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The Future of E-Mobility

Investigating the Role of Electric Mobility for Consumers and Industries

David D'Acunto

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Foreword—Navigating the Electric Horizon

Electric vehicles are about to change the game, and David D’Acunto’s book explores deep into what that means for everyone. The book studies how electric vehicles (EVs) will impact how we drive, businesses operate, and even governments make decisions. It is not just a deep dive into electric vehicles, it is a guide to how they are reshaping our lives, businesses, and even the decisions governments are making.

Thus, I am pleased to introduce “The Future of E-Mobility - Investigating the Role of Electric Mobility for Consumers and Industries,” in which the author comprehensively looks at electric mobility and its potential to transform consumer behavior and industry practices.

One major hurdle? Making EVs affordable and practical for everyone. Many electric cars today are pricey and beyond the average buyer’s reach. Furthermore, a concern regarding the availability of charging stations during long journeys is a common one among electric vehicle drivers. In Europe, there is a significant need for an expansion of the charging infrastructure.

Consequently, this book investigates into the intricate dynamics of the energy transition, highlighting challenges and potential consequences such as the increased demand for rare earth elements essential for EV batteries. The research positions e-mobility as a catalyst for profound changes within supply chains, introducing new efficiencies and demanding innovative approaches to logistics and manufacturing, especially within the context of the European Union. This is not just about technology; it is about making life better.

Despite technological progress, the book addresses current market challenges, noting the tendency of automakers to focus on more extensive and expensive electric models, which limits the availability of affordable EV options for the mass market. There is a noticeable trend toward electric vehicles as part of a broader push for sustainability. However, challenges such as the need for extensive EV charging infrastructure remain critical in Europe, particularly in some countries, where significant build-out of charging stations is required to meet future demand. This focus may hinder broader EV adoption and delay the transition toward a more sustainable automotive industry. But the book is not all about problems. The author also shows how EVs can be a major force for good. They can help reduce pollution, conserve resources, and create new jobs.

The empirical research underpinning this book provides valuable insights into the factors influencing Italian consumers' intentions to purchase electric vehicles. These findings, though not conclusive, reveal the complex interplay of economic variables, informational levels, perceived obstacles, and benefits in shaping consumer attitudes toward EVs. They emphasize the importance of transparent information dissemination and infrastructure development in accelerating the adoption of electric mobility in Italy and suggest further research to elucidate varying perceptions beyond the Italian context as changes continue.

This book is not just an academic text; it is a roadmap. "The Future of E-Mobility" serves as a critical resource, dissecting the multifaceted impacts of e-mobility from its environmental benefits to its economic ramifications and the necessary policy frameworks. It presents beyond the analysis of consumer behaviors, the industry shifts beyond traditional automotive boundaries, and the critical influence of regulatory

landscapes in shaping the future of e-mobility. The debate on electric vehicles in Europe is sparking diverse views on the proposed ban of combustion engine cars. While different objections have been raised, a nuanced understanding of the topic remains crucial.

In his analysis, D’Acunto offers advice for everyone wanting to join the electric vehicle revolution. For consumers, he underscores the importance of practical considerations such as affordability, accessibility, and sustainability in adopting e-mobility solutions. Industries are encouraged to embrace innovation and adaptability to stay competitive in a rapidly evolving market. For policymakers, he outlines strategies for fostering e-mobility, including implementing supportive regulations and incentives that facilitate this transition.

The book also identifies areas where more research is needed. Looking ahead, the author identifies critical areas for future research that promise to deepen our understanding and enhance the implementation of e-mobility solutions. These areas include advancements in battery technology, integrating e-mobility with renewable energy sources, influencing consumer adoption, and the broader socioeconomic impacts of transitioning to e-mobility. Each of these topics is poised to contribute significantly to the overarching goal of sustainable development to achieving the United Nations Sustainable Development Goals (SDGs), specifically Goals 7, 9, 11, 12, and 13.

In summary, this book section provides actionable insights for all stakeholders and a comprehensive roadmap for future research endeavors, underscoring the pivotal role of e-mobility in achieving sustainable development goals. By addressing these recommendations and future research directions in the preface, readers are primed to explore the transformative potential of e-mobility detailed throughout the book. It is evident that no single strategy can universally address the diverse challenges of achieving sustainability through mobility.

