A SYSTEM DYNAMICS MODELING OF INCENTIVE POLICIES TO INCREASE ELECTRIC VEHICLE ADOPTION IN INDONESIA

A Thesis

Submitted to the Master's Study Program of Master of Public Policy Specializing in Climate Change at the Faculty of Social Sciences in partial fulfillment of the requirements for the degree of

Master of Public Policy (M.P.P)

by:

Fuad Muhamad Fahrudin

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UNIVERSITAS ISLAM INTERNASIONAL INDONESIA

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ABSTRACT

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Indonesia's electric vehicle (EV) adoption remains limited despite various government incentives. This study employs system dynamics modeling to evaluate the effectiveness of fiscal policies, such as purchase subsidies, VAT reductions, electricity incentives, and infrastructure support, in accelerating EV adoption and reducing carbon emissions. The model consists of three interconnected subsystems: fiscal budget (APBN), EV adoption behavior, and carbon emission mitigation. Simulation results show that purchase subsidies and VAT incentives significantly increase EV uptake, especially in the motorcycle segment. However, when electricity tariff incentives are introduced in 2026, public purchasing intention grows more sharply, demonstrating that bundled policies are more effective. The model also reveals long-term fiscal pressure as a limiting factor, and emphasizes that EV adoption alone cannot significantly reduce national emissions without decarbonizing the electricity grid. This research highlights the importance of integrated policy strategies combining fiscal, infrastructure, and behavioral interventions. It offers a systems-based perspective for designing sustainable and inclusive EV transition policies in Indonesia.

Keywords: *Electric Vehicles, Incentive Policy, System Dynamics, Carbon Emission, Fiscal Sustainability, Indonesia*

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ABBREVIATION DIRECTORY

APBN	: *State Budget (Anggaran Pendapatan dan Belanja Negara)*
BEV	: *Battery Electric Vehicle*
BKF	: *Fiscal Policy Agency (Badan Kebijakan Fiskal)*
CLD	: *Causal Loop Diagram*
CO_2	: *Carbon Dioxide*
EV	: *Electric Vehicle*
ENDC	: *Enhanced Nationally Determined Contribution*
ESDM	: *Ministry of Energy and Mineral Resources (Energi dan Sumber Daya Mineral)*
GAIKINDO	: *Association of Indonesia Automotive Industries*
GHG	: *Greenhouse Gas*
HSD	: *High Speed Diesel*
IESR	: *Institute for Essential Services Reform*
IPCC	: *Intergovernmental Panel on Climate Change*
KLHK	: *Ministry of Environment and Forestry (Kementerian Lingkungan Hidup dan Kehutanan)*
$LCCO_2$	: *Life Cycle Carbon Dioxide Emissions*
NRE	: *New and Renewable Energy*
PLN	: *State Electricity Company (Perusahaan Listrik Negara)*
SDM	: *System Dynamics Modeling*
SFD	: *Stock and Flow Diagram*
SPKLU	: *Public Electric Vehicle Charging Station (Stasiun Pengisian Kendaraan Listrik Umum)*
VAT	: *Value Added Tax*

CHAPTER I
INTRODUCTION

1.1 Research Background

Climate change is a global issue that demands real action from all countries, including Indonesia, in an effort to reduce carbon emissions. The latest report from the Intergovernmental Panel on Climate Change (IPCC, 2023) states that global temperatures have increased by 1.1°C compared to the pre-industrial era, and will continue to increase if there are no significant mitigation efforts. Indonesia as a developing country is in a vulnerable position, given its large population and high dependence on fossil fuels. Data shows that Indonesia's total greenhouse gas emissions in 2023 reached 69.1 million tons of CO_2e, the highest figure in the history of emission recording in Indonesia. Dependence on fossil fuels is still very dominant, where 81% of national electricity needs in 2023 were met from fossil fuels, with coal contributing around 62% of total national electricity generation. Projections from the Climate Action Tracker and IESR even estimate that with current policies, Indonesia's emissions could reach between 1,487 and 1,800 million tons of CO_2e in 2030 if there are no significant policy changes. The data reinforces the urgency of the energy transition and strengthening decarbonization policies in the energy and transportation sectors, as emphasized in the national targets in the *Enhanced Nationally Determined Contribution* (ENDC) document which sets the target of reducing emissions to 662 $MtCO_2e$ by 2030.

One of the largest emission contributors in Indonesia is the transportation sector, which is estimated to contribute 53% of total national emissions by 2030 if no serious intervention is made (Hakam & Jumayla, 2024). Therefore, the transformation of the transportation sector through the adoption of electric vehicles (EV) is a strategic priority. This emission reduction policy is not only important from an environmental perspective, but also has a positive impact on energy security and national economic growth (Damanik et al., 2025).

In response to this urgency, the Indonesian government has issued a number of policies to encourage the transition to electric vehicles, one of which is Presidential Regulation Number 55 of 2019 concerning the Acceleration of the Battery-Based Electric Motor Vehicle Program. This policy is an important foothold in building a national electric vehicle ecosystem. However, the effectiveness of this policy still needs to be evaluated comprehensively. Based on GAIKINDO data, until the end of 2024, only around 865,723 electric vehicles were sold in Indonesia, indicating a very small market share (Lazuardy et al., 2024). This reflects the ongoing structural challenges in policy implementation, especially related to fiscal incentives, supporting infrastructure, and public education. In the context of policy, effectiveness is highly dependent on the involvement of industry players, market readiness, and the attractiveness of the incentives provided (Qadir et. al., 2024). Without a participatory and adaptive policy design, EV adoption is predicted to be slow. The success of this policy also requires synergy between the central government, local governments, and the private sector in order to create solid cross-sector collaboration.

The main challenges in encouraging the adoption of electric vehicles in Indonesia come not only from the regulatory side, but also from economic and social factors. The price of electric vehicles, which is still higher than conventional vehicles, is a major obstacle for the wider community (Zhang, Al-Aiban & Abbas, 2024). The price of batteries, which are the most expensive component of electric vehicles, accounts for around 30–40% of the total production cost (Lazuardy et al., 2024). Although global battery prices have declined in the last decade, this decline has not been sufficient to reach the lower-middle market segment. This purchasing power gap is a serious problem, especially outside large urban areas such as Jakarta and Surabaya. On the other hand, public perception of electric vehicles is still low, due to a lack of information about energy efficiency and long-term cost savings (Damanik et al., 2025). In fact, various studies show that the operating costs of electric vehicles can be 40–60% lower than gasoline-fueled vehicles in the long term. However, Indonesians tend to consider the initial costs more than the long-term benefits (life-cycle costs). Therefore, a massive and integrated public communication strategy is needed with a behavior change approach to encourage wider adoption.

In terms of infrastructure, the biggest challenge lies in the uneven distribution of public electric vehicle charging stations (SPKLU) throughout Indonesia. Until early 2024, the number of SPKLUs had only reached around 1,000 units and most of them were concentrated on Java Island (IESR, 2023). This condition raises consumer concerns about the limited range and availability of charging (*range anxiety*). Most vehicle users still feel that EVs are not suitable for long-distance travel outside big cities (Hakam & Jumayla, 2024). In addition, the relatively long charging time is a challenge in itself, especially for users who are accustomed to time efficiency when refueling. Fast charging infrastructure is still limited and expensive. The government has indeed provided incentives for the development of SPKLUs, but the private sector response is still low because it has not seen the prospect of short-term profits. Therefore, a sustainable infrastructure development strategy based on public-private partnerships needs to be encouraged, in order to provide benefits for both parties (Catala, Saval & Chaves- Ávila, 2022). Furthermore, the integration of SPKLU with local renewable energy such as solar panels or microhydro can reduce dependence on fossil-based electricity and add environmental value.

In addition to internal challenges, lessons from other countries show that the success of EV adoption is greatly influenced by the consistency and comprehensiveness of public policies. Countries such as Norway and the Netherlands have succeeded in increasing EV adoption to more than 50% of total new vehicles through tax incentives, special lane access, and free parking (Damanik et al., 2025). Meanwhile, China relies on direct subsidies and the development of a domestic battery industry. India provides subsidies and encourages local production of EVs through the “Make in India” scheme (Lazuardy et al., 2024). These studies show that targeted and long-term policies can accelerate the energy transition in the transportation sector. Therefore, Indonesia needs to design policies that are not only symbolic, but also touch on the structural and social aspects of adopting new technologies, including the development of an EV industry ecosystem that supports the creation of green jobs and increasing national competitiveness.

