Research Article

Public Economy Analysis in Electricity-based Transportation in Jakarta: Dilemmas and Costs

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Abstract.

Transportation is of the major component when it comes to city's economy. In Jakarta, the dense and fast-growing Indonesian capital, fossil-fuel-based motor vehicles account for most of the greenhouse gas emissions and air pollution. Therefore, implementing electricity-based transportation has become very relevant and important for Jakarta to create a more sustainable environment. The main objective of this research is to conduct a public economic analysis of the development and operation of electricity-based transport in Jakarta, focusing on the dilemmas and related costs. The research uses qualitative approaches, combining document analysis, interviews with related stakeholder documents, and economic models to calculate the related costs and benefits. The results show that despite the high initial costs associated with infrastructure and vehicle acquisition, electricity-based transport has the potential to generate significant long-term economic, environmental, and social benefits. The result can provide important insights for policymakers on the economic implications of the development of electricity-based transportation in Jakarta. To obtain such benefits, significant initial investments, strong policy support, and collaboration between the public and private sectors are needed.

Keywords: public economy, context and electricity-based transportation, interests

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1. Introduction

In the context of Jakarta, a megacity grappling with high levels of air pollution and traffic congestion, conducting a public economic analysis of the development and operation of electricity-based transport is crucial. Despite the growing recognition of the urgent need to mitigate environmental degradation, prior research has often overlooked the nuanced challenges and associated costs of transitioning to greener transportation alternatives. By addressing the limitations of previous research, this study aims to shed light on the complexities involved in adopting electric-based transport solutions and to uncover novel insights that can inform policy and decision-making.

Transportation stands as a cornerstone of modern economies and societies, facilitating the movement of people and goods globally. Nevertheless, the conventional modes

of transportation, particularly fossil-fuel motor vehicles, have significantly contributed to environmental degradation, exacerbating climate change through the emission of greenhouse gases [1]. This underscores the imperative for transitioning towards more sustainable alternatives.

In response to these pressing concerns, electric-based transportation has emerged as a promising avenue for reducing carbon emissions and mitigating the adverse effects of air pollution. The evolution of technology has rendered electric vehicles (EVs) increasingly viable, offering extended mileage, reduced operational expenses, and diminished environmental footprints compared to their conventional counterparts.

However, the transition to electric transportation is fraught with multifaceted challenges, ranging from infrastructural development, such as the establishment of charging stations, to socio-economic barriers. These challenges necessitate a comprehensive understanding of the intricacies involved, encompassing both the potential benefits and the obstacles encountered in the adoption process. By elucidating these dynamics, this study aims to facilitate the formulation and implementation of effective strategies aimed at expediting the transition to greener and more sustainable modes of transport, thereby contributing to the broader agenda of environmental sustainability and urban resilience.

2. Methods

This research uses a content analysis method. The purpose of using the content analysis method in this research is to understand the perceptions of the people of Jakarta towards the use of electricity-based transportation, analyze the economic implications of adopting this technology, identify the challenges faced, present the findings systematically, and provide a basis for formulating more effective policy recommendations in supporting development of electricity-based transportation in Jakarta.

3. Library Review: Public Economy Context and Electricity-Based Transportation Interests

Transportation is an important component of the economy of any city. In the Jakarta context, electricity-based transport is an important step towards addressing air pollution and traffic density. Increased urbanization and economic growth have led to increased demand for transport [2]. The use of conventional motor vehicles based on petrol or diesel contributes to most of the greenhouse gas (GHG) emissions in Jakarta. Therefore,

the development of electricity-based transport is important in the context of the public economy, as it can help reduce the burden related to public health, reduce carbon emissions, and improve energy efficiency [3].

Economic barriers to the development of electricity-based transportation Although the growth of electric transportation has great potential to address these problems, there are some economic barriers that need to be overcome. High initial costs for charging infrastructure and electric vehicles are a major obstacle to the development of electricity-based transportation [4]. Moreover, adequate electricity availability and competitive electricity prices are also important factors that influence the growth of electrical transportation [5].

