

Infrastructure and Investment Challenges in Accelerating the Adoption of Electric Vehicles as a Substitute for Fuel

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Abstract. *Accelerating the adoption of electric vehicles as a substitute for petroleum fuels (BBM) is a strategic step in supporting the energy transition and reducing greenhouse gas emissions. However, its implementation still faces various challenges, particularly in infrastructure and investment. This study aims to analyze the limitations of electric vehicle charging infrastructure, the challenges of investment and high initial costs, as well as the development prospects and strategies for accelerating adoption. The study results indicate that limited charging infrastructure is a major obstacle to increasing electric vehicle use. The uneven distribution of charging stations, especially outside urban areas, raises concerns among users regarding the availability of energy access. Furthermore, the relatively longer charging time compared to conventional fueling also affects the level of comfort and efficiency of using electric vehicles in daily activities. From an investment perspective, developing an electric vehicle ecosystem requires significant costs, including for the construction of charging infrastructure, increasing electricity grid capacity, and developing battery technology. The relatively high price of electric vehicles compared to fuel-based vehicles also hinders public adoption of this technology. Limited access to financing and high investment risks also affect investor interest in supporting the development of this sector. Nevertheless, the prospects for electric vehicle development remain promising. Advances in increasingly efficient and affordable battery technology, along with growing public awareness of environmental issues, are key driving factors. Strategies to accelerate adoption can be implemented through synergy between the government and the private sector, such as providing fiscal incentives, integrated infrastructure development, and innovation in technology and business models. Therefore, despite various challenges, electric vehicles have significant potential to be a solution to reduce dependence on fossil fuels and support sustainable development. Comprehensive and sustainable policies are needed to ensure the acceleration of electric vehicle adoption is effective and inclusive.*

Keywords: *Electric; Fuel; Infrastructure; Transition.*

1. Introduction

Accelerating the adoption of electric vehicles as a substitute for petroleum fuels is a strategic step in addressing the challenges of the global energy crisis and climate change. High dependence on petroleum not only puts pressure on the limited availability of fossil fuel resources but also contributes significantly to increased greenhouse gas emissions. In this context, electric vehicles present a more environmentally friendly and sustainable alternative solution. However, efforts to accelerate electric vehicle adoption are not without various obstacles, particularly those related to infrastructure readiness and the need for substantial investment.¹

One of the main challenges in the development of electric vehicles is the limited charging infrastructure. The limited and uneven availability of electric vehicle charging stations is a significant barrier to people switching from fuel-based vehicles. This situation raises concerns about charging accessibility, especially for long-distance travel or in areas lacking adequate supporting facilities. Furthermore, the relatively longer battery charging time compared to conventional fuel charging also impacts the comfort and efficiency of using electric vehicles in everyday life.²

On the other hand, investment challenges and high initial costs are also inhibiting factors in accelerating the adoption of electric vehicles. Developing an electric vehicle ecosystem requires significant investment, including the construction of charging infrastructure, strengthening the electricity grid, and developing battery technology. Furthermore, the relatively high price of electric vehicles compared to conventional vehicles hinders public purchasing power. Limited access to financing and high investment risks also make the private sector cautious in developing this industry.³

Despite these challenges, the prospects for electric vehicle development continue to show significant potential. Rapid technological advancements, particularly in battery efficiency and capacity, offer opportunities to lower production costs and increase the competitiveness of electric vehicles. Furthermore, growing global awareness of the importance of reducing carbon emissions, along with government policy support

¹Sudjoko, C. Strategi Pemanfaatan Kendaraan Listrik Berkelanjutan Sebagai Solusi untuk Mengurangi Emisi Karbon. *Jurnal Paradigma: Jurnal Multidisipliner Mahasiswa Pascasarjana Indonesia.*, 2021.

²Budi, S., & Lestari, R. Analisis Dampak Lingkungan dari Mobil Listrik dan Mobil Konvensional. *Jurnal Lingkungan dan Pembangunan*, 10(2), 2021, 75-88.

