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RESEARCH

Electric Vehicles' (EVs) Contribution to Sustainable Long-Term Investment for Public and Private Sectors: The Role of Value Co-Creation

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ABSTRACT

PURPOSE: This study aims to explore the viability of major economic benefits from timely investment and development of electric vehicles (EVs) across public and private sectors. It also examines how value co-creation can be seen as a strategy to overcome high initial capital costs, and discusses implications for adoption, profitability, and sustainability.

DESIGN/METHODOLOGY/APPROACH: This study adopts a systematic literature review (SLR) approach to synthesise information from 37 articles published between 2003 and 2024 across the fields of business management, public policy, and sustainable development. This analysis is supplemented by descriptive data established from institutional reports (IEA, WHO, etc.) with the statistical records of leading EV manufacturers.

FINDINGS: First, the paper elucidates how EV-targeted initiatives can realise robust returns on investment (ROI) through revenue stream diversification, market valuation increases, and conducive policy incentives. Second, it highlights how much the public sector could save in healthcare from cutbacks in vehicle emissions, as well as budgetary advantages from climate-friendly policies. Third, it shows how models of value co-creation, for instance shared R&D labs, battery leasing, and government-industry partnerships, can help overcome the high upfront costs of EV production and acquisition. Taken together, these findings demonstrate a synergy that there is a tight linkage between environmental gains and the bottom line.

ORIGINALITY: Related works have predominantly aimed to assess EV's environmental value proposition; this paper examines financial and strategic constituents. An analysis of how co-creation as a phenomenon could subdue the financial barrier is also presented. The study presents a wide-reaching argument of how EV development has influenced the public and private sectors, offering new perspectives and approaches to sustainable business.

KEYWORDS: *Electric Vehicle (EVs); Value Co-Creation; Sustainable Investment; Public Sector Profitability; Collaborative Innovation, Capital Costs*

INTRODUCTION

Background and Significance

Electric vehicles (EVs) are driving a revolution in global transportation, driven by several key factors: increasing fossil fuel costs, the introduction of government-led emission standards, and growing public concern over the climate crisis. This was true even in the midst of the COVID-19 pandemic, when overall vehicle sales declined by approximately 16%, indicating strong and somewhat defensive continuity of consumer interest in electric vehicles (IEA, 2021). EV market dynamism continues to reinforce the notion that the EV revolution is not simply a trend with a short shelf life, but a cornerstone of an ongoing paradigm shift in how mobility will be powered, governed, and financed (Figure 1).

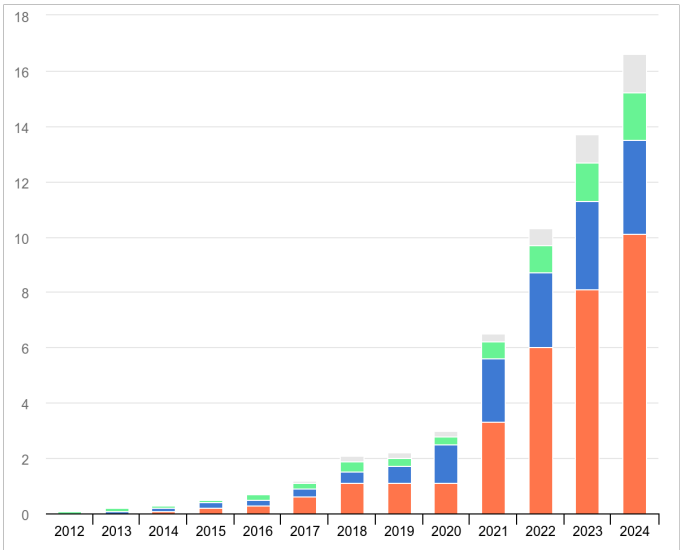

Figure 1: Statistical data of EV increasing adoption rate

Notes: Blue – North America; Red – Europe; Green – China; Orange – Rest of the World
Source: IEA, 2023a

From the business perspective, this change is closely linked with profit, ROI, and market growth. EV manufacturers, such as Tesla, BYD, NIO, and Rivian, have reached remarkable stock market valuations, with Tesla achieving a trillion dollar market. Meanwhile, big, legacy manufacturers like Volkswagen and General Motors have indicated the same aggressive turns towards EV production, allocating substantial capital and forming new partnerships. Governments worldwide also play a crucial role in underpinning this by spending billions on infrastructure and incentives, from tax credits to direct purchase subsidies (The White House, 2022).