Public policy plays an important role in overcoming such economic barriers. Tax incentives, subsidies, and support for charging infrastructure are examples of public policies that can accelerate the development of electricity-based transportation [6]. Moreover, collaboration between the public and private sectors is also vital for the growth of electrical transport [7].

4. Dilemma Analysis: Early Investment

The replacement of conventional transport infrastructure with an electricity-based solution is a significant financial challenge. One of the biggest obstacles in this transition is the initial costs associated with the construction of the necessary infrastructure. As with new technologies, the initial cost of products and services associated with electric vehicles tends to be more expensive than existing conventional solutions. This applies to the purchase of electric vehicles, the construction of fast charging stations, as well as other supporting technologies such as energy management systems.

In Table 1, the direct cost difference between internal combustion vehicles and electric vehicles in 2020 and 2030 is 45% and 9% more expensive than electric vehicles [8].

Electric charging stations, for example, are not just “gasoline pumps” for electric vehicles. It is a center of advanced technology that requires specialized hardware and software, as well as integration with the power grid. The investment also involves labour training, changes in local regulations and policies, as well as adaptation to evolving technologies.

However, despite the huge costs ahead, these investments have the potential to deliver a positive ROI (Return on Investment) in the long term. Over time, the operating costs of electric vehicles tend to be lower than those of fossil fuel vehicles, mainly due to better energy efficiency and lower maintenance costs [9]. Moreover, with increased

Table 1: Comparison of costs of BBM vehicles versus electric vehicles (Ribu Euro).

Fees Type	2020		2030	
	BBM Vehicle	Electric vehicles	BBM Vehicle	Electric Vehicles
Assembly	1,6	1,5	1,6	1,3
Chassis	1,2	1,3	1,2	1,2
Eksterior	1,7	2,1	1,8	1,8
E/E	1,8	2,0	1,9	2,0
Interior	2,7	2,7	2,9	3,0
Power Train	2,0	0,7	2,1	0,6
Mesin/Aux	3,0	-	3,1	-
E-Drive	-	2,0	-	1,8
Baterai	-	8,0	-	4,3
Total	14,0	20,3	14,6	16,0

Source: Oliver Wyman FAST 2030 proprietary model, Bank of America, IEA Global EV Outlook, expert interviews, Oliver Wyman Research [8]

adoption of EVs, it is expected that there will be economies of scale that will lower the cost per unit of infrastructure and vehicle [10].

Thus, although it seemed expensive at first, investments in electric transport should be seen as a strategic step towards creating a more sustainable, economical, and environmentally friendly transport future.

5. Environmental Impact Analysis

Early analysis related to transportation; its environmental impact is often the focus of attention. Since the industrial revolution, motor vehicles powered by fossil fuels have been a major source of air pollution [11], with emissions that include carbon dioxide, fine particles, nitrogen oxides, and more. These emissions not only damage the environment, but also have direct effects on human health [12].

Electric vehicles (EVs) offer solutions that potentially change this scenario. With zero exhaust emissions, EVs can significantly reduce greenhouse gas emissions. Greenhouse gases like carbon dioxide are responsible for the effects of global warming, which causes climate change. Through the adoption of EVs, Indonesia is on the right track to reduce its carbon footprint and help prevent global overheating.

More than that, reducing air pollution from vehicles also means reducing contaminants that can damage human health. Fine particles and other pollutants from fossil fuel vehicles have been linked to a range of health problems, ranging from respiratory

disorders, heart disease, to decreased life expectancy. By reducing these emissions, the public not only saves the environment but also reduces the burden on the public health system. This means lower health costs, improved quality of life, and healthier longevity for the population.

In a broader context, electric vehicles also encourage the adoption of renewable energy. Along with the growth of the EV market, there is an increasing impetus to ensure that the electric resources that charge these vehicles come from sustainable and environmentally friendly sources, such as solar and wind energy. This adds environmental benefits from the transition to electric transport.

In short, by understanding the significant environmental impact of electricity-based transport, we can see a bigger picture of how this technology can help us have a more sustainable and healthy future for future generations.

6. Fossil Energy Dependency Analysis

Electric vehicles (EVs) have been praised as one of the most promising solutions to addressing emissions and climate change. However, the sustainability of such vehicles depends not only on zero emissions during operation, but also on how the electricity that drives them is generated.