³Haryanto, T., & Lestari, Y. Perbandingan Emisi Karbon Mobil Listrik dan Mobil Bensin di Indonesia. *Jurnal Ilmu Lingkungan*, 11(1), 2021, 30-42.

through incentives and regulations, are key drivers in accelerating electric vehicle adoption. Therefore, an integrated and collaborative strategy between the government, the private sector, and the public is needed to overcome existing obstacles and achieve a sustainable energy transition.⁴

2. Research Method

Qualitative research is descriptive and analytical in nature. Descriptive in qualitative research means describing and explaining the events, phenomena, and social situations being studied.⁵

3. Results and Discussion

3.1. Limitations of Electric Vehicle Charging Infrastructure

The limited availability of electric vehicle charging infrastructure is a major challenge in accelerating the adoption of electric vehicles in various countries, including developing ones. Charging infrastructure, or charging stations, plays a crucial role in supporting electric vehicle operations, as without adequate access to energy sources, electric vehicles cannot be used optimally. Although electric vehicle technology continues to advance rapidly, the uneven availability of charging infrastructure is a significant obstacle in encouraging people to switch from fuel-powered vehicles to electric vehicles.

One major issue is the distribution of charging stations, which is still concentrated in urban areas. In large cities, the presence of charging stations is increasing with government support and investment from the private sector. However, in rural and suburban areas, the availability of these facilities remains very limited. This uneven distribution creates uncertainty for electric vehicle users, especially those who frequently travel long distances or across regions. This condition creates a phenomenon known as range anxiety, which is the fear that users will run out of power before reaching the next charging point.⁶

⁴Rahman, A., Sari, R., & Wibowo, S. Insentif Pemerintah dan Pengembangan Infrastruktur untuk Mobil Listrik di Indonesia. *Jurnal Kebijakan Energi*, 15(3), 2022, 201215.

⁵Lexi J Moleong, *Metodologi Penelitian Kualitatif*, Bandung : Remaja Rosda Karya.

⁶Zainal Ibad, M., Nabilla Antiqasari, S., Hudalah, D., & Dirgahayani, P. Transisi Energi terbarukan di Indonesia: Dinamika Kendaraan Listrik Dengan pendekatan self-organization di kota Jakarta. *Jurnal Teknik Sipil*, 29(2), 2022, 161–170. <https://doi.org/10.5614/jts.2022.29.2.7>

In addition to uneven distribution, the number of available charging stations is still not commensurate with the potential growth in the number of electric vehicles. As public interest in electric vehicles increases, the need for charging infrastructure will also increase significantly. However, if infrastructure growth cannot keep pace with the growing number of vehicles, long queues at charging stations will occur, ultimately reducing user convenience. This could be a barrier to increasing public trust in electric vehicles.

Another limitation relates to the type and capacity of available charging stations. Not all charging stations offer fast charging capabilities, which allow for rapid battery charging. Many still use slow charging technology, which takes hours to fully charge the battery. This situation presents a challenge for users who seek time efficiency in their daily activities. Therefore, the development of fast charging technology is crucial to support the adoption of electric vehicles.

Beyond technical aspects, the limitations of charging infrastructure are also closely related to the readiness of the electricity grid. Large-scale development of charging stations requires a stable electricity supply and adequate network capacity. In some areas, particularly those with underdeveloped electricity infrastructure, increased electricity demand due to electric vehicle use can pose a risk of supply disruptions. Therefore, strengthening the electricity grid is an integral part of developing electric vehicle infrastructure.

Another equally important issue is the standardization of charging technology. Currently, various types of connectors and charging systems are used by different electric vehicle manufacturers. The lack of uniform standards can make it difficult for users to access specific charging stations, thus reducing the flexibility of electric vehicle use. Standardization is a crucial step to ensure interoperability between different types of vehicles and charging infrastructure.

