Proceedings of the First Australian International Conference on Industrial Engineering and Operations Management, Sydney, Australia, December 20-21, 2022

Study on Electric Vehicle Policy in Indonesia

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Abstract

The target of reducing greenhouse gas emissions led the Indonesian government to set a medium-term action called RUEN. For the transportation sector which produces the second largest emission, electric car use was being promoted. The government implemented several policies to encourage people to swiftly move from fuel cars to electric cars. Since the target achievement of electric car sales is still very low which is around 5%, the author studies the impact of policies that have been applied by using the system dynamics method. The government of Indonesia has applied policies of tax deduction, tax redemption, and road exemption to attract new electric car users. In this research, author finds that policies do not significantly affect sales of electric cars. Considering the target of 132.000 units in 2030, the sales of the remaining 8 years need to be drastically increased. It could be done by applying several new policies referring to other countries.

Keywords
electric vehicle, system dynamics, policy, emission

1. Introduction

As Indonesia commit a target of a 29% reduction of Green-House-Gas emissions in 2030, the government had appointed several actions described in the roadmap called RUEN (Rancangan Umum Energi Menengah). RUEN consists of an action plan to reduce GHG emissions and substitute non-renewable energy for renewable energy in several sectors such as energy producers, transportation, manufacturing, household, etc. The transportation sector has become one of the highlights of GHG emission and renewable energy utilization because it produces the second largest emission in 2018 (Laporan Inventarisasi Gas Rumah Kaca dan Monitoring, Pelaporan, Verifikasi tahun 2019, 2019) and consumes the largest energy (Handbook of Energy and Economy Statistics of Indonesia, 2020).

Actions taken on long-term plan (to 2030) in transportation is stimulating to use of biofuel and electric vehicle. Electric vehicle use in Indonesia has been started in 2017 for two-wheels and in 2019 for four-wheels. The target for each use in 2030 is 398.530 units and 132.983 units (Regulation of Ministry of Industry Number 27 Year 2020, 2020). Both achieve very low target, but the electric car was lower which is around 5% on August 2022 (Gaikindo, 2022). As the regulator, the government implement policies to encourage Indonesian to use the electric vehicle (EVs). Those are tax deductions and non-restriction roads for even odd for the same type of date. It should be pushing electric car numbers sold, however by simple calculation reaching 132.938 units in 2030 (which means around 15.000 per year) seems difficult.

Countries in the world have kinds of policies for scaling up the EV market. Several of them are implementing similar policies, such as tax deductions or exemptions, no public parking fees, free recharging, etc. Ziegler and Abdelkafi (2022) stated that incentives and policies have successfully increased electric car sales in Norway. Because of its policies such as tax exemption, no road tolls or public parking fees, and free recharging, there is a large diffusion of electric car usage. Referring to other country policies and their effect on car sales, the author studies the impact of electric car use policies in Indonesia and whether it is effectively increasing the number of electric car sales. If it doesn't have quite an impact, several new policies or adjusting current policies will be needed. In the end, GHG emissions could be measured by whether electric car sales had a high impact on reducing GHG emissions.

1.1 Objectives

The objectives of this research are to understand factors that affect EV use in Indonesia and how policies affect EV sales. Since EV said to be one of options to reduce GHG emissions, understanding how EVs relate to GHG emissions in Indonesia is also being an objective.

2. Literature Review

2.1. Electric Car Market Policies

Li et al. (2022) assessed the influence of electric car policies that have been implemented in China using a system dynamics model. Li divides the model into 4 subsystems, namely consumers, government, manufacturing companies, and infrastructure. The consumer subsystem describes how consumers choose to use electric cars with the influence of environmental friendliness, life cycle costs, license plate restriction for fuel cars, and the availability of supporting infrastructure. The subsystem describes the policies implemented by the government in promoting the use of electric cars such as social assistance and price subsidies. The manufacturing company subsystem describes the total revenue earned by the company. The infrastructure subsystem defines the number of charging stations and depreciation. In this research, the subsystem of manufacturing companies is not included because Indonesia's manufacturing capabilities are quite early in the production of electric cars.