Nevertheless, there are serious limitations of knowledge regarding how EV investments translate into sustainable and long-term returns, both financial and otherwise, over time for both private and public sectors. For the private sector, the fundamental questions are around how to reduce EV production's capital-intense nature, especially the expense of batteries, and how to maintain high market valuations over time. For the public sector, policy-makers face the challenge of balancing short-term fiscal trade-offs (e.g., tax breaks for EV buyers) and longer-term societal benefits (e.g., savings on healthcare spending, climate benefits).

Problem Statement

Although EVs have a clear environmental advantage and become increasingly more competitive in the car market through continued development, there are still barriers to their commercialisation, particularly high upfront costs: batteries account for around 40% of the total production cost

(Campagnol *et al.*, 2022). Large-scale deployment of charging stations requires collaborative investments that often require direct co-operation from the government, utility sector, and private sector (Kumar *et al.*, 2021). While EVs offer lower lifetime running costs than comparable internal combustion engine (ICE) vehicles, the financial equation quickly becomes complicated when consumers pay a premium for an electric vehicle.

Previous research either focuses on societal benefits (such as reduced greenhouse gas emissions) or the limited profit opportunities for automotive companies. Some research has succeeded in incorporating both perspectives into multi-stakeholder frameworks where co-operation between governments, manufacturers and end-users can achieve maximal reductions of the barriers. Here, "value co-creation" is a valuable conceptual framework. Co-creation, which has its origins in the marketing and innovation literature (Prahalad and Ramaswamy, 2004), calls for multiple actors to participate actively at all stages of the product life cycle, from R&D through financing to servicing.

Objectives and Research Questions

By examining how co-creative strategies enhance the return on investment for public-sector EV investments, this paper addresses critical knowledge gaps concerning both the long-term profit of EV investments as well as public-sector benefits of pollution reduction and reduced healthcare costs. The broad goals are:

1. show how EV investments translate to positive ROI for private actors from automobile makers to start-ups and infrastructure providers;
2. demonstrate the importance of using multiple touchpoints over time to paint the picture of how public-sector players (especially governments) will benefit in the long run in terms of a reduced healthcare burden and environmental benefits from the mass adoption of EVs;
3. explore the potential value co-creation, including partnerships among manufacturers, policy-makers, and consumers, to alleviate the problem of high capital costs;
4. offer a series of recommendations outlining the synergies between co-creative investment and sustainability and provide a roadmap for policy-makers and practitioners.

In doing so, the paper seeks to advance the conversation about how investments and policies driven by and linked to EVs can produce durable, mutually beneficial returns, cultivating not only profit, but also the public good.

LITERATURE REVIEW

Evolution of EV Markets and Profitability

Market Growth Drivers

A confluence of factors has combined to boost global EV uptake, such as increasing fuel costs and stricter emission regulations. The relative benefits of EVs compared to ICE vehicles are increasing with governments tightening emission standards and/or introducing carbon taxes (Li and Nam, 2022).

Concurrently, consumer sentiment has evolved, shaped at least in part by media coverage about climate change and by the documented health impacts of air pollution (Eccleston, 2007; Bennett *et al.*, 2016). On the finance side, attracting large investments has been a boon for EV makers. Tesla's revenue grew from US$21.46 billion in 2018 to US$81.46 billion in 2022 (Tesla Investor Relations, 2022b). Similar situations can also be seen with Rivian (partially owned by Amazon) who at one point had a valuation greater than US$100 billion in an initial public offering (Hussain and Klayman, 2021). This reflects strong investor confidence in the technology behind EVs, further supported by steady consumer interest; global sales of the vehicles nearly doubled between 2020 and 2021 (Figure 2), with forecasts expecting continued growth in the coming years (IEA, 2023b).