From an investment perspective, developing electric vehicle charging infrastructure requires significant costs. Building a single charging station, especially one with fast charging capacity, requires significant investment, including installation costs, equipment, and connection to the electricity grid. Furthermore, operational and maintenance costs must also be factored in. These high costs are one reason why

charging infrastructure development has been relatively slow, especially in countries with limited financial resources.⁷

Besides costs, the level of infrastructure utilization is also a consideration for investors. In the early stages of electric vehicle adoption, the number of users is still relatively small, resulting in suboptimal charging station utilization. This results in a longer payback period, ultimately discouraging investors from developing this infrastructure. Therefore, government incentive policies are needed to attract investment in this sector.

Limited land is also a challenge in building charging stations, especially in dense urban areas. Providing space for charging stations requires careful spatial planning to avoid disrupting other land uses. Furthermore, integration with public facilities such as shopping centers, offices, and parking areas is crucial to improve accessibility and user comfort.

In a policy context, coordination between government agencies is also a factor influencing the development of charging infrastructure. Unintegrated planning can lead to a mismatch between infrastructure development and on-the-ground needs. Therefore, synergy between the central government, regional governments, and the private sector is needed to design and implement supportive policies.

Public education and awareness also play a crucial role in supporting the development of electric vehicle charging infrastructure. Many people still don't understand how to use charging stations or the overall benefits of electric vehicles. This lack of information can hinder electric vehicle adoption, even when the infrastructure is in place. Therefore, ongoing education campaigns are essential.

On the other hand, technological advancements offer hope for overcoming the limitations of charging infrastructure. Innovations such as wireless charging and battery swapping systems can offer more flexible alternative solutions. These

⁷Seddig, K., Jochem, P., & Fichtner, W. Integrating renewable energy sources by electric vehicle fleets under uncertainty. *Energy*, 141, 2017, 2145-2153.

technologies allow for recharging without relying entirely on conventional charging stations.⁸

Furthermore, the concept of home charging is also a potential solution, especially for private electric vehicle users. By installing a charging device at home, users won't need to rely on public charging stations. However, implementing this solution still requires support from an adequate electricity network and clear regulations.

Charging infrastructure development can also be combined with renewable energy sources, such as solar panels. This approach not only reduces the burden on the electricity grid but also improves the sustainability of the overall energy system. Integrating electric vehicles and renewable energy is a crucial step in creating a clean and efficient energy ecosystem.

In the long term, the limitations of electric vehicle charging infrastructure can be addressed through careful planning and sustained investment. The government has a crucial role to play in providing regulations, incentives, and policy support that encourage the development of this infrastructure. Meanwhile, the private sector can contribute through innovation and investment in charging technology.

Collaboration between various parties is key to overcoming this challenge. Collaboration between government, industry, and the public can accelerate the development of adequate and integrated charging infrastructure. With a comprehensive approach, infrastructure limitations will no longer be a major barrier to electric vehicle adoption.

Overall, the limited availability of electric vehicle charging infrastructure is a complex but manageable challenge. With the right policy support, adequate investment, and technological innovation, charging infrastructure could expand significantly in the coming years. This will pave the way for accelerated adoption of electric vehicles as a more environmentally friendly and sustainable transportation solution.⁹

⁸Adiatma, J. C., & Marciano, I. *The Role of Electric Vehicles in Decarbonizing Indonesia's Road Transport Sector*. Institute for Essential Service Reform, 2020.

⁹Sihombing, Gunawan. "Transformator Energi, Potensi Dan Pengujian Model Energi." *Jurnal Syntax Transformation*, No. 9 (2020): 612–18. <https://doi.org/10.46799/jst.v1i9.150>.

