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Electric Vehicle Market Analysis.

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ABSTRACT

Electric vehicles (EVs) are a promising technology for achieving a sustainable transport sector in the future, due to their very low to zero emissions. They are being introduced to the passenger car market in addition to the already popular hybrid vehicles. Fully electric and electric hybrid vehicles potentially introduce new types of post-crash hazards, and it is important that crash test organizations and rescue organizations understand and are prepared for the potential hazards. Electric vehicle drives offer a number of advantages over conventional internal combustion engines, especially in terms of lower local emissions. The motor vehicle industry has been the leading consumer of fossil fuel worldwide, resulting in adverse effects on the environment, and the introduction of electric cars aims to address this issue. Electric vehicles are gaining momentum due to several factors, including price reduction as well as climate and environmental awareness. Further research is needed to provide insight into the manufacturing process of electric vehicles and to investigate the current state of more efficient energy storage technologies.

1. Introduction

Electric vehicles (EVs) are vehicles that use one or more electric motors for propulsion. They can be powered by a collector system with electricity from external sources or by onboard energy storage, such as a battery or fuel cell. EVs include all-electric vehicles (AEVs), also known as battery electric vehicles (BEVs), and plug-in hybrid electric vehicles (PHEVs) . The first mass-produced electric vehicles appeared in America in the early 1900s, and the technology has seen a revival in the 21st century due to growing interest in sustainable transportation. EVs are known for providing instant torque, a quiet driver experience, and high acceleration rates, making them desirable for personal transportation. They are also more energy-efficient, converting over 59–62% of grid energy to the wheels, compared to around 17–21% for conventional gasoline vehicles, With their potential to significantly reduce carbon emissions, EVs are considered a promising technology for achieving a sustainable transport sector in the future

1.1 Electric Vehicle Working Principle

Electric vehicles (EVs) operate by converting electrical energy stored in batteries into mechanical energy to propel the vehicle. The key components of an electric vehicle include the electric motor, inverter, battery, battery charger, controller, and charging cable. When the brakes are pressed or the car is decelerating, the motor becomes an alternator and produces power, which is sent back to the battery. The battery pack stores energy gathered from the grid during charging and powers the vehicle's motor and other electrical components. Electric traction motors are commonly powered by alternating current (AC), which is more efficient and reliable than direct current (DC) motors. The electric vehicle's charge port allows the battery pack to receive energy from an external power source, and electric vehicle inverters change the battery pack's flow of electrons from DC into AC, which is then used to power the electric traction motor.

1.2 Objectives of the Study

Electric vehicles (EVs) have several objectives, ranging from environmental benefits to user-centric approaches and performance optimization. Here are the key objectives of electric vehicles based on the provided search results:

1. **Environmental Benefits:**
    - EVs contribute to reducing carbon footprint and air pollution by producing zero tailpipe emissions
    - Using renewable energy sources can make the use of electric vehicles more eco-friendly
2. **Lower Running Costs:**
    - The running cost of an electric vehicle is much lower than that of an equivalent petrol or diesel vehicle.

3. **User-Centric Approach:**
    - Optimizing the development and operation of electric vehicles to meet user expectations in terms of vehicle characteristics, usability, reliability, affordability, driving range, and convenience of long-range travel.
4. **Energy Efficiency:**
    - Implementing eco-driving and smart fast charging to optimize energy consumption and charging patterns
5. **Public Charging Infrastructure:**
    - Planning and operating public electric vehicle charging infrastructures to provide valuable information to stakeholders involved in their implementation
6. **Performance Optimization:**
    - Setting specific targets for each aspect of EVs to maximize battery capacity and reduce energy consumption, thereby boosting overall performance

These objectives collectively aim to promote the widespread adoption of electric vehicles, reduce environmental impact, and enhance user experience and performance.

1.3 Scope and Limitations

Electric vehicles (EVs) have gained attention due to their potential to reduce CO2 and NOx emissions, create an energy-efficient transportation sector, and contribute to environmental sustainability. However, they also have certain limitations that need to be considered.The scope of an EV can vary depending on several factors, including the size and capacity of the battery, the efficiency of the motor, and driving conditions such as speed, terrain, and weather. Generally, newer EV models have larger batteries and more efficient motors, which can result in longer ranges.

Advantages and Scope:

Electric vehicles offer several advantages, including:

- Environmental benefits: EVs produce no pollutants and do not rely on fossil fuels, making them environmentally friendly.
- Energy efficiency: They have fewer moving components and are simple to maintain.
- Safety: EVs are less likely to explode in accidents due to the absence of combustible fuel or gas.