Academic research on electric vehicles in Indonesia is starting to develop, but most of it is still conceptual or limited to technical and economic aspects. Empirical studies that examine the effectiveness of public policies holistically are still very limited. For example, research by Damayanti et al. (2020) developed a conceptual model of the relationship between policy and consumer behavior, but has not tested the relationship quantitatively. In fact, consumer decisions in the real world are influenced by complex interactions between risk perceptions, economic incentives, and social norms. Therefore, a research approach that is able to capture the dynamics of the system between variables is needed, such as *the system dynamics* approach or *policy network analysis*. A multidisciplinary approach involving social sciences, economics, and engineering is needed to produce a comprehensive understanding and applicable solutions.

This study attempts to fill this gap by using a *system dynamics approach* to model the relationship between policy variables, public perception, infrastructure, and electric vehicle purchasing decisions. This approach allows researchers to understand how certain policy interventions can produce long-term impacts in various scenarios (Forrester, 1994). Policy analysis is also conducted to compare the effectiveness of alternative policies in accelerating the adoption of electric vehicles. This study not only offers theoretical results, but can also be a basis for formulating evidence-based policies. With the results of simulations and scenario analysis, it is hoped that the government will have more precise guidance in designing policies that are responsive to changes in market conditions and technology.

Overall, the urgency of developing electric vehicles in Indonesia cannot be separated from the national and global decarbonization agenda. Electric vehicles are not just technological innovations, but part of a structural transformation towards a fairer, greener, and more inclusive transportation system. Massive adoption of EVs has the potential to create green jobs, encourage local industries, and strengthen national energy security by reducing dependence on fuel imports. However, the success of this agenda is highly dependent on policy consistency, infrastructure readiness, and active involvement of the community and private sector. Therefore, research that holistically examines the determinants of EV adoption in Indonesia is very important to ensure the sustainability of the national energy future. This research is also expected to provide strategic recommendations that support the achievement of Indonesia's Net Zero Emission target by 2060, as well as strengthen Indonesia's position in global climate diplomacy.

1.2 Research Question

This study seeks to answer the following questions:

1. How incentive policies can increase electric vehicle (EV) adoption in Indonesia using System Dynamics Modeling?
2. How do current incentives impact EV costs and consumer demand in Indonesia?
3. What key factors, beyond incentives, influence EV adoption rates in Indonesia?
4. Which policy scenarios best achieve Indonesia's EV adoption and emission reduction targets?

1.3 Research Objective

This study aims to analyze in depth the system dynamics that influence the adoption of electric vehicles (EVs) in Indonesia. Using a *system dynamics approach*, this study will examine the complex interactions between various factors, such as economic factors (EV prices and operating costs), technological factors (range and charging time), infrastructure factors (availability of public electric charging stations/SPKLU), and consumer behavior factors (risk perception and brand preference) as identified by Yong et al. (2015).

In addition, this study also aims to evaluate the effectiveness of various fiscal and non-fiscal incentives that have been implemented by the Indonesian government in encouraging market penetration of electric vehicles. This evaluation will include an analysis of the impact of policies such as tax reductions, elimination of import duties, purchase subsidies, and regulations related to safety and environmental standards

(Handopo & Princes, 2024) (Falisa & Tricahyono, 2025). By analyzing the interaction of these policies dynamically, this study is expected to be able to provide a comprehensive picture of the strengths and limitations of existing incentives.

Furthermore, this study also aims to identify policy leverage points *that* have great potential to accelerate EV adoption significantly and sustainably. This identification will be carried out based on a deep understanding of the system structure and feedback *loops* that influence the behavior of EV adoption in society.

As a final objective, this study aims to formulate optimal policy recommendations based on the results of dynamic system modeling. These recommendations are intended to support the clean energy transition in the transportation sector and the achievement of greenhouse gas emission reduction targets set in Indonesia's national climate commitment (Ministry of Energy and Mineral Resources of the Republic of Indonesia, 2021). Thus, this study is part of a scientific effort to strengthen a more targeted, adaptive, and inclusive energy transition strategy.

1.4 Hypothesis

This study tests the following hypotheses:

1. **H1**: Financial incentives, such as tax reductions and purchase subsidies, will significantly increase electric vehicle (EV) adoption in Indonesia.
2. **H2**: Increased government incentives, such as direct subsidies and tax exemptions, significantly reduce EV costs and increase consumer demand in Indonesia.
3. **H3**: Factors beyond incentives, such as charging infrastructure, consumer behavior, costs, have a significant influence on EV adoption rates in Indonesia.
4. **H4**: Policy scenarios that combine fiscal incentives, infrastructure development, and conventional vehicle emission regulations are more effective in achieving EV adoption and emission reduction targets compared to fiscal incentives alone

1.5 Research Contributions

This study makes important contributions both academically and practically in supporting the clean energy transition in Indonesia. Scientifically, the *System Dynamics approach* used enriches the literature in the field of green technology innovation and poverty transition, especially in developing countries like Indonesia that still face structural and institutional barriers in the adoption of electric vehicles (Sterman, 2000). The dynamic model built in this study not only bridges the relationship between policy, technology, and consumer behavior, but can also be a conceptual framework for further research in sustainable mobility policies in the Southeast Asia region (Markard, Geels & Raven, 2020).

From a practical perspective, this study provides simulation-based strategic insights for automotive industry players, EV technology providers, and infrastructure operators such as PLN and Pertamina NRE. With scenarios calibrated to local parameters, the results of this study can be used for more precise decision-making in product development, determining SPKLU locations, and planning renewable energy business models (Li et al., 2023). This is also in line with the importance of synergy between public policy and market response to accelerate the development of the electric vehicle ecosystem.

For policy makers, the dynamic simulation model developed in this study is an important tool for testing policies ex-ante. This approach helps minimize the risk of policy failure before widespread implementation, as well as understanding systemic dynamics such as feedback, time lags, and trade-offs between interventions. In accordance with the *Green Industrial Policy approach* (Juhász, Lane & Rodrik, 2021), electric vehicle policies cannot stand alone, but must be integrated with energy, transportation, fiscal, and urban planning policies. Therefore, the results of this study can also be used as a scenario-based policy roadmap to support the work of ministries and institutions such as the Ministry of Industry, ESDM, KLHK, and Bappenas.

Furthermore, this study has broad social and environmental impacts. By encouraging the reduction of fossil fuel vehicles, this study supports improvements in air quality and public health through reduced CO_2 and PM 2.5 particle emissions in urban areas (Liang et al., 2020). In addition, increasing EV adoption also opens up opportunities for green jobs in manufacturing, battery technology, and intelligent vehicle services. This study strengthens the argument that the electric vehicle transition is not only a technical-environmental issue, but also part of a just and inclusive economic transformation (Pucheta & Sánchez 2022).

CHAPTER II
LITERATURE REVIEW

2.1 Literature Review

In the global effort to reduce carbon emissions, the transportation sector is a major focus because of its role as one of the largest contributors to emissions. One of the transformative solutions widely adopted by various countries is vehicle electrification, especially through the use of electric vehicles (EVs) as a more environmentally friendly alternative to fossil fuel vehicles (Egbue & Long, 2012; Rezvani et al., 2015). Among the types of EVs available globally, BEVs are often considered the cleanest option because they do not use fossil fuels directly (Li et al., 2017). However, the effectiveness of BEVs in reducing CO_2 emissions is highly dependent on the electricity source used, because life cycle emissions ($LCCO_2$) will remain high if electricity is still coal-based (Hawkins et al., 2013; Alghamdi et al., 2017; Bickert et al., 2015).

This condition is very relevant for Indonesia, which until now still relies on electricity from coal-fired power plants, with an emission factor of 0.813 $kgCO_2/kWh$ (Takahashi & Louhisuo, 2020). Around 86% of national electricity is still fossil-based, although the government has targeted a renewable energy mix of 23% by 2025 and has begun to prepare a plan for a gradual reduction of coal-fired power plants. The high national electrification ratio, which has reached 99.4 % (ESDM, 2021), shows the readiness of basic infrastructure, but structural challenges and the quality of clean energy are still obstacles to optimizing the environmental benefits of EVs.