3.2. Investment Challenges and High Initial Costs

Investment challenges and high initial costs are among the main obstacles to accelerating the adoption of electric vehicles as a fuel substitute. While electric vehicles offer various long-term benefits, such as higher energy efficiency and lower operating costs, the reality on the ground shows that high initial costs remain a major barrier for both consumers and investors. This creates a gap between the potential benefits of electric vehicles and the still-limited adoption rate in many countries.

One of the main factors contributing to the high initial cost of electric vehicles is the price of the battery. The battery is the most expensive component in an electric vehicle, accounting for a significant portion of the total production cost. Battery technology, which is still evolving, requires significant investment in research and development, so production costs have not been significantly reduced. Although battery prices have decreased in recent years, they remain relatively high compared to conventional vehicle components.¹⁰

In addition to battery costs, the still-limited scale of electric vehicle production also contributes to high selling prices. Unlike fossil-fueled vehicles, which have been mass-produced for decades, electric vehicle production is still in the development stage and has not yet reached optimal economies of scale. This results in high per-unit production costs, which ultimately impacts the selling price to consumers.

On the consumer side, the higher price of electric vehicles compared to conventional vehicles is a major barrier to purchase decisions. Despite lower operating costs for electric vehicles, such as fuel and maintenance, many consumers prioritize the initial cost over the long-term benefits. This situation indicates a perception gap that needs to be addressed through education and appropriate policies.

Furthermore, limited access to financing also poses a challenge to electric vehicle adoption. Not all consumers have the means to purchase an electric vehicle outright, while available financing schemes often don't fully support electric vehicle purchases. High interest rates, limited loan terms, and the uncertainty of the residual value of

¹⁰Suprobowati, Gayatri Dyah, Georgia Monica Candra Apriliana, and Wulandari Putri Hutami. "Indonesian Electric Vehicle Policy, Realization and Development." *Proceedings of the International Conference For Democracy and National Resilience (ICDNR 2021)* <https://doi.org/10.2991/assehr.k.211221.018>.

electric vehicles are factors that influence financial institutions' interest in providing financing.

From an investor perspective, developing an electric vehicle ecosystem requires significant investment. This investment includes the construction of charging infrastructure, electricity grid development, and technology research and development. This high capital requirement often presents a barrier to investment, particularly in developing countries with limited financial resources.

Besides the significant investment requirements, the high level of risk is also a significant consideration for investors. The electric vehicle industry still faces uncertainties related to technological developments, regulations, and market adoption rates. This uncertainty makes investors cautious about investing, thus slowing the development of the electric vehicle ecosystem.

Another investment challenge is the long payback period. Investments in electric vehicle infrastructure, such as charging stations, take a significant amount of time to reach break-even. This is due to the limited number of electric vehicle users, resulting in suboptimal infrastructure utilization. This situation means investors must wait longer to realize profits.¹¹

Furthermore, a lack of government incentives can also be a barrier to attracting investment. Fiscal incentives, such as subsidies, tax breaks, or financing support, are crucial for reducing initial costs and increasing investment attractiveness. Without adequate support, electric vehicle development will be slower.

On the other hand, inconsistent or changing policies can also increase investment risks. Investors require regulatory certainty to plan long-term investments. Policy uncertainty can undermine investor confidence and hinder capital flows into the electric vehicle sector.

Despite the challenges, several factors can support cost reductions and increased investment in the future. One such factor is the continued advancement of battery

¹¹Umar, Ehsan Javanmardi dan Mahmudul Hoque dan Abdul Tauheed dan Muhammad. "Evaluating the Factors Affecting Electric Vehicles Adoption Considering the Sustainable Development Level." *World Electr. Veh. J* 14, no. 5 (2023). <https://doi.org/10.3390/wevj14050120>.

technology. Innovations in battery materials and production processes are expected to significantly lower costs, making electric vehicles more affordable.

Furthermore, increasing production scale can also help reduce costs. As demand increases, electric vehicle manufacturers can achieve greater economies of scale, thereby lowering per-unit production costs. This will result in lower selling prices and increase the competitiveness of electric vehicles.

