied

12) What influenced your decision to choose it in terms of environmental concern for electric car

- Pollution
- Fuel cost

- Maintenance cost
- Current trend
- Other...

13) Have you experienced any safety issues or concerns when operating your Electric car

- Battery safety
- High voltage system
- Silent operation
- Charging safety
- None of the above

14) How convenient is it to access charging stations in your area

Very inconvenient 1 2 3 4 5 Very convenient

15) Do you have any additional comments or suggestions regarding the operation of your Electric car

16) On average how much do you spend on your petrol car annually

- Below Rs. 50,000
- Rs. 50,000 - 1,00,000
- Rs. 1,00,000 - 2,00,000
- Rs. 2,00,000 - 2,50,000
- Above Rs. 2,50,000

17) Average range provided by your petrol car in full tank (in kilometer)

- Below 200
- 200 to 300
- 300 to 400
- 400 to 500

18) Are you satisfied with the fuel economy of your vehicle

- Extremely satisfied
- Satisfy
- Neutral

- Not satisfy
- Extremely not satisfied

19) What influenced your decision to choose it in terms of environmental concerns for petrol car

- Fuel efficiency
- Limited alternative infrastructure
- Range anxiety
- Lifestyle
- Other...

20) Have you experienced any safety issues or concerns when operating your Petrol car

- Combustible Fuel
- Exhaust Emissions
- Noise Pollution
- Maintenance Hazards
- None of the above

21) How convenient is it to find refueling stations in your area

Very inconvenient 1 2 3 4 5 Very convenient

22) Do you have any additional comments or suggestions regarding the operation of your Petrol car.

ANNEXURE II – RESEARCH ARTICLE

A COMPARATIVE STUDY ON ELECTRIC VEHICLE AND PETROL VEHICLE

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ABSTRACT

The automotive industry is currently undergoing a significant transformation with the growing emphasis on sustainability and environmental responsibility. This comparative study examines the key differences and implications between electric vehicles (EVs) and traditional petrol vehicles, providing a comprehensive analysis of their respective technologies, environmental impact, performance, and economic considerations. The research approach includes a detailed review of existing literature, an analysis of real-world data, and expert interviews to establish a well-rounded understanding of the subject. This study aims to address the fundamental questions surrounding the adoption of electric vehicles as an eco-friendly alternative to traditional internal combustion engine vehicles. The study first delves into the technological disparities between electric and petrol vehicles, considering factors such as powertrain design, energy sources, charging infrastructure, and maintenance requirements. It also explores the environmental footprint of each vehicle type, evaluating their respective emissions, resource consumption, and long-term sustainability.

INTRODUCTION

The global automotive landscape is undergoing a momentous transformation, driven by a growing awareness of environmental sustainability and the need to reduce our dependence on fossil fuels. In this era of innovation and change, the comparative study of petrol vehicles and electric vehicles (EVs) stands as a crucial endeavour, offering a comprehensive evaluation of two distinct paradigms that represent the past and future of transportation.

Petrol vehicles, with their internal combustion engines, have held a dominant position on the world's roads for over a century. These vehicles are known for their reliability, range, and the familiar growl of an engine running on gasoline. However, the environmental repercussions of petrol vehicles, including air pollution, greenhouse gas emissions, and the depletion of finite fossil fuel resources

REVIEW OF LITERATURE

Lai Yang, Biying Yu, Bo Yang, Hao Chen, Gabriel Malima, Yi-Ming Wei (2020), thinks the environmental impact of electric vehicles (EVs) in China using a life cycle assessment (LCA). It compares carbon dioxide (CO₂) and air pollutant emissions across the entire life cycle, including production, use, and end-of-life, for three types of passenger vehicles: internal combustion engine vehicles (ICEV), plug-in hybrid electric vehicles (PHEV), and battery electric vehicles (BEV).

ISABELLA BURCH AND JOCK GILCHRIST (2018), describes the lack of political will to ban internal combustion engine (ICE) vehicles and the absence of a comprehensive database documenting global efforts to transition to electric vehicles. The first version of the survey was well-received in 2018 and has since been updated to include the increasing number of countries, cities, and companies committing to electrified vehicle fleets.

DANIEL DE WOLF AND YVES SMEERS (2023), describes the need for alternative energy infrastructure, particularly for hydrogen (for fuel cell electric vehicles) and electricity (for battery electric vehicles), due to the ban on fossil fuel vehicles in European cities. It compares the advantages and constraints of both

propulsion modes, hydrogen's autonomy and fast recharging and electricity's affordability and wide grid availability.