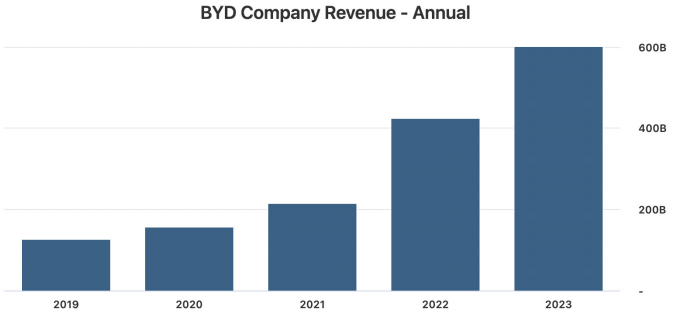

Figure 2: BYD Company Revenue - Annual

Source: Stock Analysis, 2024

Private Sector Profitability

The private sector's foray into EV manufacturing indicates the high ROI potential. In addition to selling vehicles directly, EV companies can also gain revenues in a variety of ways in the EV ecosystem, through battery leasing, through charging infrastructure and services. Since the capital

requirements for charging stations vary in the order of magnitude (in relatively lower range) with respect to automotive plants, niche manufacturers are not prevented from forming charging networks and establishing another source of revenue (Kumar *et al.*, 2021). Similarly, bundling solar, home energy storage, and EV ownership (together with future business lines that have yet to be developed) is a practice by which Tesla intends to increase factors of loyalty and aggregate profits (Tesla, 2022a).

This may lead to inflated development costs regarding the R&D associated with batteries; however, this is likely to fall with production scale, through economies of scale, state incentives, and the reduced mechanical components required in EVs (Schmuch *et al.*, 2018). It should also be noted that the marginal cost might become less in the long run after a manufacturer has achieved mass production of the EV batteries (Kapustin and Grushevenko, 2020).

Public Sector Benefits

Health Savings from Reduced Emissions

Studies have shown links between ICE vehicles and respiratory and cardiovascular diseases (Bell *et al.*, 2008; Gao *et al.*, 2018). Petrol powered vehicles are major sources of localised air pollution, emitting carbon monoxide, volatile organic compounds (VOCs), nitrogen oxides (NOx), and PM2.5. EVs, in contrast, eliminate all tailpipe emissions, significantly reducing these pollutants (Ghosh, 2020; Moro and Lonza, 2018). Li *et al.* (2016) conducted a scenario analysis in Taiwan and forecast that there would be significant reductions in CO (85%), VOCs (79%), NOx (27%), and PM2.5 by 2027.

Although the health benefits of EV adoption, such as reductions in pollution-related diseases, such as asthma and heart disease, may take time to manifest, the widespread uptake of EVs has the potential to lower healthcare costs (Ochieng *et al.*, 2024). Indeed, reducing public healthcare expenditure can also alleviate financial burdens on individual families. Public policies of this nature can strengthen a virtuous circle of improved well-being and sustainable economic activity (Murray, 2024), with the savings eventually reinvested back into additional infrastructure or social services.

Environmental Compliance and Climate Goals

With the structures of international climate agreements, such as the Paris agreements, the majority of nations have committed to ambitious Greenhouse Gas (GHG) reduction targets. As the transport sector contributes greatly to carbon emissions (Girod *et al.*, 2014), the transition to EVs represents one of the most tangible policy measures available. Electrified transportation networks offer a way for governments to forego the inefficiencies on costly international climate finance mechanism, to fulfil climate treaties, strengthen international legitimacy, and develop green industries.

Moreover, a few regions apply an elevated value-added tax to traditional automotive fuel or even fines to ICE vehicles as an incentive to increase EV adoption (Yanatma, 2023). Although this means losing revenue from fuel taxes, it opens the door to other revenue streams (such as the use of electricity to power charging stations); this would be a more sustainable revenue source in a decarbonised future. Put together, these factors highlight the economic and environmental reasoning at the root of public investment in EV technology.

Value Co-Creation: Conceptual Overview

Defining Co-Creation

The concept of value co-creation is rooted in service-dominant logic in marketing, and emphasises that value is not only derived by producers but also from interaction with consumers (Vargo *et al.*, 2008). Prahalad and Ramaswamy (2004) further expand this idea, suggesting that customers can be active participants at every stage of the product development process, from conception to design and continuous improvement. For instance, in the EV sector, co-creation can cover different kinds of interaction between manufacturers (such as joint research and development projects), governments (for example, the development of a policy framework), and consumers (for example, contributing to demand profiles or preferences on charging infrastructure).