The government plays a crucial role in addressing investment and initial cost challenges. Through appropriate policies, the government can create a conducive environment for electric vehicle development. Fiscal incentives, supportive regulations, and investment in infrastructure are crucial steps in accelerating electric vehicle adoption.

Furthermore, collaboration between the public and private sectors can also be a solution to overcome investment constraints. Public-private partnership models can be used to share investment risks and costs, thereby accelerating infrastructure development and technology advancement.¹²

The development of new business models can also help reduce the initial cost burden on consumers. For example, battery leasing schemes allow consumers to purchase vehicles without having to bear the high cost of batteries. This model can increase the affordability of electric vehicles and accelerate their adoption.

On the other hand, growing public awareness of environmental issues can also drive demand for electric vehicles. Higher demand will attract more investment and accelerate industrial development. This creates a positive cycle that can help overcome cost and investment challenges.

In the long term, the transition to electric vehicles will not only offer environmental benefits but also significant economic opportunities. Developing the electric vehicle industry can create new jobs, boost technological innovation, and strengthen national economic competitiveness.

¹²Wirabrata, Achmad. "Percepatan Program Kendaraan Bermotor Listrik Di Indonesia." *Kajian Singkat Terhadap Isu Aktual Dan Strategis Percepatan Program Kendaraan Bermotor Listrik Di Indonesia XI (2019): 1–6.* <https://www.iea.org/gevo2019/>.

However, the success of this transformation depends heavily on the ability of various parties to overcome investment and initial cost challenges. A comprehensive and integrated approach is needed to ensure electric vehicles are accessible to the wider community.

Overall, investment challenges and high initial costs are significant barriers to accelerating the adoption of electric vehicles. However, with appropriate policy support, technological innovation, and collaboration between various parties, these challenges can be overcome. Therefore, electric vehicles have significant potential to become a key solution for creating a sustainable and environmentally friendly transportation system in the future.¹³

3.3. Development Prospects and Strategies to Accelerate Adoption

The prospects for developing electric vehicles as a substitute for petroleum fuels are increasingly positive, as global attention to climate change, the energy crisis, and environmental sustainability grows. Electric vehicles are seen as a strategic solution to reduce greenhouse gas emissions while simultaneously reducing dependence on increasingly limited fossil fuels. In recent years, technological advances, government policies, and changing consumer preferences have accelerated the adoption of electric vehicles in various countries. However, to ensure an effective and equitable transition, a comprehensive and integrated strategy is needed.

One of the main factors supporting the prospects for electric vehicle development is advances in battery technology. Batteries are a key component in electric vehicles, and innovations in this technology have resulted in increased energy storage capacity, efficiency, and reduced production costs. Advances in lithium-ion battery technology, along with research into next-generation batteries such as solid-state batteries, offer hope that electric vehicles will become more affordable and have a

¹³Zola, Gianfranco, Siska Dwi Nugraheni, Andhien Atta Rosiana, Dzamar Ananto Pambudy, Nainta Agustanta, Departemen Administrasi Publik, and Universitas Negeri Yogyakarta. "Inovasi Kendaraan Listrik Sebagai Upaya Meningkatkan Kelestarian Lingkungan Dan Mendorong Pertumbuhan Ekonomi Hijau Di Indonesia." *Jurnal Ekonomi Sumberdaya Dan Lingkungan*, No. 3 (2023): 159–70. <https://online-journal.unja.ac.id/JSEL/article/view/30229>.

longer range. This directly increases the attractiveness of electric vehicles to consumers.¹⁴

Furthermore, growing public awareness of the negative impacts of fossil fuel use on the environment is also a key driver of electric vehicle adoption. Air pollution, climate change, and the health impacts caused by conventional vehicle emissions have prompted people to seek more environmentally friendly alternatives. In this context, electric vehicles are becoming an increasingly relevant and desirable option, especially among the younger generation who are highly concerned about sustainability issues.