Limitations

The limitations of electric vehicles, such as their driving range and charging infrastructure, are areas where ongoing research and technological advancements aim to address these challenges and expand the scope of electric vehicles in the future. In conclusion, while electric vehicles offer numerous advantages, including environmental benefits and energy efficiency, their limitations, such as high initial cost and driving range, need to be considered when evaluating their scope and potential impacts in the transportation sector. Ongoing advancements in technology and infrastructure are expected to address some of these limitations and expand the scope of electric vehicles in the future

2. Literature Review

Several literature reviews are available on electric vehicles. One study proposes a framework for analyzing the impact of consumer innovation and attitudes on electric car functional qualities. Another literature review focuses on issues and solutions related to vehicle deployment and integration with the U.S. electrical grid. A third study provides an integrative review methodology on the adoption of electric vehicles. A fourth literature review compares the economic and psychological approach towards consumer preferences for electric vehicles. Finally, a systematic literature review analyzes the findings of research conducted on consumer adoption of electric vehiclesAll authors contributed extensively to the work presented in this paper, i.e., to the paper conceptualization, to the resources analysis, as well as to the writing, review, and editing processes. All authors have read and agreed to the published version of the manuscript.

2.1 Theoretical Frameworks of Employee Retention

Employee retention is a critical aspect of organizational success, and various theoretical frameworks have been developed to understand and address this issue. Some of the most prominent theoretical frameworks of employee retention include:

- This model emphasizes the importance of meeting employees' basic needs, such as physiological needs, job security, belonging, self-esteem, and self-actualization, to enhance retention.

- Herzberg's theory focuses on motivator and hygiene factors that influence employee satisfaction and retention. Motivator factors, such as recognition and growth opportunities, contribute to employee satisfaction and retention.This theory suggests that employees' connections and links within an organization influence their decision to stay, emphasizing the importance of social ties and organizational commitment

2.2 Key Factors Influencing Electric Vehicles

Electric vehicle (EV) adoption is influenced by various factors, including consumer preferences, government policies, environmental awareness, and technological advancements. Several key factors affecting EV adoption include:

Driver Factors:

Public Awareness About EVs: Consumer awareness and education about the benefits of EVs play a crucial role in their adoption.

Range: The driving range of EVs is a significant consideration for consumers, and improvements in battery technology are essential for widespread adoption.

Charging Speed: Faster charging infrastructure and technology are important for enhancing the convenience of EVs.

Cost and Cost Comparison: The upfront cost of EVs and their operating costs compared to traditional vehicles influence consumer decisions.

Manufacturing Factors:

Incentives: Government incentives and subsidies can make EVs more affordable and attractive to consumers.

Production Rate: The availability of a variety of EV models and the rate of production influence consumer choices.

These factors collectively contribute to the adoption and acceptance of electric vehicles, reflecting the complex interplay between consumer preferences, technological advancements, and policy interventions.

3. Research Methodology

Research on electric vehicles (EVs) encompasses various methodologies, including surveys, quantitative studies, systematic forecasting, and user perspective evaluations.

The Union of Concerned Scientists and Consumer Reports conducted a telephone survey to estimate the current suitability of plug-in electric vehicles for personal transportation in the United States and to evaluate public opinion of EV options. The study used self-reported driving and parking behavior questions to assess the potential use of battery electric vehicles (BEVs) and found that 42 percent of households with vehicles could potentially use these types of EVs currently on the market.

A quantitative study aimed to measure the attributes of electric vehicles that influence consumers' attitudes towards EVs. This study focused on understanding the factors that influence consumers' purchase intent for electric vehicles.Additionally, systematic methodologies have been developed for mid- and long-term electric vehicle charging load forecasting. This type of research focuses on modeling EV charging profiles to forecast charging loads.

Furthermore, a methodology for electric vehicle battery packs redesign for circular economy has been presented to address industrial limitations. This study focuses on a structured design approach for redesigning e-mobility batteries.

Finally, a methodological framework for user studies on electric vehicles has been proposed, along with the presentation of first results from a 1-year field trial in Berlin. This study focuses on evaluating electric vehicles from a user's perspective.

These methodologies collectively contribute to a comprehensive understanding of electric vehicles, encompassing consumer attitudes, charging load forecasting, circular economy redesign, and user perspective evaluations.

3.1 Research Design

Fig 4. BLDC MOTOR CONTROLLER CIRCUIT

There are several research designs related to electric vehicles. Here are some examples of research studies related to electric vehicles: A quantitative study of electric vehicle attributes and consumer attitudes influence on purchase intent : This study aims to measure the attributes of electric vehicles that influence consumers' attitudes towards EVs. Electric Vehicle Research and Development: The U.S. Department of Energy (DOE) is working with its partners in the public and private sectors to research, develop, demonstrate, and deploy technologies that enhance the performance of electric-drive vehicles. This includes research on environmental and market analysis, vehicle electrification, and electric vehicle grid integration.

Electric Vehicle Modelling for Future Technology and Market Penetration Analysis: This study uses numerical simulation, using MATLAB, to investigate and improve the overall performance of battery electric vehicles (BEVs). The study provides a critical analysis of the performance and limitations of medium-sized BEVs available in the market today, and performs a techno-economics analysis of BEVs.