In addition to environmental issues, economic considerations are an important element in consumers' decisions to adopt EVs. Studies in China show that BEVs have up to 50% lower operating costs than conventional vehicles (She et al., 2017), mainly due to energy efficiency and lower electricity tariffs. However, high initial purchase prices and expensive battery replacements remain significant barriers, especially in developing countries such as Indonesia (Egbue & Long, 2012; Haram et al., 2021; Ouyang et al., 2021). Although EVs have lower maintenance costs due to fewer mechanical components (Krause et al., 2013), EV prices in Indonesia are still far beyond the means of most consumers, with a price difference twice that of gasoline-powered vehicles.

These economic constraints are exacerbated by infrastructure limitations. The average daily travel distance of urban Indonesians such as in Jakarta reaches 60 km, but the cheapest BEV's range is only around 305 km on a single charge, much lower than conventional vehicles which can travel up to 450 km per tank. The lack of public electric vehicle charging stations (SPKLU), which are still concentrated in Java (ESDM, 2020), and the longer charging time compared to refueling (Zhang et al., 2021), also strengthen consumer concerns about limited range (*range anxiety*) (Liu et al., 2021; Shafiei et al., 2012).

Addressing these challenges, developed countries have implemented consistent and comprehensive incentive policies to encourage EV adoption. Norway and the Netherlands, for example, have managed to increase EV market share to more than 50% by offering fiscal incentives such as exemption from purchase taxes, special lane access, and free parking (Bjerkan et al., 2016; Damanik et al., 2025). In Asia, China combines direct subsidies with the development of a domestic battery industry (Zhou et al., 2019), while India encourages local production through its "Make in India" program (Lazuardy et al., 2024). Cross-country studies show that a combination of fiscal incentives, supportive infrastructure, and industrial policies are key to accelerating the EV transition (Sierzchula, 2014; Kester et al., 2018; Li et al., 2023).

Indonesia itself has begun to respond through the Presidential Regulation No. 55 of 2019 which includes exemption from purchase tax, reduction of vehicle tax, charging subsidies, and electricity tariff incentives by PLN (ESDM, 2020; Mulyana, 2020). At the regional level, for example in Jakarta, electric vehicles are exempt from motor vehicle tax, while fossil fuel vehicles are subject to a tariff of up to 12.5 % (GOJ, 2019). PLN also plans to build more than 7,000 SPKLU by 2030 in line with the government's target that 25% of national vehicles by 2030 will be *Low Carbon Emission Vehicles* (MINISTRY OF ENERGY AND MINERAL RESOURCES REPUBLIC OF INDONESIA, 2024). This policy is starting to show results, with EV sales increasing to 0.36 % of total vehicles in 2021, although this figure is still far from the target.

Amidst these developments, academic studies in Indonesia still tend to be partial. Most studies focus on technical or economic aspects separately, without examining how policies, perceptions, infrastructure, and consumer behavior interact with each other. For example, Damayanti et al. (2020) have developed a conceptual model of the relationship between policies and purchasing decisions, but have not conducted quantitative testing that can capture the complexity of these interactions systematically. In fact, in reality, EV adoption is influenced by the dynamics of interrelated and non-linear variables.

To address these challenges, the *system dynamics approach* is relevant because it is able to map the causal relationships, feedback *loops*, and long-term impacts between variables in a complex system (Sterman, 2000; Yong et al., 2015; Ma et al., 2020). Several global studies have utilized this approach to examine low-carbon transportation policies, but applications in the Indonesian context are still very limited. Therefore, this study seeks to fill this gap by building a system dynamics model that is able to explain how incentive policies impact EV adoption through price, infrastructure, and consumer perception channels. By conducting scenario-based policy simulations, this study is expected to produce evidence-based policy recommendations to support a more effective and sustainable electric vehicle transition in Indonesia.

2.2 Conceptual Framework

The adoption of electric vehicles (EVs) is part of the transformation of the transportation system towards low emissions, which is influenced by a combination of economic factors, public policy, infrastructure, and social behavior. In the context of a developing country like Indonesia, EV adoption faces complex structural challenges, including high vehicle prices, limited charging stations, and low public perception of the long-term benefits of EVs (Damayanti et al., 2020; Lazuardy et al., 2024).

Research by Ouyang et al. (2021) and Li et al. (2023) emphasizes that the success of EV incentive policies largely depends on how they are translated into consumers' perceptions of value. For example, subsidies and tax exemptions can lower EV prices, but their effects on purchasing decisions will depend on perceived risk, convenience, and infrastructure readiness. When perceived risk is low and convenience is high, incentives will be more effective in driving purchase intentions and ultimately increasing adoption rates.

To analyze the relationship between these factors systematically, the System Dynamics approach is relevant because it is able to describe the cause-and-effect interactions and dynamic feedback loops (Yong et al., 2015; Ma et al., 2020). This approach maps how changes in one variable, such as fiscal incentives, can trigger changes in other variables such as price perception or purchase intention, which then have an impact on the structure of the electric vehicle market.

The model structure developed in this study consists of three main interconnected subsystems, namely the fiscal subsystem in the form of policy financing through the APBN, the electric vehicle adoption system by the community, and the environmental impact system in the form of carbon emission reduction. All three operate within a *balancing feedback framework*, a balancing mechanism that reflects that growth in one sector (for example, increasing subsidies or EV adoption) will be limited by other factors, such as fiscal capacity, behavioral delay time, or national energy system capacity. There is no unlimited reinforcement in this system, so that the dynamics of growth take place in a controlled and realistic manner. Then later the relationship between these subsystems will be visualized in the form of a Causal Loop Diagram (CLD) to understand the system structure qualitatively.

With this system modeling, the relationship between incentives, public perceptions, and environmental outcomes is not understood linearly, but as an interactive process involving causal linkages and time delays. Through this conceptual model, the study aims to identify the most effective policy pathways, understand the system boundaries in supporting EV adoption, and provide a basis for simulating policy scenarios that can accelerate the sustainable electric vehicle transition in Indonesia.

CHAPTER III
RESEARCH METHODOLOGY

3.1 Methodology

The adoption of electric vehicles (EVs) is part of the transformation of the transportation system towards low emissions, which is influenced by a combination of economic factors, public policy, infrastructure, and social behavior. In the context of a developing country like Indonesia, EV adoption faces complex structural challenges, including high vehicle prices, limited charging stations, and low public perception of the long-term benefits of EVs (Damayanti et al., 2020; Lazuardy et al., 2024).

This study uses the System Dynamics Modeling (SDM) approach to analyze the effectiveness of incentive policies in encouraging the adoption of electric vehicles (EVs) in Indonesia. This approach was chosen because it is able to capture the characteristics of a complex, dynamic, and interconnected system, involving fiscal aspects, consumer behavior, and environmental impacts over a long period of time. SDM allows modeling of feedback*,* accumulation (*stock*), and time delay *between* variables, making it suitable for analyzing non-linear and interactive policy scenarios (Sterman, 2000; Schünemann, Johanning, Herold, & Bruckner, 2024).

In various studies of sustainable energy and transportation policy, this approach has been widely used. For example, Yu et al. (2018) developed a dynamic model to analyze EV adoption in China, while Setiawan I. C. (2022) modeled policy scenarios in Indonesia using a combination of dynamic system approaches and policy analysis. This study adopts a similar approach and focuses on secondary data-based simulations to ensure that the research results can be completed within the time limit and remain methodologically valid. This decision was made based on the consideration that the available literature is rich enough to build a strong conceptual and quantitative model, while considering the principles of research efficiency and effectiveness as recommended in structured research design (Creswell, 2017).

3.2 Conceptualization Model: Causal Loop Diagram (CLD)

The causal relationship diagram (CLD) in this study was developed entirely based on literature review and secondary data. No expert interviews or perception surveys were used in its preparation. The CLD structure was designed by referring to general patterns that have been discussed in various previous studies, such as those conducted by Setiawan et al. (2022), Yu et al. (2018), and Lopez-Arboleda & Cardenas (2021).