The government's role in supporting the development of electric vehicles is also significant. Many countries have implemented various policies to encourage electric vehicle adoption, such as subsidies, tax incentives, and regulations limiting the use of fossil-fueled vehicles. These policies aim not only to increase the attractiveness of electric vehicles but also to create an ecosystem that supports the growth of the electric vehicle industry as a whole.

In the context of the strategy to accelerate adoption, developing charging infrastructure is a top priority. Widespread and accessible charging stations are key factors in increasing public trust in electric vehicles. Therefore, the government and the private sector need to collaborate to expand the charging network, both in urban and rural areas. Furthermore, integrating charging infrastructure with public facilities such as shopping centers, offices, and parking areas can improve user convenience.

Another strategy that can be implemented is the development of faster and more efficient charging systems. Fast and ultra-fast charging technologies allow for faster battery charging, bringing the experience of refueling closer to conventional fueling. Innovations such as battery swapping can also be an alternative solution, particularly for two-wheeled vehicles and public transportation.¹⁵

¹⁴Veza I, Abas MA, Djamari DW, Tamaldin N, Endrasari F, Budiman BA, Idris M, Opia AC, Juangsa FB, Aziz M. (2022). Electric Vehicles in Malaysia and Indonesia: Opportunities and Challenges. *Energies*. [Online]. 15(7). <https://doi.org/10.3390/en15072564>

¹⁵Maghfiroh, M.F.N.; Pandyaswargo, A.H.; Onoda, H. Current Readiness Status of Electric Vehicles in Indonesia: Multi Stakeholder Perceptions. *Sustainability*. [Online]. 2021, 13(23). available: <https://doi.org/10.3390/su132313177>.

From an economic perspective, reducing the cost of electric vehicles is a crucial factor in accelerating adoption. Achieving this requires increasing production scale and efficiency in the supply chain. The government can encourage investment in the electric vehicle industry through supportive policies, such as the development of dedicated industrial zones, incentives for manufacturers, and support for research and development.

Innovative financing strategies can also help increase the affordability of electric vehicles. Flexible financing schemes, such as low-interest loans, leasing, or subscription-based models, can make it easier for people to own an electric vehicle. Business models like battery leasing can also reduce the initial cost burden for consumers.

The public transportation sector plays a crucial role in accelerating adoption. Electrifying public transportation, such as buses, taxis, and government operational vehicles, can be an effective first step in introducing electric vehicles to the public. Furthermore, the use of electric vehicles in public transportation can significantly reduce emissions in urban areas.

Public education and outreach are also crucial strategies. Many people still have negative perceptions or lack information about electric vehicles, such as concerns about battery life, maintenance costs, or infrastructure availability. Therefore, a comprehensive educational campaign is needed to increase public understanding and trust.

Advances in digital technology can also accelerate the adoption of electric vehicles. Digital-based applications can help users locate charging stations, monitor charging status, and manage energy consumption. Integrating electric vehicles and digital technology can improve efficiency and user convenience.¹⁶

In the long term, integrating electric vehicles with renewable energy presents a very promising prospect. Using renewable energy sources like solar and wind to charge electric vehicle batteries can reduce dependence on fossil fuels and improve the

¹⁶Li, W.; Long, R.; Chen, H.; Chen, F.; Zheng, X.; Yang, M. Effect of Policy Incentives on the Uptake of Electric Vehicles in China. *Sustainability*. [Online]. 11, 2019, 3323. Available: DOI:10.3390/su11123323

sustainability of the energy system. This concept also supports the development of a more efficient and flexible smart grid.

Beyond environmental benefits, the development of electric vehicles also presents significant economic opportunities. The electric vehicle industry can create new jobs in various sectors, such as manufacturing, technology, and services. Furthermore, the development of this industry can also increase the competitiveness of the national economy in the global market.