Many countries today still rely on fossil-fuel power plants, such as coal or natural gas, as their primary energy source. Therefore, electric vehicles powered by electricity from fossil fuel plants may only shift emissions from vehicle tails to plant smoke tanks. In this scenario, we're just shifting the problem, not really solving it.

It highlights the importance of integrating electricity transportation with the development of renewable energy infrastructure. Solar, wind, water, and geothermal energy are some examples of energy sources that can generate electricity without emissions. When electric vehicles are combined with renewable energy, their potential to reduce greenhouse gas emissions is maximized.

In addition, the transition to renewable energy has additional benefits: it can reduce countries' dependence on oil imports, improve energy resilience, and support job creation in the clean energy sector.

In conclusion, although electric vehicles play a critical role in efforts to reduce emissions, the role of energy sources in the vehicle's life cycle should not be ignored. An integrated strategy that supports the development of EVs along with the adoption of renewable energy will provide truly sustainable solutions to current and future environmental challenges.

7. Economics Scale Analysis

The basic economic principle teaches that when the production of a commodity increases, the average cost per unit often decreases. This is known as economics of scale. In the context of electric vehicles (EVs), this has very important implications for its adoption and long-term affordability.

As EV popularity grows and production increases, the industry will begin to see efficiency in various aspects of production. Raw materials, like lithium for batteries, will be purchased in larger quantities, which can negotiate a lower price per unit. Manufacturing processes will be optimized, reducing production costs. Research and development that focuses on EV technology will also benefit from greater investment, resulting in faster innovation and increased efficiency.

In addition, supporting infrastructure, such as charging stations, will also benefit from economies of scale. As more stations are built, technology and construction methods will become more efficient, reducing capital and operational costs per station.

However, economics of scale did not only benefit producers. Consumers will also benefit from lower prices for electric vehicles. As a result of lower production costs, electric vehicle sales prices will be more competitive than conventional vehicles. This, in turn, would stimulate further adoption, creating a positive cycle where the more EVs on the road means the lower the cost to produce and have one.

In the end, economics of scale play a crucial role in making electric vehicles an increasingly affordable and attractive choice for consumers, while supporting the vision of a world with lower carbon emissions.

8. Adoption Barrier Analysis

The transition to electric vehicles is not a journey without obstacles. Although its potential to reduce emissions and other environmental impacts is clear, there are several barriers that could hinder the mass adoption of this technology.

As a major supplier of fuel for conventional vehicles, the oil industry has a lot at stake. Loss of market share could mean loss of income and jobs. Therefore, some players in this industry may seek to lobby or advocate against the adoption of electric vehicles, search for regulatory gaps, or even create misleading information campaigns to maintain the status quo.

However, resistance doesn't just come from industry. Some sections of society may feel skeptical or unprepared to adapt to new technologies. For example, concerns

about battery life, long charging times, or a lack of charging infrastructure can be reasons for consumers to keep choosing fossil-fueled vehicles. Besides, there are also social and cultural perceptions that may consider new technologies as unproven or less “masculine” compared to conventional gasoline engines that are meaningless platitudes.

Furthermore, the high initial cost of electric vehicles, although expected to decrease over time, can currently still be a barrier for many consumers, especially in developing countries or for those with tight budgets.

To overcome these obstacles, education and public awareness are key. Information campaigns, training, and incentive programs can help in educating people about the real benefits of electric vehicles and how they can be long-term solutions to a variety of environmental and economic problems.

Addressing these barriers requires a comprehensive approach, involving collaboration between governments, industry, and society to ensure that the transition to more sustainable transport can be realized.

9. Power Consumption and Availability Analysis

As electric vehicles (EVs) become increasingly popular, the need to recharge them will require a significant increase in electricity consumption. This creates new challenges and opportunities for the electricity sector.

The first challenge is to ensure that the power grid can accommodate increased demand. Many power grids are currently designed for certain loads and a sharp increase in demand can cause excessive loads on the system, increasing the risk of shutdowns or other interference. Therefore, significant investments are needed in the upgrading and strengthening of the electricity infrastructure.