Kim et al. (2021) describes the condition of the electric car market in Korea through the causal loop diagram. The four main factors in the spread of electric cars in the country consist of national subsidies, regional subsidies, charging infrastructure, and fuel prices. The impact of the policies implemented by the local government is projected until 2030 to see the achievement of targets. Kim stated that other encouragement in the form of other policies with different characteristics needed to be implemented.

The development of the electric car market in China is also researched by Liu et al. (2018). Liu describes a causal loop diagram that is divided into five subsystems, namely research and development, investment, costs of using electric cars, carbon quotas and costs of using conventional cars. Liu conducted a simulation using four scenarios that focused on the policies implemented by the government. On the other hand, Vilchez et al. (2019) describes the development of the electric car market in general. In his research, Vichez looked at the economic development side, electric battery technology, the availability of electric car models and the extent of exposure to electric cars in the automotive market.

Briseno et al. (2021) considers factors other than economics in research on the growth of electric and hybrid vehicles in Mexico. These other factors are ecological factors in the form of environmental certification, energy efficiency, the percentage of households that hand over their household waste to cleaners or place it directly in landfills and the percentage of households that have separated waste into organic and inorganic. The results of Briseno's research show that the selection of these factors successfully explains about 75% of the variation in sales of low-emission vehicles in that country. The factor that has the greatest influence is the economic factor.

2.2. System Dynamics

System dynamics is a method that is often used to describe relationships between factors and predict future conditions through scenario simulations. This method is widely applied in forecasting in various fields such as manufacturing, social, supply chain, public policy, and so on. In looking at macro conditions, this method is deemed suitable for use. The ability of system dynamics to see the complexity of the system is the author's basis for proposing research using system dynamics methods.

The stages of the system dynamics method are started with understanding the system that will be observed and the problem that will be handled. The system is built through a combination of elements or variables that have their respective values and the relationships between these elements. More broadly, the system also forms a feedback loop that will determine the behavior of the system. The overall system concept will be built when the problem has been defined. Next, a causal loop diagram will be built to formulate the model to be used in the simulation. The simulation aims to test whether the model is in accordance with the desired goals. Once deemed appropriate, the model and simulation results will be used in designing and evaluating policies that will be implemented in the future.

3. Methods

Describing the EV market and GHG emission as a whole system is challenging. Thus, authors conduct literature review to gain an understanding about the dynamics of EV market in countries and modeling its condition in Indonesia. This research use the system dynamics method. Later, a simulation of the whole system was done supported by Powersim 10 software.

4. Data Collection

4.1. EV Market Understanding

First step of systems dynamic was to understand the system and problem. Author did literature review and gain 5 main variables that affect the EV sales which is stated in Tabel 1.

Table 1. Main variables in research

Variables	Definition	Author
Total Cost of Ownership (TCO)	Superiority of EV use counted from mileage, charging cost and purchase cost.	Pfahl, S., et al. (2013), Koch, N., et al. (2022), Narassimhan, E., et al. (2018), Li, et al. (2022)
Charging station	Number of available charging station.	Koch, N., et al. (2022), Narassimhan, E., et al. (2018), Tan, Q., et al. (2014)
Car subsidies	Subsidies given by government such as tax redemtion or road non restriction.	Bienias, K., et al. (2020), Narassimhan, E., et al. (2018), Aasness, M., A., et al. (2015)
Car demand	Demand is affected by gross domestic product and population number.	Lopez-Arboleda, E., et al. (2021), Koengkan, M., et al. (2022)
Energy	Energy production amount and capacity	Lopez-Arboleda, E., et al. (2021), Tan, Q., et al. (2014)

Giansoldati et al. (2018) conducted an analysis of the reasons for purchasing electric cars by consumers in Italy. The results of the study show that infrastructure development will affect consumer purchasing decisions. The effect of infrastructure is greater than the influence of the distance traveled and the selling price of electric cars. These three things are the main factors driving the purchase of electric cars by consumers. On the other hand, the price factor is one of the main factors determining the purchasing activities of automotive products in Indonesia. This is because the electric car market in developing countries tends to be price-sensitive (Almansour et al., 2022).