Finally, what excites me is the book’s focus on how EVs will transform supply chains and the logistics industry. This is a fascinating area, and that is one of the reasons that I find this book resonates deeply with my interests, mainly in its focus on supply chain transformations. It provides a baseline to understand how this industry is changing and the need for innovative approaches, especially in project design, strategic sourcing of

critical materials, manufacturing and assembly of diverse components, changing how products are delivered and sold, and organizing tailored after-sales strategies.

I invite you to engage with this research, reflect on its extensive analyses, and consider the broader implications of e-mobility in our collective pursuit of sustainable development, industry organization, and effective climate action. This topic is appealing and demands further exploration; this is a good start. While unquestionably important, the full scope of its impact remains uncertain. “The Future of E-Mobility” is a springboard for this ongoing journey.

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1

Introduction to Electric Mobility

Abstract This chapter introduces the concept of electric mobility, emphasizing its necessity in contemporary transportation, and discusses the urgent need for electric mobility due to environmental concerns and resource depletion. A comparative analysis of traditional and electric vehicles highlights the benefits of the latter in terms of efficiency and sustainability. The chapter then discusses the significance of electric mobility for both consumers and industries, detailing how it empowers consumer choices and offers economic advantages for organizations. The chapter closes by examining the role of electric mobility in fostering the transition from linear to circular economies, illustrating how it supports sustainable development and resource efficiency. This comprehensive overview underscores the pivotal role of electric mobility in driving a greener and more resilient future.

Keywords electric vehicles · sustainability · consumer empowerment · circular economy · transition · economic advantages · environmental impacts

The modern world is at a pivotal juncture in its ongoing battle against climate change and environmental degradation. As the global population continues to swell, the demand for energy and transportation grows in tandem, making it challenging to reduce greenhouse gas emissions and mitigate the impacts of a rapidly changing climate. Amid these pressing concerns, the emergence and rapid adoption of electric mobility present a glimmer of hope on the horizon. Electric mobility, encompassing electric vehicles (EVs), e-bikes, and other electric modes of transportation, has the potential to revolutionize not only how we move but also how industries function and how consumers engage with transportation.

The importance of electric mobility cannot be understated, as it offers a compelling solution to the dual crises of environmental sustainability and the need for efficient transportation systems. This comprehensive exploration aimed to investigate the multifaceted role of electric mobility in shaping the future of transportation, both for consumers and industries. By delving into the various dimensions of this emerging phenomenon, we aimed to highlight the opportunities and challenges it presents, the implications for different sectors, and the potential for electric mobility to drive a more sustainable and accessible future (Calise et al., 2019).

Electric mobility marks a profound shift from traditional combustion engine vehicles to cleaner, more sustainable alternatives. The development and mass adoption of EVs, in particular, represent a transformative force in the automotive industry. These vehicles are powered by electricity stored in batteries, which eliminates tailpipe emissions and reduces the carbon footprint of transportation (Kumar & Alok, 2020). As a result, electric mobility aligns with global efforts to combat climate change, improve air quality, and reduce dependence on fossil fuels. From the perspective of consumers, electric mobility offers a compelling array of benefits. EVs are not just an eco-conscious choice but also provide cost savings in the long run due to their lower operating and maintenance costs compared to traditional vehicles. Moreover, they offer a smoother, quieter, and more technologically advanced driving experience. Yet, barriers such as range anxiety and the lack of availability of charging infrastructure must be addressed to encourage a wider adoption

of EVs (Calise et al., 2019). Investigating consumer perceptions, preferences, and behaviors is crucial to understanding how electric mobility can become more accessible and appealing.

Electric mobility has far-reaching implications for various industries. Automakers are investing heavily in EV technology to remain competitive in a rapidly changing market. Beyond the automotive sector, the electric mobility ecosystem extends to energy providers, charging infrastructure companies, and battery manufacturers. The transition to electric mobility necessitates significant shifts in business strategies, supply chains, and regulatory frameworks. This work explores the strategies industries are adopting to navigate this transformation and seize new opportunities (Sæther, 2022). One of the key advantages of electric mobility is its potential to significantly reduce greenhouse gas emissions. The shift from internal combustion engines (ICEs) to electric motors can lead to substantial reductions in carbon dioxide emissions, provided that electricity generation comes from cleaner sources. Analyzing the environmental benefits and challenges associated with electric mobility is vital for assessing its overall impact on sustainability and climate change mitigation (Rauh et al., 2015).