OBJECTIVE OF THE STUDY

- Primary objective focuses on a comparative study on electric vehicle and petrol vehicle.
- To analyze the total cost of ownership, considering factors like fuel or electricity costs, maintenance expenses, and potential incentives for both types of vehicles.
- To examine the range limitations provided by electric vehicle and petrol vehicle.
- To conclude with the best mode of vehicle after a benchmark analysis.

NEED OF THE STUDY

- The world faces increasing concerns about climate change and environmental degradation, there is a growing need to transition to cleaner and more sustainable transportation options. Electric vehicles (EVs) represent a potential solution to reduce the carbon footprint associated with traditional petroleum vehicles.
- It addresses the need to explore alternative energy sources and reduce dependence on finite fossil fuels. Electric vehicles, powered by electricity from renewable sources, offer a promising alternative to traditional vehicles relying on petroleum-based fuels.

SCOPE OF THE STUDY

- Initial purchase cost and total cost of ownership. Government incentives and subsidies. Charging infrastructure costs versus traditional refueling infrastructure.
- Carbon emissions during manufacturing, usage, and disposal. Comparative life cycle analysis. Assessment of the environmental benefits of electric vehicles, considering the energy mix.
- Availability and accessibility of charging stations. Charging time and convenience. Comparison of home charging and public charging options.

RESEARCH METHODOLOGY

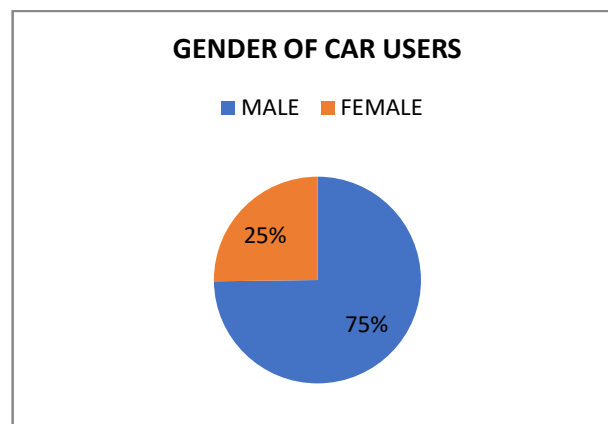
Research methodology is mainly needed for the purpose of framing the research process and the designs and tools that are to be used for the project purpose. A comparative study on electric vehicles (EVs) and petrol vehicles involves examining various aspects to understand the advantages, disadvantages, and overall performance of each type of vehicle. Collect opinions and experiences from users of both electric and petrol vehicles through surveys. Understand their satisfaction, concerns, and preferences.

DATA ANALYSIS AND INTERPRETATION

4.1. GENDER OF CAR USERS

S.NO.	GENDER OF CAR USERS	NO.OF.RESPONDENT	PERCENTAGE ANALYSIS
1	MALE	107	75%
2	FEMALE	36	25%
Total		143	100%

4.1. CHART



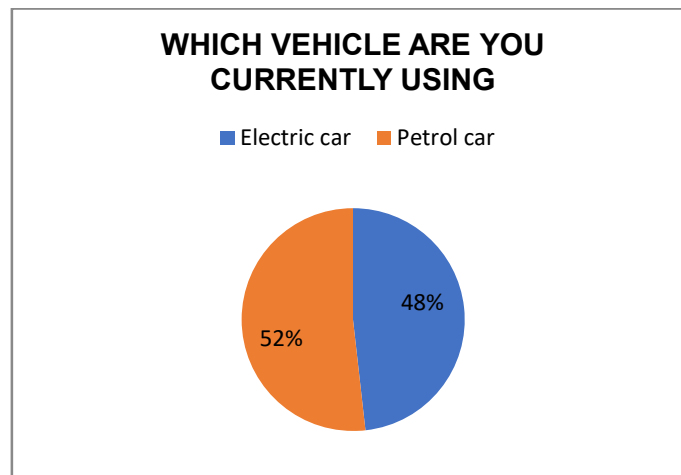
INTERPRETATION

75% of respondents were given by the male users and 25% were given by female users.

4.2. WHICH VEHICLE ARE YOU CURRENTLY USING

S.N O	WHICH VEHICLE ARE YOU CURRENTLY USING	NO.OF.RESPONDEN T	PERCENTAGE ANALYSIS
1	Electric car	69	48%
2	Petrol car	74	52%
Total		143	100%

4.1.3. CHART



INTERPRETATION

The respondents, 52% of users are currently using Electric car, 48% of the users are currently using Petrol car.

CHI SQUARE

HYPOTHESIS 1

- H0: There is no significant association between age group and the factors influencing the choice of an electric car based on environmental concerns
- H1: There is a significant association between age group and the factors influencing the choice of an electric car based on environmental concerns.