Furthermore, the energy sources used to meet this demand are also important. If most electricity comes from fossil fuels, then most of the environmental benefits of electric vehicles will be compromised. To maximize the positive impact of EVs, it is essential to integrate more renewable energy sources such as solar, wind, and hydropower into the energy matrix.

However, renewable energy itself has its challenges. For example, solar and wind energy are intermittent, meaning they are not always available. This highlights the need for reliable energy storage solutions, such as large-scale batteries, that can store energy when production exceeds demand and release it back to the grid when needed.

On the other hand, energy demand from EVs can also be an opportunity. An electric vehicle connected to the grid can act as a “moving battery”, storing energy when it’s excessive and returning it to a grid when needed. This concept, known as “vehicle-to-grid” (V2G), can help in balancing the load of the network and improving the overall efficiency of the system.

Overall, the transition to electric vehicles requires a holistic approach to the electricity sector. Investment in infrastructure, integration of renewable energy sources, and innovation in storage technology and network management will be key to supporting the growth of electric vehicles without sacrificing the reliability and sustainability of our energy systems.

10. Social Impact Analysis

As technology evolves, societies adapt, and the social impact of these changes is often complex and varied. In the context of the transition to electric vehicles, the social impact is significant.

First, there is the potential for dramatic change in the workplace. For example, the conventional car manufacturing industry may see a decline in demand for certain components that are typical of petrol or diesel vehicles, such as internal combustion engines. This could result in a reduction in jobs in certain factories. Meanwhile, there is potential for job growth in other sectors, such as battery production, the development of charging infrastructure, or the maintenance of electric vehicles.

Furthermore, there is a need for re-training the affected employees. Mechanics familiar with conventional engine repair may require specialized training to work with electric vehicle systems. This indicates the urgent need for relevant education and training programs that can help these workers transition to a new role in the era of electric vehicles.

Not only jobs, but these technological changes may also affect the social and cultural dynamics of different societies. For example, in some places, large, motorized vehicles have become a symbol of status or pride. The shift to quieter and more environmentally friendly vehicles can change this perception and drive new values around sustainability and environmental responsibility.

In addition, the adoption of EVs may also affect community mobility patterns, with more people likely to choose electric vehicles for short distances, while fossil-fueled vehicles or other modes of transport may become more popular for long-distance travel or special needs.

To cope with this social impact, it is important for stakeholders at all levels - government, industry, community groups - to collaborate in identifying solutions that prioritize the well-being of the community. Through proper dialogue, training, and support, communities can be navigated through this change in an inclusive and sustainable way.

11. Government Policy Analysis and Incentives

Governments have a crucial role to play in facilitating and accelerating the transition to electricity-based transport. With the right policy tools, the state can encourage the adoption of electric vehicles (EVs) among consumers, drive industrial innovation, and ensure that the necessary infrastructure is ready to support the growth of this sector.

Tax incentives One of the most effective ways to encourage the adoption of EVs is by providing a tax incentive to buyers. It can be in the form of tax cuts, sales tax relief, or even tax credits for individuals or that buy EVs. Such incentives can lower the initial cost of ownership of electric vehicles and make them more attractive to consumers.

Direct subsidies for EV purchases, or incentives for manufacturers that develop and sell EVs, can boost market growth. Moreover, subsidies for infrastructure, such as electricity charging stations, can accelerate its spread, ensuring that drivers have easy access to charging facilities.

Regulations In addition to incentives, governments can also implement regulations that encourage the adoption of EVs. For example, tighter emission standards can encourage automotive manufacturers to increase EV production. In addition, emission-free zones in the city center can provide an incentive for consumers to switch to EV.

Government education programmes and awareness campaigns can play a role in educating the public about the benefits of EVs, both environmentally and economically. Effective information campaigns may help overcome myths and misunderstandings about EVs and encourage wider adoption.

Cooperation with the private sector Partnerships between government and industry are also important. By working together, both can ensure that the latest technology is implemented, the necessary infrastructure is developed, and market barriers overcome.

In a global context, many countries have begun to implement a combination of incentives and regulations to boost the transition to electric transport. Through the right approach, based on the specific circumstances and needs of each country, government policies can be a major driving force in making electric transport the new norm worldwide.