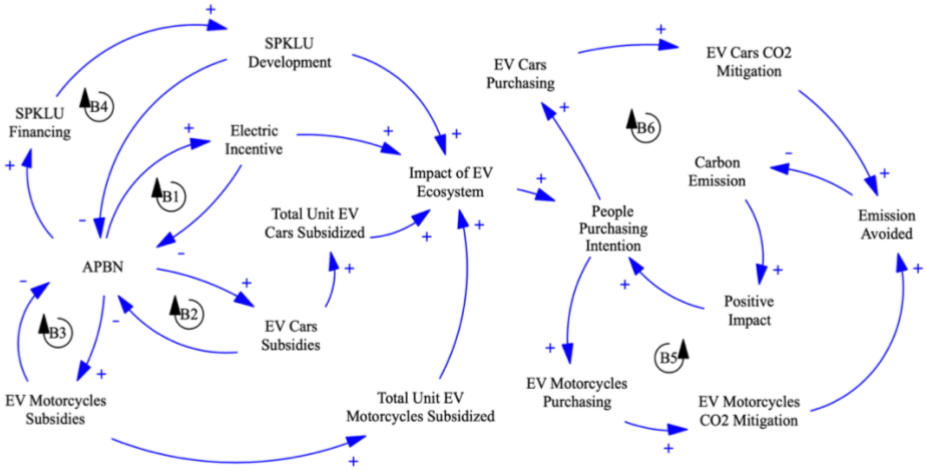


Figure 3.1 Causal Loop Diagram
Source: Processed by the author (2025)

The Causal Loop Diagram (CLD) in this study serves to map the causal structure of the electric vehicle subsidy policy system in Indonesia, and illustrates the dynamics between fiscal policy, EV infrastructure, consumer behavior, and emissions. carbon influences each other in an interconnected system. This diagram consists of six loops, all of which are *balancing loops* forming a dynamic structure that aims to control the growth of a variable so that the system remains stable in the long term (Sterman, 2000).

These loops illustrate that while subsidy policies can accelerate EV adoption, fiscal capacity and budget constraints remain key limiting factors. In addition, public perception of the environmental benefits of EVs also acts as a reinforcing mechanism that accelerates adoption while still having a balancing effect on carbon emissions.

Here is an explanation of each loop:

1. **Balancing Loop B1: Electricity Tariff Incentives and APBN Absorption Capacity Channel**
   Flow: APBN (–) → Electric Incentive (+) → APBN (-))
   This loop illustrates the relationship between the provision of **electricity tariff incentives to EV users** and the state's fiscal burden. The greater the incentives provided (for example, electricity bill discounts for EV-owning households), the greater the expenditure from the state budget. However, because the state budget is limited, increasing incentives will automatically suppress fiscal capacity, creating a balancing effect. This concept is consistent with the findings in the study by Castrejon-Campos et al. (2020), which shows that electricity tariff incentives are only effective in a sustainable fiscal context.

2. **Balancing Loop B2: EV Cars Subsidies and Fiscal Expenditure**
   Flow: APBN (–) → EV Cars Subsidies (+) → APBN (–)

   The four-wheeled electric vehicle subsidy aims to lower the selling price of EVs to make them more competitive. When subsidies increase, the number of electric cars purchased by the public also increases, which means that more units require subsidies from the state budget. In a dynamic system, this effect creates back pressure on the state budget, limiting the country's ability to expand subsidies without increasing revenue. The study by Yu et al. (2018) also underlines that the fiscal structure of developing countries must be very careful in designing subsidy schemes for EVs so as not to create long-term fiscal burdens.
3. **Balancing Loop B3: EV Motorcycles Subsidies and Fiscal Burden**
   Flow: **APBN (–) → EV Motorcycles Subsidies (+) → APBN (–)**

   Similar to subsidies for electric cars, subsidies for electric motorcycles also increase the fiscal burden when the volume of adoption increases. Since the majority of private vehicle users in Indonesia are two-wheeled users, the potential for increased demand due to this subsidy is greater. Therefore, this loop functions as a fiscal control mechanism, so that the subsidy policy remains measurable and in accordance with the state's financial capacity. This is also supported by findings from the Fiscal Policy Agency (BKF) which states that incentive programs need to consider the population of two-wheeled vehicles which is much larger than four-wheeled vehicles.
4. **Balancing Loop B4: SPKLU Development and Fiscal Support**
   Flow: **APBN (–) → SPKLU Financing (+) → SPKLU Development (+) → APBN (–)**

   Charging infrastructure or SPKLU (Public Electric Vehicle Charging Station) is one of the main prerequisites in the development of the EV ecosystem. The more SPKLUs are built, the more comfortable it is for people to use EVs. However, each SPKLU construction requires a large cost, which comes from the APBN. Therefore, this loop shows the reciprocal relationship between infrastructure development and fiscal burden. As explained in the study by Lopez-Arboleda & Cardenas (2021), limited infrastructure funds in developing countries are often a major obstacle to EV development, so this balancing loop is very relevant to Indonesian public policy.
5. **Balancing Loop B5: Electric Motorcycle Adoption and Carbon Emission Mitigation**

Flow: **EV Motorcycles Purchasing (+) → EV Motorcycles CO2 Mitigation (+) → Emission Avoided (+) → Carbon Emission (–) → Positive Impact (+) → People Purchasing Intention (+) → EV Motorcycles Purchasing (+)**

This loop shows how the adoption of electric motors directly contributes to the reduction of carbon emissions through annual mitigation per vehicle unit. The emissions that are successfully avoided then strengthen the public perception that EVs provide real benefits to the environment, driving higher purchase intentions. However, because the ultimate goal is to reduce the growth rate of *carbon emissions*, this loop functions systematically as a balancing loop. This is consistent with the principle of *policy resistance* in dynamic systems, where the system will try to correct back to a stable state after experiencing intervention (Sterman, 2000).

6. **Balancing Loop B6: Electric Car Adoption and Carbon Emission Mitigation**

   Flow: **EV Cars Purchasing (+) → EV Cars CO2 Mitigation (+) → Emission Avoided (+) → Carbon Emission (–) → Positive Impact (+) → People Purchasing Intention (+) → EV Cars Purchasing (+)**

   This loop works in a nearly identical way to B5, but focuses on four-wheeled vehicles. The emission mitigation per unit of electric cars is even greater than that of motorcycles, so the *emission avoided effect* is more significant. The positive effect on the environment triggers a better public perception of EVs, and again encourages the purchase of electric cars. Although it looks like a loop that strengthens adoption, this system leads to control over the *carbon emission variable*, making it a *balancing loop*.

From the six loops above, it can be seen that the system works in two main domains of influence: the fiscal side and the environmental side. Loops B1–B4 emphasize the importance of considering fiscal capacity as an upper limit in providing incentives, while loops B5–B6 show that environmental impacts have the potential to drive gradual changes in public perception. What is important to note is that environmental outputs such as *emissions avoided* are not only indicators of impact, but also function as feedback on social perceptions that influence purchasing intentions. This creates a non-linear system, where small policy changes can have large impacts if implemented at the right points (*leverage points*). Therefore, this CLD is not only a descriptive tool, but also a conceptual guide to designing policies that are not trapped in direct costs, but rather consider the overall dynamics of the long-term system.

CHAPTER IV
RESULT AND ANALYSIS

4.1 Stock and Flow Diagram (SFD)

Dynamic system simulations were conducted to analyze the effectiveness of incentive policies in encouraging the adoption of electric vehicles in Indonesia. This study compares two main scenarios, namely Scenario 1 (baseline) which reflects the current vehicle incentive and infrastructure development policies, and Scenario 2 which adds an electricity tariff incentive of IDR 50,000 per user per year starting in 2026. Evaluations were conducted on key indicators such as the number of electric vehicles adopted, the state fiscal balance (APBN), public purchasing intentions, and carbon emissions avoided. Simulations were run for the period 2023 to 2030 using Vensim software. These results serve as a basis for understanding how policy interventions affect the system systemically, dynamically, and sustainably.