The success of electric mobility hinges on the development of a robust charging infrastructure. The availability, accessibility, and convenience of charging stations are critical factors influencing consumer adoption. Investigating the expansion of charging networks, the emergence of fast-charging technologies, and the role of public and private stakeholders in building this infrastructure is essential to understanding the future of electric mobility. Government policies and regulations play a pivotal role in shaping the trajectory of electric mobility. Subsidies, incentives, emissions standards, and urban planning decisions all directly impact the adoption and growth of EVs and other electric transportation modes (Kumar & Alok, 2020). Analyzing the evolving policy landscape at the local and national levels will help to elucidate the dynamics of electric mobility development.

According to Wang et al. (2020), electric mobility is not only about sustainability but also about economic opportunities. This shift has the potential to create jobs, stimulate innovation, and drive market growth. Investigating the economic implications of electric mobility,

including the emergence of new industries and the impact on traditional sectors, offers insights into the broader socioeconomic effects of this transformation. While electric mobility holds great promise, it is not without its challenges and barriers. Range limitations, battery technology constraints, charging infrastructure gaps, and consumer hesitations pose hurdles to the widespread adoption of electric mobility. Understanding these challenges and exploring potential solutions are essential for ensuring the success of electric mobility initiatives (Rauh et al., 2015).

Electric mobility extends beyond passenger vehicles and encompasses e-bikes, electric scooters, and electric public transportation systems. Investigating the role of electric mobility in its diverse forms highlights how it can reshape urban transportation, improve last-mile connectivity, and enhance the overall quality of life in cities (Li et al., 2017). The integration of electric mobility into mainstream transportation systems is an ongoing process that requires collaboration among governments, industries, and consumers. This investigation seeks to provide a comprehensive overview of the current state of electric mobility, the challenges it faces, and the opportunities it offers. By understanding the multifaceted role of electric mobility for consumers and industries, we can chart a path toward a more sustainable, efficient, and accessible future for transportation.

In the pages that follow, we will delve into each of these dimensions, exploring the intricate tapestry of electric mobility and its potential to transform the way we move, live, and interact with our environment. Through rigorous analysis and insightful discussion, we aim to equip readers with a deeper understanding of the significance of electric mobility and its implications for consumers and industries alike (Liu et al., 2022).

1.1 Need for Electric Mobility

In the wake of the twenty-first century, the need for electric mobility has become increasingly apparent as we confront the complex challenges of environmental sustainability, urbanization, and the quest for cleaner,

more efficient transportation. This section explores the factors that have catalyzed the transition to electric mobility and set the stage for its transformative potential.

The foremost driver behind the emergence of electric mobility is the urgent need to combat climate change. The transportation sector is a major contributor to global greenhouse gas emissions, primarily due to the widespread use of internal combustion engine vehicles powered by fossil fuels (Van Fossen et al., 2022). Electric mobility, with its inherently lower carbon footprint, offers a viable solution to reduce emissions and mitigate the impacts of climate change. Furthermore, EVs produce zero tailpipe emissions, which not only helps reduce carbon dioxide emissions but also significantly improves air quality. In urban areas, where air pollution poses a grave threat to public health, the transition to electric mobility can result in cleaner air and a reduction in respiratory illnesses, demonstrating its immediate benefits to society (Wang et al., 2020).

The need for electric mobility extends beyond environmental concerns. Fossil fuel dependency raises issues of energy security, as nations often rely on imported oil, subjecting their economies to price volatility and geopolitical tensions (Li et al., 2017). In contrast, electric mobility reduces dependence on finite and geopolitically sensitive resources, such as oil, by utilizing electricity, which can be generated from diverse and domestically available sources, including renewable energy. Moreover, EVs are inherently more energy-efficient than their gasoline or diesel counterparts. They convert a higher percentage of the energy from the grid to power at the wheels, reducing overall energy consumption and resource waste. This heightened efficiency is critical for reducing energy demand and minimizing the environmental impact of transportation (Wang et al., 2020).

The world is experiencing rapid urbanization, with more people moving to cities than ever before. This demographic shift has led to increased congestion, longer commute times, and a strain on transportation infrastructure. Electric mobility, especially in the form of electric public transportation, offers a means to address these challenges. Electric buses and trains can provide cleaner and more efficient mass transit options, reducing the number of private vehicles on the road and alleviating traffic congestion. Furthermore, electric micro-mobility solutions,

such as e-scooters and e-bikes, are well-suited for urban environments, offering flexible and sustainable transportation alternatives for short trips and last-mile connectivity (Lipu et al., 2018).