12. Cost Analysis Benefits

In making decisions related to the adoption of new technologies, especially electricity transportation, the cost-benefit analysis (ABM) approach has become crucial. ABM provides a framework for evaluating the entire spectrum of related costs and benefits, both short-term and long-term, so that stakeholders can make appropriate and responsible decisions.

High initial costs are usually associated with investments in electric vehicle technology, supporting infrastructure such as charging stations, as well as research and development. Sometimes, operating costs may also be higher in the early stages of adoption of these technologies. However, it is important to consider that these costs will decrease as production efficiency, innovation, and technology deployment improve.

Environmental benefits Electric vehicles generate zero emissions when operating, contributing to a reduction in greenhouse gas emissions. It helps countries meet their climate change targets and mitigate the negative impacts of climate changes, such as sea-level rise and natural disasters.

Health Benefits Reducing the number of fossil-fueled vehicles on highways means reducing air pollution, which has a direct impact on public health. It can reduce respiratory diseases, such as asthma and chronic obstructive lung disease, as well as reduce the burden of health costs incurred by communities and governments.

Economic benefits In the long run, the transition to electric vehicles could reduce dependence on oil imports, save currency, and even open up new opportunities in the EV-related manufacturing and services industry.

To get a complete picture, cost-benefit analysis should consider all these aspects in a temporal context - distinguishing between short-term costs and benefits versus long-term. Through this analytical approach, stakeholders can have a strong basis for making strategic decisions on the adoption and promotion of electric transport.

13. Technology Aspect Analysis

When we talk about the electric transport revolution, technology is at the forefront of change. With rapid development and constant innovation, technological advances have become the main drivers of the change that we see in the electrical transport industry, and it is very relevant when discussing the performance, durability, and cost of electric vehicles.

One of the most vital components of an electric vehicle is the battery. Research focused on increasing energy storage capacity, reducing charging time, as well as increasing battery life and durability, has a direct impact on the attractiveness of electric vehicles to consumers. More efficient and durable batteries can reduce the need for replacement and maintenance, which ultimately reduces the total cost of ownership of the vehicle.

Vehicle Efficiency The latest technology also focuses on improving vehicle efficiency, whether in terms of energy consumption, aerodynamics, or the use of lightweight and high-strength materials. More efficient vehicles mean longer mileage with a single charging, maximizing user comfort and reducing charging frequencies.

Technological integration Advances in communication and information technology also enable better integration between electric vehicles, charging stations, and power grids. Solutions such as demand management, where vehicles can be recharged when electricity demand is low, can help optimize resource use and reduce the load on the power grid.

Economic Impact As mentioned, technological advances can influence economic analysis. For example, if the cost of battery production drops significantly due to innovation or scale efficiency, this could make electric vehicles more affordable for consumers and increase adoption.

Thus, investment in research and technology development is a must for industry and governments who want to see the adoption of electric vehicles grow. Technological advances not only improve the performance and attractiveness of electric cars but can also help wider environmental and social goals.

14. Recommendations to be Made by the Government

Based on the analysis and discussions we have conducted in connection with the Public Economy Analysis in Electricity-Based Transport in Jakarta, here are some recommendations that can be addressed to the Indonesian government:

14.1. Initial investment in infrastructure

Governments need to invest in the construction of the necessary infrastructure, such as charging stations, to facilitate the transition to electric vehicles.

14.2. Fiscal incentives and subsidies

Giving fiscal incentives such as tax cuts, or direct subsidies for purchases of electric vehicles and related infrastructure, could boost adoption of these technologies. Governments could also provide financial assistance for research and development in electric vehicle technology.

14.3. Strengthening public policy

Developing policies that support the transition to electric transportation is important. These can be emission mandates, zoning policies, or even policies that limit the use of fossil-fuel-based motor vehicles in some areas.

14.4. Collaboration with the private sector

Governments should work with the private sector to share the burden of investment and risk. Business models such as public-private partnerships (PPP) can be explored to build and operate the necessary infrastructure.