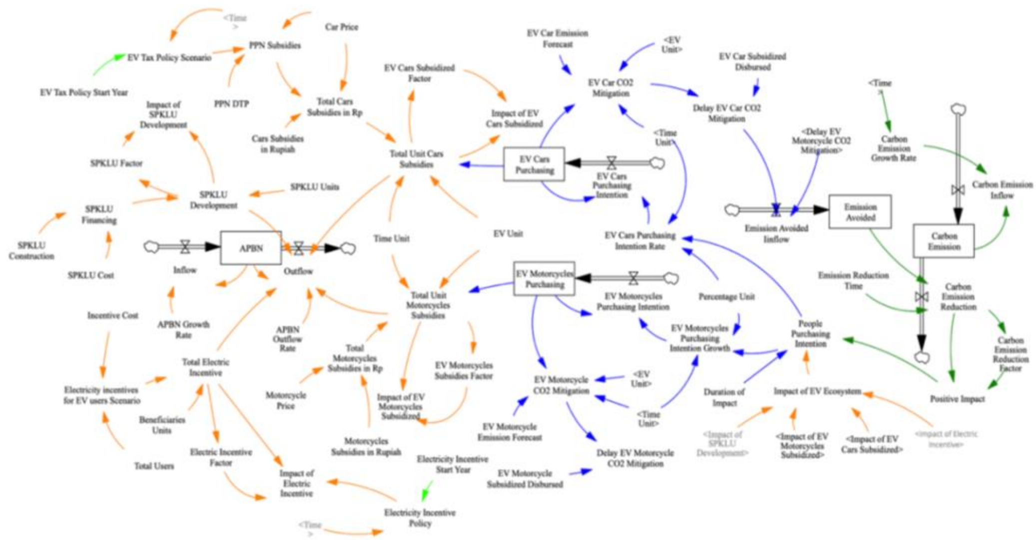


Figure 4.1 Stock Flow Diagram
Source: Processed by the author (2025)

4.2 Fiscal Dynamics and State Budget Pressure

The adoption of electric vehicles (EVs)

In this dynamic system model, the core variable in the fiscal subsystem is the APBN stock, which represents the country's total fiscal capacity to finance programs related to accelerating the adoption of electric vehicles. The inflow component in this system comes from the annual APBN growth, which in this model is assumed to follow the trend of state revenue growth of 5.25 % per year, as reflected in the government's financial statements. Meanwhile, the outflow is determined by total government spending in four main categories: (1) four-wheeled electric vehicle subsidies, (2) two-wheeled electric vehicle subsidies, (3) construction of SPKLU (Public Electric Vehicle Charging Stations), and (4) annual electricity incentives for EV users, which will start in 2026.

Each expenditure component is calibrated based on actual parameters:

- Electric car subsidy: IDR 80 million per unit, minus VAT according to the VAT Borne by the Government (DTP) scheme,
- Electric motorbike subsidy: IDR 7 million per unit,
- SPKLU construction costs: IDR 500 million per unit, with a construction target of 50 units per year,
- Household electricity incentive: IDR 50,000 per user per year (starting 2026).

These four spending variables form four main balancing loops (B1–B4), which reflect that the greater the fiscal intervention provided by the government, the more the state budget capacity will decrease. In other words, policies that are too expansionary without control and efficiency design risk causing pressure on national fiscal sustainability.

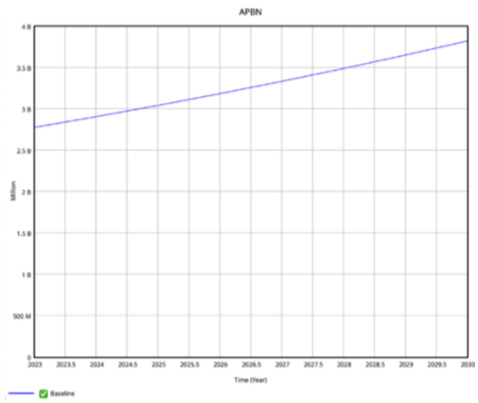


Figure 4.2 APBN

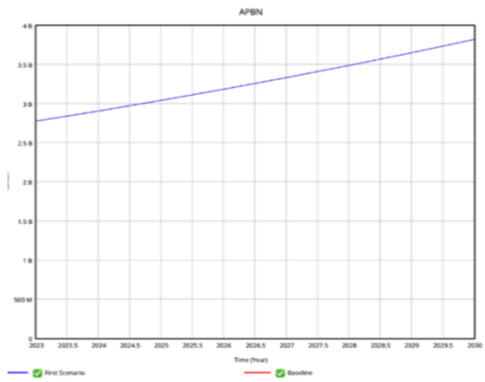
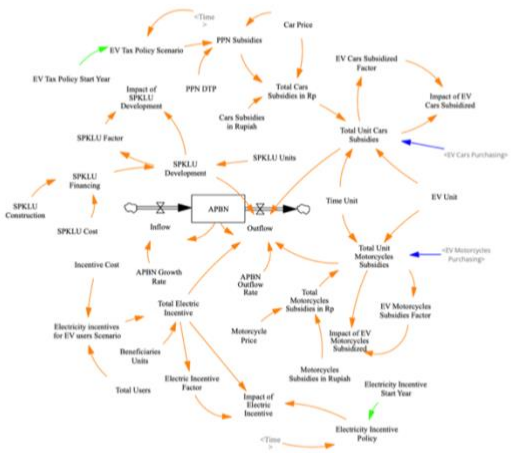


Figure 4.3 Impact of Electricity Incentive on APBN

The simulation results show that even though the state budget is assumed to continue growing, total spending on the EV program increases faster, especially after 2026 when electricity incentives are introduced. This causes a downward trend in the fiscal balance in the long run, indicating structural pressure on the country's fiscal capacity. In a system context, this represents a balancing dynamic that becomes the upper limit of the aggressiveness of incentive policies. These findings suggest that the expansion of the electric vehicle program cannot continue to rely on the state budget without fiscal risk. Therefore, the government needs to consider innovative financing schemes such as green bonds, carbon pricing mechanisms, or the transfer of fuel subsidy budgets to the energy transition sector. Reformulating these financing schemes is essential to ensure the long-term sustainability of the electric vehicle policy without sacrificing the country's financial stability.

4.3 Behavior and Electric Vehicle Adoption



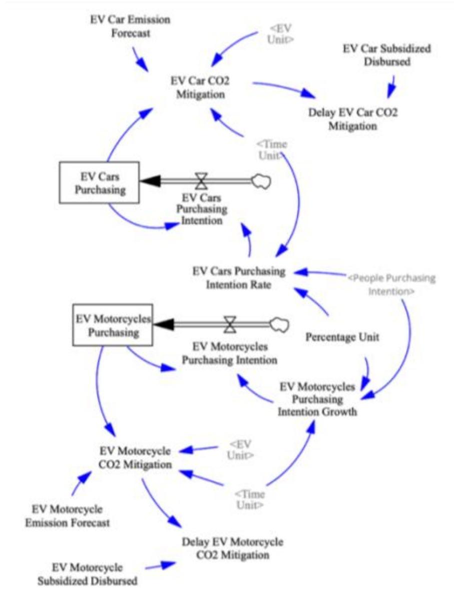


Figure 4.4 EV Subsidies System.

Figure 4.5 EV Units Purchasing System

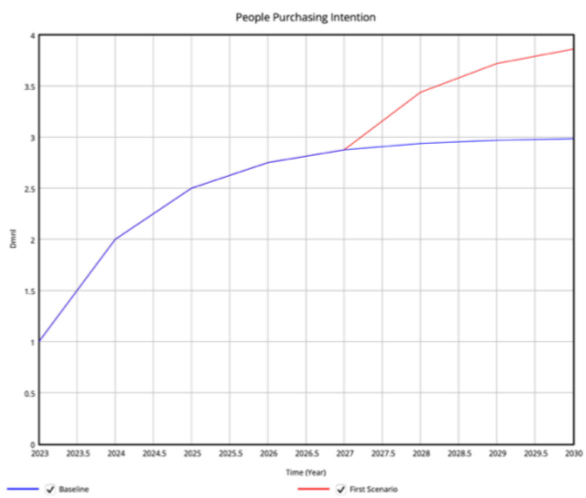


Figure 4. 6 Impact of Electricity Incentive on People Purchasing Intention (Scenario 2)

From the simulation results, it can be seen that people's purchasing intention for electric vehicles began to increase significantly after 2026 (See Figure), which is when the electricity incentive policy began to be implemented. This indicates that consumers respond more strongly to incentives that touch on routine spending aspects such as electricity cost savings, compared to one-time incentives such as discounts when purchasing a vehicle.

This fact is in line with the consumer behavior approach that emphasizes the importance of recurrent incentives in creating behavioral lock-in, which is a condition when consumers feel they have long-term benefits from using electric vehicles. In the context of a dynamic system, this response creates a delay between the time of policy implementation and the actual increase in purchasing decisions, as described in the model.