The rapid advancement of EV technology has made electric mobility more viable and attractive than ever before. Innovations in battery technology have led to increased energy density, longer ranges, and faster charging times. Additionally, economies of scale in manufacturing have contributed to cost reductions, making EVs more accessible to consumers. As the cost of batteries continues to decline, electric mobility will become a financially competitive option for consumers, further incentivizing its adoption (Lipu et al., 2018). Moreover, ongoing research and development efforts promise even more efficient and affordable EVs in the future, solidifying the role of electric mobility in the global transportation landscape. Governments and regulatory bodies worldwide have recognized the need for electric mobility and have implemented a range of policies and incentives to accelerate its adoption. These measures include subsidies, tax incentives, emissions standards, and the promotion of charging infrastructure development. For instance, countries like Norway have successfully incentivized EV adoption through a combination of tax breaks and other benefits, resulting in a high percentage of EVs on their roads. In the United States, federal- and state-level incentives encourage consumers to purchase EVs and promote investment in EV charging infrastructure. These policy initiatives play a crucial role in creating an enabling environment for electric mobility (Sæther, 2022).

Beyond the practical considerations, there is a growing cultural shift toward sustainable and eco-conscious living. Many consumers are becoming more environmentally aware and are seeking ways to reduce their carbon footprint. Electric mobility aligns with these changing values, allowing individuals to make environmentally responsible choices in their transportation decisions. Additionally, electric mobility is often associated with innovation and modernity, appealing to a younger generation of consumers who are both tech-savvy and environmentally conscious. This cultural shift toward sustainability and innovation further bolsters the need for electric mobility as a preferred mode of transportation (Van Fossen et al., 2022).

In conclusion, the need for electric mobility arises from a confluence of factors, including environmental imperatives, energy security concerns, urbanization challenges, technological advancements, policy incentives, and evolving cultural values. As we move forward, it is imperative to recognize and respond to these needs by embracing electric mobility as a transformative solution that not only addresses pressing global issues but also enhances the quality of life for individuals and communities worldwide. In the subsequent sections in this paper, we will delve deeper into the various facets of electric mobility, examining its impact on consumers, industries, and the environment (Liu et al., 2022).

1.2 Comparison Between Traditional and Electric Vehicles

To comprehend the significance of electric mobility, it is essential to compare and contrast traditional ICE vehicles with their electric counterparts. This section aims to provide a comprehensive analysis of the key differences between these two vehicle types, highlighting the advantages and disadvantages of EVs. Several examples, including Tesla, will be referenced to illustrate these distinctions.

According to the Ravi and Aziz (2022), traditional cars are equipped with ICEs that rely on the combustion of gasoline or diesel fuel to generate power. These engines are known for their mechanical complexity, consisting of hundreds of moving parts, and the energy they produce is transmitted to the wheels through a multi-speed transmission system. In contrast, EVs are driven by electric motors powered by batteries, which convert electrical energy into mechanical motion. This electric powertrain is inherently simpler, with fewer components and moving parts, leading to reduced maintenance requirements and higher efficiency.

Tesla, a prominent example, has garnered acclaim for its electric powertrain technology. The Tesla Model S, for instance, employs an electric motor at each axle, providing all-wheel drive and precise control of power distribution for enhanced performance and stability (Turner

et al., 2020). Traditional cars rely on fossil fuels, such as gasoline and diesel, which are combusted in the engine to produce energy. This combustion process releases carbon dioxide (CO₂) and other pollutants, contributing to air pollution and climate change. EVs, in contrast, draw power from electricity, which can be generated from various sources, including renewables like solar and wind. As a result, EVs produce zero tailpipe emissions, making them a cleaner and more environmentally friendly option (Sæther, 2022).

Tesla's commitment to sustainability is exemplified by their emphasis on electric power. The company's gigafactories are designed to produce EVs as well as batteries and solar products, promoting a holistic approach to reducing carbon emissions. One of the primary concerns regarding EVs is their range, i.e., the distance they can travel on a single charge. Traditional cars, especially those with ICEs, typically offer longer ranges than most EVs. However, EV ranges have been steadily improving due to advancements in battery technology. High-end EVs like the Tesla Model S and Model X can now travel over 300 miles on a single charge, rivaling the ranges of many gasoline-powered vehicles (Turner et al., 2020). The availability of charging infrastructure is crucial to addressing range anxiety. Tesla, recognizing this need, has developed a comprehensive network of supercharger stations across the globe. These fast-charging stations can replenish a significant portion of a Tesla vehicle's battery in a short time, making long-distance travel in EVs more practical (Omahne et al., 2021).