Co-Creation in the EV Landscape

Co-Creation in the EV market serves to foster synergies, such as through leveraging others' capabilities to invest in the expensive market entry barriers. Indeed, consumer feedback, particularly related to concerns regarding range anxiety, charging duration, and cost concerns, helps companies tailor their product offerings, whether it be more energy-denser battery technology or flexible financing solutions (Sutarso *et al.*, 2019). The entry of new market players naturally opens a whole new field of co-creation opportunities, all of which could lead to far more robust, consumer-relevant EV ecosystems.

High Capital Costs: A Persistent Barrier

Efforts have not been sufficient to overcome one of the main stumbling blocks to EV adoption and infrastructure expansion; high capital requirements. Batteries alone make up a significant portion of the production cost (Schmuch *et al.*, 2018), and consequently, a significant portion of the retail price. The continuing fluctuations in prices of raw materials such as lithium, cobalt, and nickel (Campagnol *et al.*, 2022) exacerbate this issue. Co-creative strategies such as forming alliances to combine R&D capacity or to implement a battery-as-a-service (BaaS) financing scheme have been shown to be a useful tool to help companies overcome these challenges (Bhattacharya and Bhattacharya, 2022).

Literature Gaps and Paper's Contribution

Most EV research either addresses the environmental benefits or technological challenges in isolation, with fewer studies integrating financial and public health implications within a unified framework. Although several scholars stress collaborative innovation whereby users and producers interact, the concept of co-creation, particularly this notion's ability to systematically lower or redistribute capital costs, remains underexplored in the EV literature (Alves *et al.*, 2016; Ramaswamy and Ozcan, 2018). In this context, this paper offers a comprehensive view, proposing a multi-stakeholder, co-creative approach that enables sustainable growth and return on equity investments.

METHODOLOGY

To develop a comprehensive overview of relevant literature, a systematic literature review was conducted following Tranfield *et al.* (2003). The review covered academic databases, including Scopus, Web of Science, and ScienceDirect, as well as grey literature (i.e., government and other documents from the US, EU, and global organisations such as the IEA and WHO). Keywords such as "electric vehicles", "EV adoption", "value co-creation", "sustainable investment", "healthcare cost", and "return on investment" were combined with Boolean operators to narrow the search.

Peer-reviewed articles published between 2003 and 2024 were used to provide historical context and incorporate the latest research. Research related to financial analysis, public-sector implications and collaborative models for EV deployment were examined, and reports from recognised institutions (e.g., IEA, WHO) provided validated statistical data.

Although an SLR provides systematic coverage, several limitations need to be acknowledged. First, limiting the review to English language sources might omit relevant regional research. Second, new developments, especially after mid-2024, may not be fully reflected, given the rapidly changing nature of EV technology and policy. Finally, the secondary nature of this research precludes direct and real-time empirical validation, e.g., through vast surveys (e.g., such as those of Nielsen) or first-hand corporate data, that falls beyond the scope of this study.

FINDINGS AND DISCUSSION

Retail Return on Investment in the Private Sector

It is evident that there has been significant growth in both revenue and market capitalisation among the leading EV manufacturers (Tesla, Rivian, BYD, NIO) (Suntychová, 2021; Hussain and Klayman, 2021). Tesla, for example, transitioned from niche brand to mainstream automaker within a decade, and now has a greater market value than established automakers. Although the EV

sector's profitability depends in part on policy support, for example, US tax credits of as much as US$7,500 (Iacurci, 2024), demand has become more independent over time, indicating a maturing market instead of a speculative growth.

On a macro level, EVs are expected to capture a significant portion of the entire passenger vehicle market by the mid-2030s (Kapustin and Grushevenko, 2020). Venture investors, institutional funds, and corporate partners have made major investments to facilitate this expansion. There's competition as other producers get into the field, which could eventually lead to compression in margins. However, many industry analysts expect first-mover advantages and technological leadership, especially around battery manufacturing, to allow a subset of players to maintain strong ROI.