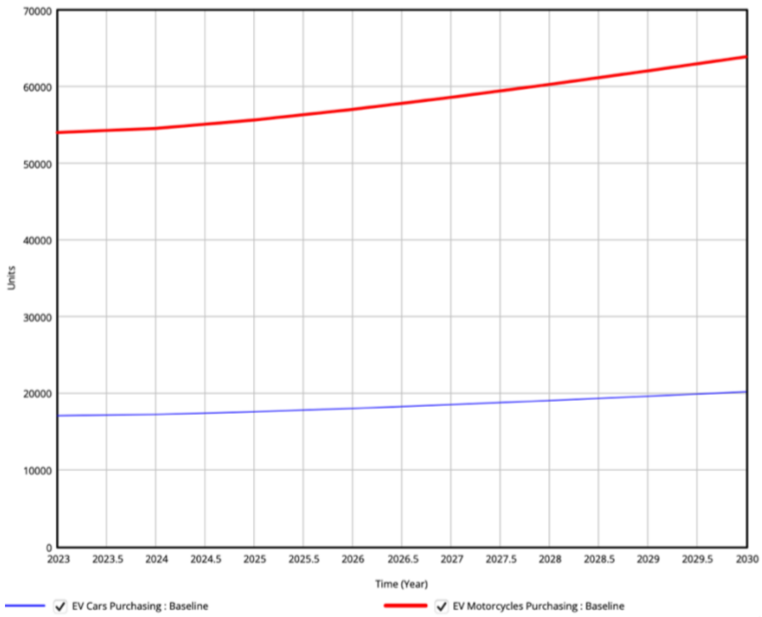


Figure 4.7 Growth in EV Purchases

However, the growth in EV adoption that has occurred has not shown a truly organic or market preference-based pattern. Consumers generally still rely on policy incentives to change their behavior. This poses a risk of market stagnation if incentives are withdrawn too quickly or are not designed gradually.

Therefore, complementary strategies are needed in the form of intensive public education, provision of transparent information, and development of an inclusive electric vehicle industry ecosystem. These interventions are important to build consumer confidence, stimulate long-term demand, and avoid excessive dependence on fiscal incentive policies.

4.4 Comparison of Effectiveness Between Scenarios

The adoption of electric vehicles (EVs)

This dynamic system simulation compares two main scenarios in the electric vehicle adoption policy: Scenario 1 (Baseline) which represents the current policy conditions, and Scenario 2 which adds an annual electricity tariff incentive of IDR 50,000 for EV users starting in 2026. The comparison is made on three main indicators: the number of electric vehicles adopted, total emissions avoided, and the fiscal burden on the state budget.

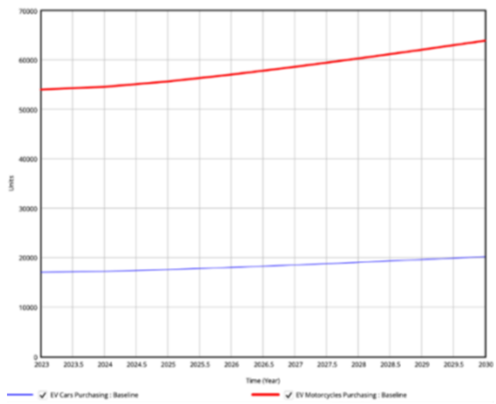


Figure 4.8 EV Purchase Growth

(Scenario 1)

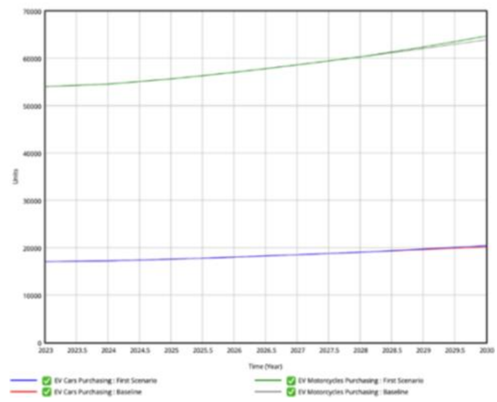


Figure 4.9 Impact of Electricity Incentive on EV Purchasing

(Scenario 2)

The results in Figure. above show that Scenario 2 results in a much higher adoption rate of electric vehicles, especially in the period 2027–2030, compared to Scenario 1 which tends to grow slower. This confirms that operational cost-based incentives, although relatively small in value, have a significant psychological and financial impact on consumer purchasing decisions. Purchase intentions in Scenario 2 increase faster because people see long-term benefits that are directly felt in everyday use.

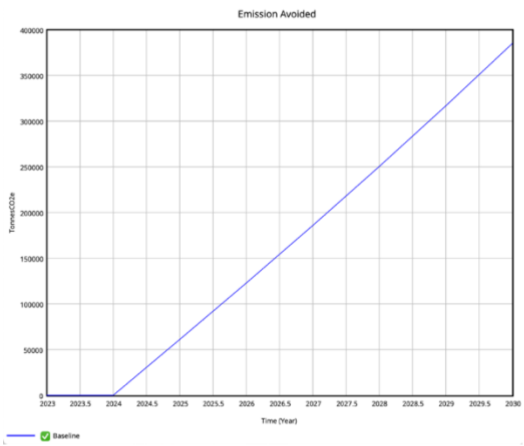


Figure 4.10 Emissions Avoided by EV Implementation
(Scenario 1)

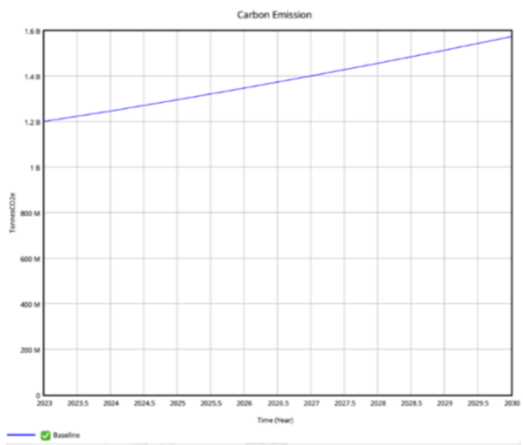
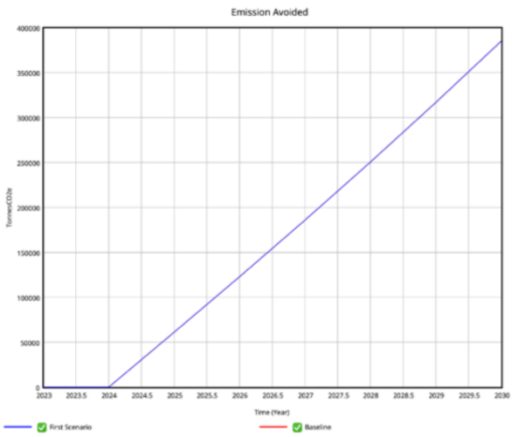


Figure 4.11 Carbon Emissions

(Scenario 1)



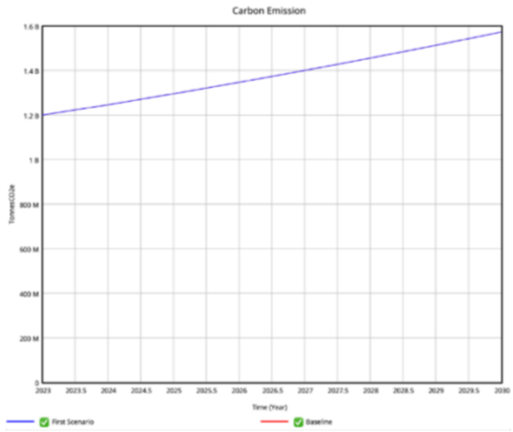
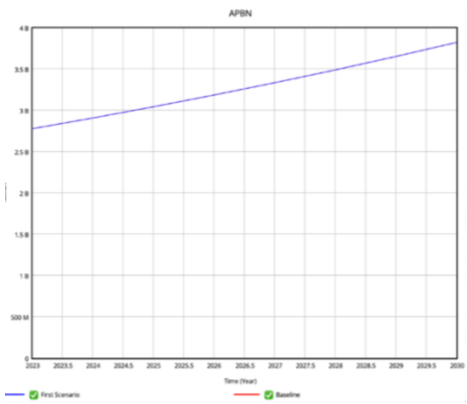


Figure 4.12 Impact of Electricity Incentive on Emission Avoided (Scenario 2)

Figure 4.13 Impact of Electricity Incentives on Carbon Emission (Scenario 2)

In addition, the amount of carbon emissions avoided also increases more in Scenario 2 (See Figure 14) , in line with the increase in the number of EVs used. However, the simulation results also show that even though emissions avoided increase, total national emissions still increase due to the high emission intensity of the electricity sector. This confirms that EVs are only effective as a mitigation strategy if accompanied by energy mix reforms towards renewable energy sources.