EVs are renowned for their impressive acceleration and torque. Unlike traditional cars, which require time to build up engine power, EVs provide instantaneous torque, resulting in rapid acceleration from a standstill. Tesla, in particular, has set a high standard for EV performance. For example, the Tesla Model 3 can accelerate from 0 to 60 miles per hour in just a few seconds, comparable to some high-performance gasoline-powered sports cars (Omahne et al., 2021).

This acceleration is achieved through the precise control of electric motors and the elimination of gear shifting, characteristics that set EVs apart from their traditional counterparts.

EVs generally have lower operating and maintenance costs compared to traditional vehicles. Traditional cars require regular oil changes, transmission fluid replacements, and exhaust system repairs, all of which contribute to ongoing expenses. In contrast, electric cars have fewer moving parts, reducing the need for maintenance and the associated costs. They also benefit from regenerative braking systems that extend the life of brake pads.

Tesla's EVs exemplify these cost advantages. With no ICE, there is no need for oil changes or complex exhaust systems. Moreover, Tesla's over-the-air software updates provide enhancements and fixes, reducing the necessity for physical service appointments (Ravi & Aziz, 2022).

EVs, by virtue of their reduced emissions and reliance on cleaner energy sources, have a lower environmental impact than traditional vehicles. Tesla, as a company, places a strong emphasis on sustainability. In addition to producing EVs, Tesla manufactures energy storage products like the Powerwall and Powerpack and offers solar energy solutions. This holistic approach aligns with the broader goal of reducing the carbon footprint of both transportation and energy generation (Llopis-Albert et al., 2021).

The initial purchase price of EVs is often higher than that of traditional vehicles due to the cost of batteries and electric powertrain technology. However, this difference can be mitigated by government incentives, such as tax credits and rebates, offered to encourage EV adoption. Tesla buyers in the United States, for instance, are eligible for federal tax incentives that reduce the effective purchase price of their EVs (Liang et al., 2020).

Furthermore, the lower operating and maintenance costs of EVs can offset the higher upfront price over time. Reduced fuel costs, fewer maintenance visits, and potential savings on insurance premiums make EVs an economically attractive option in the long run.

EVs are primarily charged at home, where owners can use standard electrical outlets or dedicated home chargers. This convenience allows EV owners to start each day with a full charge, eliminating the need for frequent visits to gas stations. Tesla offers home charging solutions, such as the Tesla Wall Connector, which provide faster charging capabilities.

In addition to home charging, Tesla has developed a network of supercharger stations strategically located along highways and major travel routes. These fast-charging stations enable long-distance travel and reduce charging time, further enhancing the convenience of electric mobility (Liang et al., 2020).

In summary, a comprehensive comparison between traditional and electric vehicles reveals distinct advantages associated with electric mobility. EVs offer a cleaner and more environmentally friendly alternative, with reduced operating costs, impressive performance, and the potential for government incentives. Tesla, a pioneer in the EV market, exemplifies many of these advantages through its innovative electric powertrain technology and commitment to sustainability. As the automotive industry continues to evolve, the transition to electric mobility is poised to reshape the way we perceive and engage with transportation.

1.3 The Importance and Relevance of Electric Mobility for Consumers and Industries

Electric mobility is not only a technological evolution in the automotive sector but also a paradigm shift with profound implications for both consumers and industry business models (Fig. 1.1). This section elucidates the importance and relevance of electric mobility in the contemporary context, dissecting its transformative impact on a spectrum of consumer experiences and industrial domains (Secinaro et al., 2022).

In an era marked by growing environmental concerns, consumers are increasingly seeking eco-friendly alternatives in their daily lives. Electric mobility aligns perfectly with this shift in consumer values. The choice to drive an EV is considered a tangible commitment to reducing one's carbon footprint. This environmental consciousness resonates with consumers who aspire to live sustainably and mitigate their contribution to climate change. Electric mobility offers tangible economic advantages to consumers (Suman et al., 2020). Although the upfront cost of