SIGNIFICANT ASSOCIATION BETWEEN AGE GROUP AND FACTORS INFLUENCING THE CHOICE OF AN ELECTRIC CAR BASED ON ENVIRONMENT CONCERNS

			If you own an electric car, what influenced your decision to choose it in terms of environmental concerns				
			Current trend	Fuel cost	Maintenanc e cost	Pollution	
AGE GROUP YOU BELONG TO	18 to 25	Count	2	11	10	5	28
		Expected Count	3.7	8.9	8.5	6.9	28.0
	26 to 35	Count	2	4	7	6	19
		Expected Count	2.5	6.1	5.8	4.7	19.0
	36 to 45	Count	3	4	2	2	11
		Expected Count	1.4	3.5	3.3	2.7	11.0
	46 to 60	Count	1	1	2	2	6
		Expected Count	.8	1.9	1.8	1.5	6.0
	Above 60	Count	1	2	0	2	5
		Expected Count	.7	1.6	1.5	1.2	5.0
Total	Count	9	22	21	17	69	
	Expected Count	9.0	22.0	21.0	17.0	69.0	

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.919 ^a	12	.710
Likelihood Ratio	10.307	12	.589
N of Valid Cases	69		

a. 15 cells (75.0%) have expected count less than 5. The minimum expected count is .65.

INTERPRETATION

The p value is 0.710 which is greater than the significance value (0.05). Hence null hypothesis (H0) is accepted and alternate hypothesis (H1) is rejected. There is no significant association between age group and the factors influencing the choice of an electric car based on environmental concerns.

CORRELATION

HYPOTHESIS 2

- H0: There is no significant difference between the average range of electric cars and the annual spending on petrol cars
- H1: There is a significant difference between the average range of electric cars and the annual spending on petrol cars

DIFFERENCE BETWEEN THE AVERAGE RANGE OF ELECTRIC CARS AND THE ANNUAL SPENDING ON PETROL CARS

Correlations

		Average range provided by your electric car when full charged (in kilometer)	On average how much do you spend on your petrol car annually
Average range provided by your electric car when full charged (in kilometer)	Pearson Correlation	1	.927
	Sig. (2-tailed)		.001
	N	69	74
On average how much do you spend on your petrol car annually	Pearson Correlation	.927	1
	Sig. (2-tailed)	.001	
	N	69	74

INTERPRETATION

The p value is 0.927 is rounded to 1. "1" represents positive correlation. Hence null hypothesis (H0) is rejected and alternate hypothesis is accepted. Therefore, it has significant difference between the average range of electric cars and the annual spending on petrol cars.

SUGGESTION

- Clearly define the operational parameters you will be assessing. This could include factors such as range, fueling infrastructure, maintenance requirements, and adaptability to different operational environments.
- If focus on fleet operations. Assess how EVs and PVs perform when integrated into corporate or municipal fleets. Consider factors like total cost of ownership, fueling logistics, and maintenance expenses.
- Evaluate the impact of charging infrastructure on the operational efficiency of electric vehicles. Consider the convenience and accessibility of charging stations, especially in the operational areas of interest.
- Conduct a comprehensive total cost of ownership analysis, incorporating not only the initial purchase price but also ongoing operational costs, maintenance expenses, and potential incentives for both electric and petrol vehicles.
- Assess the long-term operational sustainability of both vehicle types. Consider the availability and cost of spare parts, the ease of upgrading technologies, and the potential for extending the operational life of each vehicle.

CONCLUSION

EVs generally have a lower environmental impact compared to PVs, especially in terms of greenhouse gas emissions. The study emphasizes the importance of transitioning to electric vehicles to mitigate climate change and reduce air pollution.

Electric vehicles demonstrate higher energy efficiency in terms of converting energy from the source to vehicle movement. This is attributed to the efficiency of electric motors compared to internal combustion engines in petrol vehicles.

The comparative analysis reveals shifting market dynamics, with a growing consumer interest in electric vehicles. As environmental consciousness rises and EV technology matures, automakers need to adapt their strategies to meet evolving consumer preferences and regulatory requirements.

Electric vehicles represent a focal point for innovation within the automobile industry. The study emphasizes the importance of continued research and

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REFERENCES

1. <https://ackodrive.com/car-guide/electric-car-vs-petrol-car/>
2. <https://www.godigit.com/motor-insurance/car-insurance/find/electric-car-vs-petrol-car>
3. <https://www.hdfcergo.com/blogs/car-insurance/electric-cars-vs-petrol-cars>
4. <https://www.bajajallianz.com/blog/motor-insurance-articles/electric-car-vs-petrol-car.html>
5. <https://e-amrit.niti.gov.in/benefits-of-electric-vehicles>
6. https://en.wikipedia.org/wiki/Electric_car
7. https://en.wikipedia.org/wiki/Petrol_engine