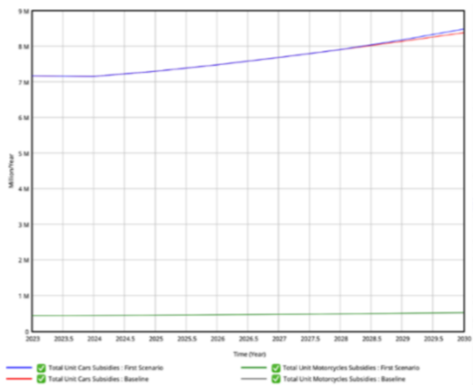


Figure 4.14 Impact of Electricity Incentive on APBN (Scenario 2)

Figure 4.15 Impact of Electricity Incentive on Units EV Subsidies (Scenario 2)

From the fiscal side, Scenario 2 creates an additional burden on the state budget, although not as big as the surge caused by vehicle purchase subsidies. This means that, relatively speaking, electricity tariff incentives are more efficient in driving adoption than purchase subsidies, when viewed from the ratio of “fiscal costs to new EV units”.

However, these results also show the risk of regressive policies. In both scenarios, groups with higher purchasing power and better access to infrastructure remain the first to benefit from incentive policies. This suggests that without affirmative policy interventions, such as conditional subsidies or support for vulnerable groups, EV policies have the potential to widen social and spatial disparities.

Overall, this comparison confirms that integrated policies are more effective in driving systemic change, but also carry more complex fiscal and social consequences. Therefore, future policy strategies must be holistic: not only combining fiscal and technical instruments, but also considering the dynamics of benefit distribution and long-term financing capacity.

CHAPTER V
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This study aims to evaluate the effectiveness of incentive policies in encouraging the adoption of electric vehicles in Indonesia through a dynamic system approach. By building a model that includes fiscal variables, consumer behavior, infrastructure, and carbon emissions, simulations are carried out on two main scenarios, namely baseline and additional electricity incentives. The results obtained indicate that fiscal policy is indeed able to increase the adoption of electric vehicles, especially in the initial phase, but there are systemic limitations in the form of fiscal pressures and infrastructure limitations that limit the long-term effectiveness of these interventions.

Progressive adoption of electric vehicles will only occur if public incentives are not only aimed at the initial purchase price, but also at the long-term operational cost efficiency directly felt by users. In this case, electricity tariff incentives have proven to be more stable and encourage changes in consumer perception. However, the success of electric vehicle adoption in reducing national emissions is highly dependent on the source of electrical energy used. If electricity is still dominated by fossil-based energy, then the impact of emission mitigation will remain limited, even if the number of electric vehicles increases significantly.

The dynamic system model built in this study also shows the importance of a holistic and systems-based policy approach. Every intervention in the policy system will create feedback, response delays, and resource limits that must be anticipated in program design. Therefore, the transition to electric vehicles is not just a matter of technology or subsidies, but requires structural transformation involving the energy, financial, transportation sectors, and broad community participation. By considering the simulation results and the systemic dynamics that have been analyzed, this study concludes that electric vehicle adoption policies must be designed adaptively, responsively, and integrated within the framework of inclusive and sustainable low-carbon development.

5.2 Policy Recommendation

This study aims to evaluate the effectiveness of incentive policies in encouraging the adoption of electric vehicles in Indonesia through a dynamic system approach. By building a model that includes fiscal variables, consumer behavior, infrastructure, and carbon emissions, simulations are carried out on two main scenarios, namely baseline and additional electricity incentives. The results obtained indicate that fiscal policy is indeed able to increase the adoption of electric vehicles, especially in the initial phase, but there are systemic limitations in the form of fiscal pressures and infrastructure limitations that limit the long-term effectiveness of these interventions.

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APPENDIX

Appendix 1 EV Subsidies System

Variables, Formulas and Units	Document
APBN= INTEG (Inflow-Outflow, 2.7743e+09) Units: Million	The initial APBN assumption is 2,774.30 trillion. The realization of State Revenue and Grants until the end of December was recorded at IDR 2,774.30 trillion or 105.20 percent of the target in Presidential Decree 75/2023, and grew by 5.25 percent (yoy). Resources: https://komwasjak.kemenkeu.go.id/in/post/realisasi-belanja-negara-sd-desember-2023
APBN Growth Rate = 0.0525 Units: 1/Year	The realization of State Revenue and Grants until the end of December was recorded at IDR 2,774.30 trillion or 105.20 percent of the target in Presidential Decree 75/2023, and grew by 5.25 percent (yoy). Resources: https://komwasjak.kemenkeu.go.id/in/post/realisasi-belanja-negara-sd-desember-2023
Inflow = APBN * APBN Growth Rate Units: Million/Year	State budget inflows are influenced by the state budget growth rate, such as tax revenues and others.
Outflow= (APBN*APBN Outflow Rate)-(Total Units of Cars Subsidies+Total Units of Motorcycles Subsidies) Units: Million/Year	The APBN outflow is influenced by the rate of spending realization or APBN outflow rate.
APBN Outflow Rate=0.0083 Units: 1/Year	The realization of State Expenditure until the end of December 2023 reached IDR 3,121.94 trillion or 100.15 percent of the target in Presidential Decree 75/2023, and grew by 0.83 percent (yoy).

	Resources: https://komwasjak.kemenkeu.go.id/in/post/realisasi-belanja-negara-sd-desember-2023
Total Unit Motorcycles Subsidies= (EV Motorcycles Purchasing*Total Motorcycles Subsidies in Rp)/EV Unit/Time Unit Units: Million/Year	Number of subsidized EV motorcycle units
Motorcycle Price= 15 Units: Million	Assumption: For example, for the United E-Motor MX-1200 unit with an OTR price of around IDR 15,000,000
Motorcycles Subsidies in Rupiah= 7 Units: Million	The government subsidy assumption is 7 million rupiah.
Total Motorcycles Subsidies in Rp= Motorcycle Price-Motorcycles Subsidies in Rupiah Units: Million	Price after being subsidized by the government
EV Motorcycles Subsidies Factor= Total Motorcycles Subsidies Units Units: Million/Year	EV Motorcycles Subsidized Factor which describes how much financial incentive is given for each type of vehicle.
Impact of EV Motorcycles Subsidized= Total Unit Motorcycles Subsidies/EV Motorcycles Subsidies Factor Units: Dmnl	The impact of EV Motorcycles subsidies
Time Unit= 1 Units: Year	Time Unit
EV Unit= 1 Units: Units	EV Unit

Car Subsidies in Rupiah=80 Units: Million	A subsidy of IDR 80 million for the purchase of electric cars priced above IDR 200 million to IDR 800 million. Resources: https://astraotoshop.com/article/subsidi-kendaraan-listrik
VAT DTP = 0.01 Units: 1	Assumption: If an electric car has a minimum TKDN of 40%, then the buyer will only be charged 1% VAT on the selling price.
VAT Subsidies= Car Price*VAT DTP Units: Million	Amount of VAT Subsidies
Car Price= 500 Units: Million	Example: if the price of a car is IDR 500 million, then the VAT to be paid is IDR 500,000,000 x 1% = IDR 5 million. Before the subsidy, the VAT to be paid could be 11% of the selling price.
Total Cars Subsidies in Rp= (Car Price-Cars Subsidies in Rupiah)-VAT Subsidies Units: Million	Total EV Cars Subsidy
Total Unit Cars Subsidies= (Total Cars Subsidies in Rp*EV Cars Purchasing)/EV Unit/Time Unit Units: Million/Year	Total EV Cars units subsidized per year
EV Cars Subsidized Factor= Total Unit Cars Subsidies Units: Million/Year	EV Cars Subsidized Factor
Impact of EV Cars Subsidized= Total Unit Cars Subsidies/EV Cars Subsidized Factor Units: Dmnl	The impacts resulting from EV Car subsidies
SPKLU Development= SPKLU Financing/SPKLU Units Units: Million/Year	APBN funds are also used to improve the EV ecosystem, one of which is SPKLU or charging stations.