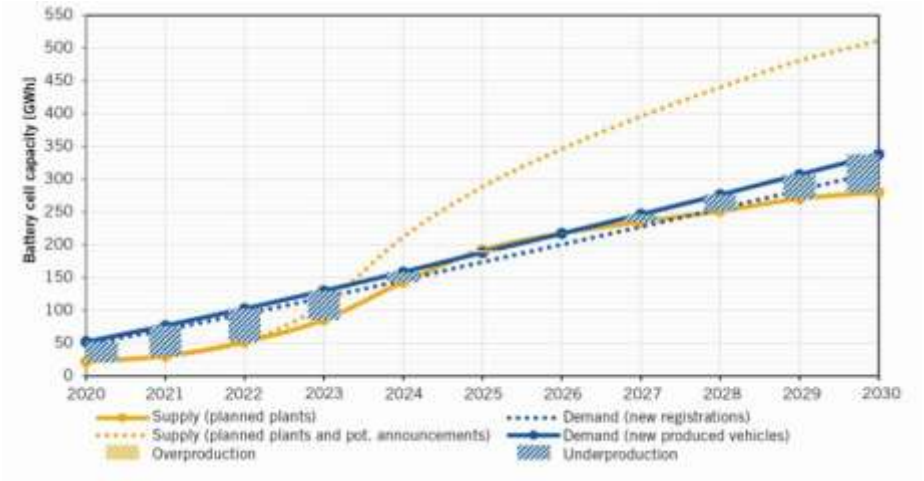
Multi-dimensional perspectives on electric vehicles design: A mind map approach: This study provides a comprehensive multi-dimensional overview of electric vehicle design. The study analyzes a 12-year period of scientific research on electric vehicle design.

3.2 Data Analysis Techniques

- The Electric Vehicle (EV) is not new, but it has been receiving significantly more attention in recent years. Advances in both EV analytics and battery technologies have led to increased automotive market share. However, this growth is not attributed to hardware alone. The modern mechatronic vehicle marries electrical storage and propulsion systems with electronic sensors, controls, and actuators, integrated closely with software, secure data transfer, and data analysis, to form a comprehensive transportation solution. Advances in all these areas have contributed to the overall rise of EV's, but the common thread that runs through all these elements is data analytics.

4. Analysis of data

Electric vehicles (EVs) are becoming increasingly popular, with a total of 14% of all new cars sold being electric in 2022, up from around 9% in 2021 and less than 5% in 2020. The major markets for EVs are currently Europe, China, and the United States. However, there are promising signs for emerging EV markets, albeit from a small base, with electric car sales generally low outside the major markets, but 2022 was a growth year in India, Thailand, and Indonesia. Battery electric SUVs often have batteries that are two- to three-times larger than small cars, requiring more critical minerals. However, last year electric SUVs resulted in the displacement of over 150,000 barrels of oil consumption per day and avoided the associated tailpipe emissions that would have been generated through burning the fuel in combustion engines. Researchers are examining opportunities and impacts associated with a full range of charging technologies, and the widespread adoption of EVs will require a robust network of charging stations, from home-based AC charging to DC powered extreme fast charging.



5. Results and discussions of Electric Vehicles:

Electric vehicles (EVs) have gained significant attention due to their potential to decarbonize road transport and reduce emissions. The global electric car stock reached 10 million in 2020, representing a 43% increase over 2019. Governments worldwide have been providing direct purchase incentives and tax deductions for electric cars, with spending reaching USD 14 billion in 2020. As the electric car market matures, reliance on direct subsidies is expected to decrease, and budget-neutral "feebate" programs are being considered as a transition policy tool .All forms of electric vehicles, including hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and all-electric vehicles (BEVs), offer benefits such as improved fuel economy, lower fuel costs, and reduced emissions. Additionally, the availability of electric heavy-duty vehicles (HDVs) models is expanding, with manufacturers showing commitments to electrification across various segments such as buses, medium freight trucks, and heavy freight trucks .

6. Conclusion

Electric vehicles (EVs) offer several advantages, including environmental benefits, cost savings, and technological advancements. The conclusion drawn from various sources highlights the following key points:

Feasibility and Environmental Impact: EVs are considered feasible for long-distance travel due to the growing network of charging stations

1. They are also preferable to petrol or diesel cars in terms of climate change and air quality

2. EVs are more efficient, produce fewer emissions, and are friendlier to the ecosystem compared to gasoline engines

3.Economic Efficiency and Future Recommendations: Harmonizing EV standards and investing in "e-highways" for electric trucks is recommended for economic efficiency

4. Additionally, further research and study are suggested to gain insight into the manufacturing process of EVs, particularly regarding fossil fuel consumption

In conclusion, the evidence supports the notion that electric vehicles are a smart choice for the environment, offering benefits such as reduced emissions, cost savings, and technological advancements. However, further research and investment in infrastructure are recommended to enhance the feasibility and environmental impact of electric vehicles.

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