Beyond vehicle sales, charging infrastructure has proven to be a lucrative sub-sector. There are different types of business models ranging from pay-per-use to subscription-based charging that provide recurrent income streams (Kumar *et al.*, 2021). Increasing collaboration between automakers and electric utility companies, both of which create synergy that should pave the way in addressing this gap, exists between vehicle development and accessible charging infrastructure. As consumer demand for fast, convenient charging grows, companies that offer reliable infrastructure are well-positioned to establish a stable revenue stream.

In fact, higher-level services, including battery swapping, battery subscription, and integrated energy management (e.g., vehicle to grid, or V2G), illustrate how EV ownership experiences can reach much further than a one-off purchase (Ramaswamy and Ozcan, 2018). EV manufacturers and service providers can achieve profitability through sustained customer engagement, leveraging long-term relationships to enhance brand loyalty.

Public Sector Gains

Healthcare Savings of Great Magnitude

In the US context, estimates suggest average annual healthcare expenditures per household of US$7,000, accounting for approximately 13.6% of total consumption (Ochieng *et al.*, 2024). Air pollution caused by petrol or diesel ICE vehicles intensifies chronic diseases such as asthma and respiratory problems, especially in dense urban areas, pushing these costs even higher. Empirical studies have consistently shown that switching to EVs reduces greenhouse gas emissions and air pollutants that would otherwise lead to hospitalisation, medication expenditures, and loss of productivity in the workforce (Bell *et al.*, 2008; Gao *et al.*, 2018).

There is an even broader benefit to society: as public health improves; governmental entities can redirect resources they would have previously spent dealing with diseases caused by pollution and instead use the funds for things such as infrastructure, education, or further decarbonisation efforts (Murray, 2024).

Content-Based Alignment of Emission Targets and Fiscal Policies

As countries worldwide set targets for net-zero emissions by the end of the coming decades, electrifying transportation is a key strategy to help reach those goals (IEA, 2024). With EV-friendly policies, such as purchase subsidies, tax credits, or ZEV mandates, governments can speed progress towards these goals. Success in emissions' reduction enhances international reputation, nurtures technological creativity, and can future-proof local businesses against global climate regulation (Girod *et al.*, 2014).

A potential fiscal challenge for the public is the fall in fuel tax revenue as ICE vehicles become less common. However, alternative revenue sources such as taxes on electricity usage, carbon price mechanisms, and congestion fees for ICE vehicles, could be implemented. Such instruments may further incentivise the transition to clean mobility while covering any funding gaps and ensuring long-term fiscal sustainability (Caetano *et al.*, 2009).

Co-Creations as a Means of Addressing High Initial Capital Expenditure

Battery production is still the most capital-intensive part of EVs (Schmuch *et al.*, 2018). Collaborative research and development (R&D) programmes, many of which are funded in part by government grants and other sources, help offset these high costs by concentrating expertise and sharing financial risk. As an example in our introduction, the state government of Nevada provided tax breaks and infrastructure to help Tesla build its gigafactory there, drastically lowering Tesla's production overheads (Lecher, 2016).

Additionally, the battery-as-a-service model (BaaS) is becoming increasingly popular. Consumers can buy an EV but do not own the battery, instead leasing it monthly (Bhattacharya and Bhattacharya, 2022). This model functions as an instalment plan, reducing the financial burden when it comes to the initial purchase price when compared to an ICE vehicle. Manufacturers benefit from recurring revenue streams, and the model could receive government backing through targeted subsidies to promote equitable EV ownership.

Co-creation extends beyond R&D alliances; it is multi-stakeholder approaches that integrate public policy, business, and consumer engagement. EV demand can also be stimulated by way of government agencies providing incentives or lower parking fees to EV drivers. To adapt, companies modify offerings such as hybrid or short-range EVs, priced lower. In response, consumers have the power to shape future EV development by pointing out usability problems (e.g., charge times, battery range) that get incorporated into future refinements of the product (Sutarso *et al.*, 2019).