SPKLU Financing= SPKLU Cost*SPKLU Construction Units: Million*Units/Year	Amount of SPKLU Development Funding
SPKLU Construction = 50 Units: Units/Year	SPKLU Unit Development Assumption per year
SPKLU Cost = 500 Units: Million	SPKLU Cost Assumption per unit 500 million Resources: https://industri.kontan.co.id/news/minat-bisnis-spklu-segini-perkiraan-cost-investasinya
SPKLU Units= 1 Units: Units	SPKLU Units
SPKLU Factor= SPKLU Development Units: Million/Year	SPKLU development factors
Impact of SPKLU Development= SPKLU Development/SPKLU Factor Units: Dmnl	The impact resulting from the construction of SPKLU
EV Tax Policy Scenario= IF THEN ELSE(Time<=EV Tax Policy Start Year,0,1) Units: Dmnl	Government Scenario in EV Tax Policy
EV Tax Policy Start Year= 2023 Units: Year	The assumed start year of the tax policy is 2023.
Electricity incentives for EV users Scenario= Incentive Cost*Total Users Units: Million*Units/Year	Electricity tariff incentives for EV users
Incentive Cost=0.05 Units: Million	The assumption of EV user incentive per household is 50 thousand rupiah, if converted to millions it is 0.05
Total Users= 10000 Units: Units/Year	The estimated number of EV users per household is 10,000

Electricity Incentive Policy= IF THEN ELSE(Time<=Electricity Incentive Start Year,0,1) Units: Dmnl	Government policy scenario in providing electricity incentive tariffs
Electricity Incentive Start Year= 2026 Units: Year	The assumed start year of the incentive policy is 2026.
Total Electric Incentive= Electricity incentives for EV users Scenario/Beneficiaries Units Units: Million/Year	Total electric incentive given
Electric Incentive Factor= Total Electric Incentive Units: Million/Year	Factors in providing electricity tariff incentives
Impact of Electric Incentive= Electricity Incentive Policy*(Total Electric Incentive/Electric Incentive Factor) Units: Dmnl	The impacts resulting from inventive electricity tariffs

Appendix 2 Units Purchasing Subsystem

Variables, Formulas and Units	**Document**
EV Motorcycles Purchasing= INTEG (EV Motorcycles Purchasing Intention, 54000) Units: Units	Based on data from the Indonesian Motorcycle Industry Association (AISI), from 2017 to 2023, electric motorbike sales only amounted to 54 thousand units. resources: https://www.tempo.co/otomotif/aisi-ungkap-alasan-motor-listrik-masih-sepepipeminat-di-2023-96518

EV Motorcycles Purchasing Intention=EV Motorcycles Purchasing*EV Motorcycles Purchasing Intention Growth Units: Units/Year	Inflow of EV Motorcycles Purchasing Intention
EV Motorcycles Purchasing Intention Growth= (People Purchasing Intention/Percentage Unit)/Time Unit Units: 1/Year	Growth rate of EV motorcycles purchases
Percentage Unit=100 Units: 1	Percentage Unit
People Purchasing Intention= DELAY FIXED(Impact of EV Subsidized,Time Unit,Positive Impact) Units: Dmnl	Fixed delay of people purchasing intention
EV Motorcycle CO2 Mitigation= (EV Motorcycle Emission Forecast*EV Motorcycles Purchasing/Time Unit)/EV Unit Units: TonnesCO2e/Year	Mitigation generated from EV Motorcycles per year
EV Motorcycle Emission Forecast=0.5 Units: TonnesCO2e	Emission reduction per unit assumption is about 0.5 tonnesCO2e/year
EV Unit=1 Units: Units	EV Unit
Time Unit=1 Units: Year	Time Unit
EV Motorcycle Subsidized Disbursed=1 Units: Year	Estimate of disbursed EV motorbike subsidies in one year
Delay EV Motorcycle CO2 Mitigation= DELAY FIXED(EV Motorcycle CO2 Mitigation, EV	EV Motorcycle delay fixed

Motorcycle Subsidized Disbursed , 0) Units: TonnesCO2e/Year	
EV Cars Purchasing= INTEG (EV Cars Purchasing Intention, 17062) Units: Units	Sales of electric vehicles (BEV) in Indonesia in 2023 reached 17,062 units, with the Hyundai Ioniq 5 being the best-selling model. Resources: https://databoks.katadata.co.id/transportasi-logistik/statistik/7 99fbb48ed5753f/penjualan-mobil-listrik-di-indonesia-melonjuk-pada-akhir-2023
EV Cars Purchasing Intention Rate= (People Purchasing Intention/Percentage Unit)/Time Unit Units: 1/Year	Growth rate of EV car purchases
EV Car CO2 Mitigation= (EV Car Emission Forecast*EV Cars Purchasing/Time Unit)/EV Unit Units: TonnesCO2e/Year	Mitigation generated from EV Cars per year
EV Car Emission Forecast=2 Units: TonnesCO2e	Emission reduction per unit of car assumption is about 2 tonnesCO2e/year
Delay EV Car CO2 Mitigation= DELAY FIXED(EV Car CO2 Mitigation, EV Car Subsidized Disbursed, 0) Units: TonnesCO2e/Year	EV Car delay fixed
EV Car Subsidized Disbursed=1 Units: Year	Estimate of disbursed EV subsidies

Appendix 3 Impact of EV Use on Carbon Emission Subsystem

Variables, Formulas and Units	Document
Emission Avoided= INTEG (Emission Avoided Iinflow, 1) Units: TonnesCO2e	Emission avoided assumption in 2023 is zero, and in vensim, this research uses number 1 because in the system cannot put 0 as an initial value
Emission Avoided Inflow=Delay EV Car CO2 Mitigation+Delay EV Motorcycle CO2 Mitigation Units: TonnesCO2e/Year	Emission mitigation inflow from EV Cars and Motorcycles
Carbon Emission= INTEG (Carbon Emission Inflow-Carbon Emission Reduction, 1.2e+09) Units: TonnesCO2e	In 2023, greenhouse gas emissions in Indonesia will increase to 1200.20 mt CO2e/year. resources: https://data.goodstats.id/statistic/development-of-greenhouse-gas-emissions-in-indonesia-2013-2023-aDUqo#: :text=In%20the%20year%202023%20gas%20emissions,year%202019%20to%20the%20year%202020.
Carbon Emission Inflow=Carbon Emission*Carbon Emission Growth Rate Units: TonnesCO2e/Year	Increment of carbon emissions per year
Carbon Emission Growth Rate = WITH LOOKUP (Time, ([(2023,0)-(2024,1)], (2023,0.0382), (2024,0.0397))) Units: 1/Year	Emission growth assumption of approx. 2023= 0.0382 2024= 0.0397 resources: https://statistik.menlhk.go.id/sisklhkX/data_prioritas/detail_202 3/275
Emission Reduction Time=1 Units: Year	Emission reduction time

Carbon Emission Reduction= Emission Avoided/Emission Reduction Time Units: TonnesCO2e/Year	The outflow and influence by emission avoidance and emission reduction time.
Carbon Emission Reduction Factor= Carbon Emission Reduction Units: TonnesCO2e/Year	Carbon Emission Reduction Factor indicates the efficiency or effectiveness of avoiding emission reductions in reducing total carbon stocks.
Positive Impact = Carbon Emission Reduction/Carbon Emission Reduction Factor Units: Dmnl	Positive Impacts resulting from the use of EVs that contribute to CO2 mitigation
People Purchasing Intention= DELAY1I(Impact of EV Subsidized,Duration of Impact, Positive Impact) Units: Dmnl	Public interest in purchasing EVs
Duration of Impact=2 Units: Year	The assumed impact is two years.
Impact of EV Subsidized= Impact of EV Cars Subsidized+Impact of EV Motorcycles Subsidized Units: Dmnl	The impact of EV subsidies by the government