4.1.1 Total Cost of Ownership

In the last 5 years the Indonesian car market has been dominated by Multi Purpose Vehicles (MPV) which are the best-selling cars (Gaikindo, 2017-2021). The first rank in four years is occupied by the Toyota Avanza with sales of more than one hundred thousand units in 2017. Toyota Avanza is a vehicle that is in the 4x2 segment category with a 1500-3000 cc engine and a tank capacity of 45 liters. Looking at sales trends in the last 5 years, this study considers MPV cars as a benchmark for conventional cars in the analysis conducted.

MPV vehicles sold in Indonesia are dominated by gasoline-powered vehicles. Gasoline sold in Indonesia through PT Pertamina's General Fuel Filling Stations is divided into RON 90, RON 92, RON 95, RON 98 and RON 100 types. RON 90 or called pertalite with a total consumption of up to 23,000,000 kilo liters in 2021 or nearly 80% of fuel consumption (Directorate General of Oil and Gas, 2022). However, in 2022 the government will find it difficult to meet the large demand for RON 90 so that a policy of reducing subsidies is implemented. The appeal is addressed to the public to refuel vehicles with RON according to vehicle specifications. MPV vehicles are encouraged to use RON

92 to maintain vehicle engine durability. Therefore, this study will use the price of RON 92 or Pertamax in the calculation.

4.1.2. Charging Station Infrastructure

To support the electric vehicle ecosystem, the Indonesian government through Presidential Regulation Number 55 of 2021 has assigned PLN to build and provide a Public Electric Vehicle Charging Station (SPKLU). PLN targets the construction of 24.720 SPKLU units in 2030. Until May 2022, PLN has built 332 SPKLU units spread across Indonesia (Ministry of Energy and Mineral Resources, 2022).

4.1.3. Government Subsidies

The provisions for the tax charged for each type of motorized vehicle are set forth in Government Regulation Number 74 of 2021. The Sales Tax on Luxury Goods (PPnBM) for hybrid cars and electric cars is 15%. Hybrid cars are subject to a Tax Imposition Basis of 33.33% while electric cars are subject to 0%.

4.1.4. Car Demand

GDP is the total added value generated by all business units in a particular country or the total value of final goods and services produced by all economic units (Badan Pusat Statistik, 2022). GDP can be used to see economic growth from year to year. Gao et al. (2017) concluded that GDP and the number of car sales have a linear relationship where GDP growth will drive growth in car sales. In the last 10 years, Indonesia's GDP growth has been positive. This underlies the addition of GDP as a variable considered in forecasting car sales.

4.1.5. Energy

One of the sources of GHG emissions is emissions generated by operated power plants. In calculating the amount of emission produced by the power plant, emission factor data is needed. The emission factor is a value that shows the relationship between the quantity released by pollutants into the atmosphere and the activities that produce these pollutants (Rauf, et al., 2014) which are measured in kg/kWh units. The emission factor will then be multiplied by the energy generated by each power plant to obtain the amount of CO2 emissions produced.

4.2. Causal Loop Diagram

Through understanding the factors influencing the growth of the electric car market discussed by previous studies, a model was carried out. The built CLD consists of various variables which are described in Figure 1. Data for each variable is secondary type data published by various parties.