This tripartite collaboration is also evidenced in Europe, where car makers (including BMW, Ford, and Volkswagen) have come together to create a network of fast-charging stations. The initial success of these networks indicates that shared infrastructure can boost EV penetration

by alleviating "range anxiety" and de-risking capital expenditures since multiple sides share the burden. From a value-co-creation perspective, the synergy depicted in the figure demonstrates how open innovation approaches can generate mutually beneficial outcomes through co-alignment of private profit-seeking motives with public policy objectives (Ramaswamy and Ozcan, 2018).

IMPLICATIONS FOR PRACTICE AND RESEARCH

Merging the Many: Rather than separate incentives to purchase an EV, grants for research, subsidies for infrastructure, and public education campaigns, policy-makers would benefit from a comprehensive set of incentives. Having such a broad-based approach can address multiple bottlenecks at once.

Regulatory Clarity: Governments need to ensure long-term consistency in their policy, actionable commitments, including guaranteed tax credits or emissions standards, ensuring that EV manufacturers and investors can plan large projects without the risk of retroactive regulatory changes.

Healthcare-Oriented Budgeting: Given that EV adoption generates long-term healthcare savings, future budgets may very well tie such savings to EV-supportive programmes, establishing an explicit feedback loop between environmental activity and public finance.

Revenue Diversification: EV manufacturers are able to diversify their revenue model from vehicle sales only to charging equipment, maintenance, and energy storage services. This diversification mitigates risks as consumer loyalty is developed.

Value Chain Alliances: As collaboration deepens, other stakeholders in the value chain become potential partners in mergers and alliances. Integrating upstream and downstream partners across the EV value chain, from raw material suppliers to energy utilities, ensures a stable supply of critical components that could otherwise pose significant challenges. Such partnerships also foster shared learning, reduce development costs, and enhance product innovation.

Consumer Engagement: Leveraging consumer input (via online communities, pilot programmes, etc.) during product design can drive the development of EVs that better align with consumer interest, reducing adoption friction.

DIRECTIONS FOR FUTURE RESEARCH

Longitudinal Impact Studies: Impact studies that measure economic (e.g., fuel savings, maintenance) and health (e.g., fewer emissions) effects of large-scale EV adoption over 10+ year periods would be valuable for understanding cumulative benefits.

Comparative Policy Analysis: The power of cross-country analyses, e.g., comparing US states with stringent EV policies to those without, can help describe best practices while also helping elucidate how local context factors can change behaviours.

Integration with Behavioural Science: There is more work to be done to integrate insights from consumer psychology (e.g., risk aversion, social norms) with co-creation processes that might help illuminate new levers to building acceptance of EVs.

Equity and Access: Additional research may delve into the extent to which socio-economic divides can be bridged in the context of EV adoption, such that low-income neighbourhoods or rural geographies have equitable access to electrified mobility (Fluchs, 2019).

CONCLUSIONS

Electric vehicles are a powerful intersection of economic opportunity and environmental necessity. The private EV market has relatively more room to gain market share, whether through reselling for commercial use or capitalising on services such as charging infrastructure and battery leasing, allowing firms a clean ROI over time as the market matures and scale economies exert their effects.

Public agencies, for their part, enjoy cleaner air and less expensive health care and are more strongly aligned with international climate goals. By creating shared resources, knowledge, and time investments between a strategic coalition of stakeholders, value co-creation emerges as a key input for countering the high, long-standing capital costs of EV manufacture and deployment.

The existing literature on financial and social returns has been covered in detail by the systematic literature review conducted throughout this paper. Far from being a zero-sum game, the findings highlight how co-operative frameworks, whether R&D alliances, battery-as-a-service programmes, or otherwise, extend the ability to deliver vehicles at competitive prices but also prompt continuous innovation. Moreover, the public sector takes a proactive approach to creating a series of incentives for investments to the entire ecosystem, such as a stable policy environment, financial arrangements, and infrastructure.

Going forward, sustainable investment in EVs will likely hinge on four factors: government commitments, corporate partners, consumers, and battery and charger technology. When they do align, the benefits have the potential to impact the world economically, environmentally, and socially. Rather than a zero-sum game, the EV revolution, driven by co-creation, has the potential to create shared value in which profitability and the public good go hand-in-hand.

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