However, realizing these prospects requires effective coordination between various stakeholders. The government, private sector, academia, and the public need to work together to design and implement effective strategies. An integrated approach will ensure that every aspect, from infrastructure to regulations, operates synergistically.

Existing challenges, such as limited infrastructure and high initial costs, cannot be overcome instantly. Therefore, the strategies implemented must be long-term and sustainable. Regular evaluation and adjustment of policies are also necessary to ensure that the strategies remain relevant to technological developments and market conditions.

Globally, cooperation between countries can also accelerate the development of electric vehicles. Technology exchange, cross-border investment, and harmonization of standards can help create a more efficient and integrated electric vehicle ecosystem. This can also accelerate the adoption of electric vehicles in developing countries.

The role of innovation in accelerating electric vehicle adoption cannot be ignored. Technology companies and startups have significant potential to introduce new solutions that can address various challenges. Supporting innovation, both through funding and policy, will accelerate the development of the electric vehicle industry.

Furthermore, it is crucial to ensure that the transition to electric vehicles is inclusive. Implemented policies must consider access for all levels of society, including low-income groups. Without an inclusive approach, this transition risks creating greater social disparities.

Overall, the prospects for electric vehicle development are very promising, but require a comprehensive and integrated acceleration strategy. With technological support, appropriate policies, and active participation from various stakeholders, electric vehicles can be a key solution to reducing dependence on fossil fuels and creating a sustainable transportation system.

Thus, accelerating the adoption of electric vehicles is not just a technological change, but a comprehensive transformation of the energy and transportation system. If managed well, this transformation will provide broad environmental, economic, and social benefits, and will be a crucial step toward a cleaner and more sustainable future.¹⁷

4. Conclusion

Accelerating the adoption of electric vehicles as a substitute for fossil fuels (BBM) is a strategic step in supporting the energy transition towards a more sustainable and environmentally friendly system. Based on the previous discussion, it can be concluded that although electric vehicles have significant potential to reduce dependence on fossil fuels and reduce greenhouse gas emissions, their implementation still faces significant challenges, particularly in infrastructure and investment. Limited electric vehicle charging infrastructure is a major obstacle to increasing adoption rates in the community. The uneven availability of charging stations, especially in non-urban areas, raises concerns regarding the accessibility and reliability of electric vehicles. Furthermore, the relatively longer battery charging time compared to conventional fuel charging also affects user comfort levels. Without adequate and integrated infrastructure support, efforts to accelerate electric vehicle adoption will struggle to achieve optimal results. Furthermore, investment challenges and high initial costs are also significant inhibiting factors. Developing an electric vehicle ecosystem requires significant investment, including the construction of charging infrastructure, increasing electricity grid capacity, and developing battery technology. Furthermore, the relatively high price of electric vehicles compared to fuel-based vehicles hinders public purchasing power. Limited access to financing and high investment risks also impact the private sector's interest in actively participating in the development of this industry. Nevertheless, the

¹⁷D. A. Asfani et al. Electric Vehicle Research in Indonesia: A Road map, Road tests, and Research Challenges. *IEEE Electrification Magazine*. [Online]. 8 (2), 2020, p. 44–51. Available: DOI:10.1109/MELE.2020.2985485

prospects for electric vehicle development remain positive. Technological advances, particularly in battery efficiency and production costs, provide opportunities to lower the price of electric vehicles in the future. Furthermore, increasing public awareness of environmental issues and government policy support through fiscal incentives, regulations, and infrastructure development are key drivers in accelerating the adoption of electric vehicles. An integrated and collaborative strategy between the government, the private sector, and the public is essential to overcome the various obstacles. Therefore, the success of accelerating the adoption of electric vehicles as a substitute for fossil fuels depends heavily on the ability of various parties to effectively manage infrastructure and investment challenges. Through appropriate policies, technological support, and cross-sector synergy, electric vehicles have significant potential to become a key solution for realizing a sustainable, efficient, and low-emission transportation system in the future.

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