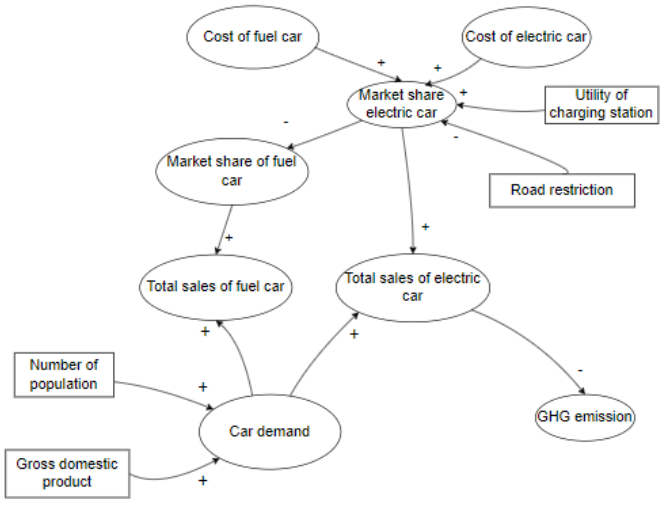

Figure 1. Causal Loop Diagram

The causal loop diagram is built into two main submodels namely:

a. Conventional car sales
This submodel is initiated by increasing car ownership as GDP and population increase. The level of ownership will affect the car demands. The size of the fuel car market share will positively affect the number of fuel car sales. The fuel car market share is influenced by the size of the electric car market share.

b. Electric car sales
This submodel also describes the relationship between the demand and market share to the number of electric car sales. The electric car market share is influenced by the total cost of fuel cars and usage utilities. The number of sales of electric cars obtained will positively affect the production of electricity that must be generated and negatively affect vehicle emissions. Electricity production will later emit positive emissions or add to GHG emissions. Conversely, vehicle emissions will negatively affect or reduce the resulting GHG emissions.

Based on the literature, the main reasons for the decision to use an electric car are cost, government subsidies, and considerations in the ease of charging. Subsidies in Indonesia that are currently running are purchase tax breaks, annual tax breaks, and exemptions in the odd-even rule on the highway. In this study it is assumed that consumers can choose three decisions in buying a vehicle, namely buying an electric car, a conventional car, or not buying a car. This is discussed in Liu's research (2017). Liu stated that consumers' ability to buy a car is determined by the main factors previously described.

5. Results and Discussion

The author analyzes dependencies between factor and result was explained below:

a. Gross domestic product is highly related to car sales. The growth of GDP will directly affect the buying ability of people. In Southeast Asia, Indonesia has the largest population, however because of GDP amount is low, vehicle ownership in Indonesia is lower than in Brunei and Malaysia. The government stated that they are aiming to increase vehicle ownership from 99 to 100 per 1000 people.
b. Fuel price is not highly related to electric car sales. Increasing fuel prices will not affect electric car sales significantly. This is due to high cost of electric car.
c. Electric car price is not highly related to electric car sales. It is because the electric car needs battery replacement, a factor that fuel car doesn't have. Besides, the utility of charging stations is still a consideration for buying an electric car.
d. Utility of charging stations is quite related to electric car sales. As today the availability of charging stations is still very low, it is needed to increase the number dramatically to affect the willingness of people to buy an electric car.

6. Conclusion

The intention of reducing GHG emissions by using electric cars has many challenges in developing countries. The government of Indonesia has applied policies of tax deduction, tax redemption, and road exemption to attract new electric car users. However, these policies need to study deeper, as the author finds that it does not significantly affect sales. Considering the target of 132.000 units in 2030, the sales of the remaining 8 years need to be drastically increased. It could be done by applying several new policies referring to other countries. The author suggests that further research could dig deeper into another commercial factor that might attract the new user.

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Biographies

Annisa Khairani currently pursues her master's degree in Industrial Engineering Department, Universitas Indonesia, concentrating in Industrial Management. She earned her bachelor's degree in Industrial Engineering from Telkom University, Bandung. Her late experience was working in automotive company as Research and Development engineer.

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