14.5. Education and socialization

Conduct public education campaigns on the long-term benefits of electric vehicles, including operating cost efficiency and its positive impact on the environment. It will help reduce social resistance and accelerate the adoption of this technology.

14.6. Research and development support

Boosting research and development in this field could help in the introduction of more efficient and affordable technologies, accelerating the adoption of electric vehicles.

14.7. Adaptation and revision of regulations

The existing regulations need to be adapted or revised to support the implementation of electric vehicles, including regulations on emission standards, vehicle technical specifications, etc.

14.8. Cost-benefit analysis

Conducting a comprehensive cost-benefit analysis will help governments understand the ROI of investments in electricity transport, so they can make better and informed decisions.

14.9. Realizing the creation of knowledge and technology transfer

a. International cooperation

The Indonesian government can cooperate with countries that are already advanced in electric vehicle technology to gain technology and knowledge transfer. This collaboration could be in the form of a joint venture, a research exchange, or a training program.

b. Collaboration with universities and research institutes

Strengthening relations with university and research institutions, both domestically and abroad, will facilitate knowledge transfer. Thus, Indonesia can develop its own research and innovation in electric vehicle technology.

c. Regulatory support

Governments should ensure that international cooperation or foreign investment in the electric vehicle industry is followed by technology transfer commitments. This can be done through provisions in agreements or through incentives for companies contributing to technology transfer.

d. Development of SDM

Investment in education and training to develop expertise in electric vehicle technology is essential. Governments can grant scholarships for advanced study or training in advanced countries in this technology.

e. Establishment of the innovation centre

Forming a dedicated innovation centre for electric vehicle technology that will be a place of collaboration between government, industry, and academia, facilitating technology transfer and local capacity development.

By considering the obstacles and potential benefits of the transition to electricity-based transport, the Indonesian government has an opportunity to lead change towards more sustainable transport. This recommendation aims to help in planning and implementing strategic measures that will have a positive impact on the economy, the environment, and society.

15. Conclusion

Electric transportation, with all its advantages and challenges, marks a new phase in the evolution of the transportation sector. As one of the major contributors to greenhouse gas emissions, the transition to electricity-based transport has the potential to have a significant positive impact on global efforts to combat climate change. However, this transformation is not without challenges. High initial investment costs, changes in social and labor dynamics, and growing infrastructure needs require careful consideration and planning.

Technology, especially in the field of batteries and vehicle efficiency, played a key role in determining this success. Continuous advances in this technology will not only improve the performance and affordability of electric vehicles but also affect economic policies and decisions related to its adoption. Additionally, supporters and policymakers must work together to ensure that the electricity resources used come from sustainable and environmentally friendly energy sources, thereby maximizing the environmental benefits of electric vehicles.

In this ever-changing landscape, the role of government is also crucial. Through incentives, regulation, and support for research and development, governments have an opportunity to accelerate the adoption of electric transport and ensure a smooth and inclusive transition for the entire society.

Finally, it is important to acknowledge that despite the challenges, the opportunities offered by electric transport are far greater. With a holistic, collaborative, and innovation-focused approach, we can realize a vision of cleaner, more efficient, and more sustainable transport for the future.

15.1. Research limitations

Although this study has provided valuable insights into the transition to electric transportation, there are several limitations that need to be acknowledged. One of these is the lack of data covering the full spectrum of economic, social, and environmental impacts of electric transportation adoption. Additionally, the focus of this research is limited to the Jakarta context, and its findings may not be directly applicable to other contexts. Therefore, further research involving more comprehensive and extensive analysis, as well as broader geographical coverage, can provide a deeper understanding of the implications and challenges of transitioning to electric transportation.

15.2. Suggestions for further research

To enhance our understanding of the transition to electric transportation and prepare more effective policy measures, there are several research directions that can be explored. One is to continue studying the long-term economic impacts of electric transportation adoption, including deeper cost-benefit analysis. Additionally, further research on consumer preferences, risk perceptions, and psychological barriers to electric vehicle use can provide valuable insights for the development of marketing and educational strategies. Lastly, cross-country research comparing policies and practices related to electric transportation can help identify the best models for promoting sustainable transportation adoption in various global contexts.

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