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Optimization of Fuel Subsidy Reallocation to Support the Electric Vehicle Program and Reduce Carbon Emissions in Indonesia

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A B S T R A C T

Indonesia faces significant challenges in subsidized fuel consumption, particularly in the transportation sector, which not only burdens the state budget but also worsens air quality. Therefore, the transition from fossil fuel-powered vehicles to electric vehicles is essential to reduce fossil fuel consumption and the air pollution caused by its use. This study employs a literature review method to analyze the potential reallocation of fuel subsidies to the electric vehicle program. The results indicate that by allocating 5% of the fuel subsidy budget, the government could fund up to 811,428 electric motorcycles and potentially reduce carbon emissions by 1,947,427 kg CO_2 per day. These reductions could then be converted into carbon credit certificates, generating up to $19,470 per day in revenue for the government, while also providing incentives for infrastructure developers to attract investment. Additionally, utilizing digital applications in the distribution of subsidized fuel can enhance targeting accuracy and minimize misuse.

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INTRODUCTION

Indonesia is currently facing significant challenges in terms of subsidized fuel consumption. As one of the countries with a growing population and increasing urbanization, the demand for fossil-based energy such as fuel continues to rise. One of the largest sectors consuming fuel is transportation. According to (Adi Ahdiat, 2023), the consumption of fuel with the RON 90 code has been steadily increasing every year, as shown in the following table:

Tabel 1. Fuel Consumtion RON 90 from 2015- 2022

Year	Oil Comsumtion RON 90
2015	379.959 Ribu
2016	5,81 Juta
2017	14,49 Juta
2018	17,71 Juta
2019	19,41 Juta
2020	18,14 Juta
2021	23,3 Juta
2022	29,7 Juta

Source: (Adi Ahdiat, 2023)

Not only does it put pressure on the national budget due to large subsidies, but it also worsens air quality in many regions, especially in major cities. This has caused several cities in Indonesia to rank among the most polluted cities in the world. On May 28, 2024, Jakarta was recorded as the most polluted city among 144 countries according to the air quality report by IQAir (Lia Wanadriani Santosa, 2024).

According to the Directorate of Energy Conservation (2024), during a sharing session on the Potential Implementation of the Carbon Market in the Battery-Based Electric Motor Vehicle Sector, it was explained that several factors are involved in fuel consumption in motor vehicles, as follows:

Table 2. Pollution contained in the use of fuel (BBM)

Type of Emmision	Satuan	Jumlah Karbon yang dihasilkan
CO2 (Carbon Dioxide)	1 Liter	2,4 kg CO2
SOx (Sulfur Oxide Emissions)	1 KM	0.008 g SOx
NOx (Nitrogen Oxide Emissions)	1 KM	0.29 g NOx

Source: Directorate of Energy Conservation (2024)

Referring to the data presented regarding fuel consumption and the emission levels contained within, it can be concluded that the CO2 emissions produced from the use of RON 90 fuel in 2022 amounted to:

$$Total\ CO2 = \ BBM\ Volume \times Emisi\ CO2\ /liter$$
$$Total\ CO2 = 29{,}7 Million \times 2{,}4\ KG$$
$$Total\ CO2 = 71{,}28\ Billion\ KG\ CO2$$

According to the calculations that have been made, the CO2 emissions produced from the use of RON 90 fuel in 2022 amounted to 71.28 billion KG of CO2. This condition highlights the need for a more sustainable energy transformation to reduce dependence on fossil fuels and mitigate air pollution.
One solution that has proven effective in many countries is the transition to electric vehicles. Electric vehicles have significantly lower emissions compared to fossil fuel-powered vehicles, which can greatly reduce air pollution levels (Cakrawati Sudjoko, 2021). In addition, electric vehicles can utilize energy from renewable power sources, such as solar or wind power, thus contributing to the creation of a more environmentally friendly energy system (Dharmawan et al., 2021).

This study aims to explore the potential of reallocating fuel subsidy funds to support electric vehicle programs in Indonesia. By reallocating these funds, the government can build supporting infrastructure, such as charging stations, and provide incentives for the public to switch to electric vehicles. This will not only reduce fuel consumption but also create new economic opportunities, such as the development of local battery and electric vehicle industries.

Furthermore, reallocating fuel subsidies to the electric vehicle program aligns with Indonesia's efforts to meet international commitments to reduce carbon emissions. In the Paris Agreement, Indonesia committed to reducing greenhouse gas emissions by 29% by 2030 through its own efforts, or up to 41% with international assistance (Anshori & Saputro, 2024). Transitioning to electric vehicles will be a strategic step toward achieving this target while also enhancing national energy security by reducing reliance on fossil fuel consumption.
Through this study, it is hoped that solutions and policy recommendations can be found to optimize the reallocation of fuel subsidy funds to the electric vehicle program. This transformation is not just about reducing air pollution or the burden on the national budget, but also about creating a more sustainable future for the next generation. Indonesia has a great opportunity to become a leader in the clean energy transition in Southeast Asia, and the electric vehicle program is a crucial first step in realizing this vision.

THEORETICAL REVIEW

Electric Vehicles

According to Presidential Regulation No. 55 of 2019, Battery Electric Vehicles are defined as vehicles that use an electric motor for propulsion and derive power from batteries, either directly within the vehicle or indirectly from external sources. Electric vehicles can be categorized into two types: two- or three-wheeled electric vehicles, and four-wheeled electric vehicles.
Regarding the charging system, based on the Minister of Energy and Mineral Resources Regulation No. 1 of 2023, there are two main methods:

1. Direct Charging System
   In this system, the electric vehicle's battery is charged directly using an external power source, such as Public Electric Vehicle Charging Stations, home chargers, or other power sources.
2. Battery Swap System
   This method allows electric vehicle users to exchange depleted batteries with fully charged ones at Public Electric Vehicle Battery Swap Stations . This system is faster than direct charging because it only requires battery replacement without the need to wait for the charging process.

PEVCS (Public Electric Vehicle Charging Station)

According to the Minister of Energy and Mineral Resources Regulation No. 1 of 2023, a Public Electric Vehicle Charging Station is a public facility that provides electricity to charge Battery Electric Vehicles (BEVs). SPKLUs are designed to support two types of charging methods: normal charging using alternating current (AC) and fast charging using direct current (DC).
Normal charging, which uses alternating current (AC), generally takes longer as the power used is lower. This method is often used at private facilities, such as home charging. Meanwhile, fast charging with direct current (DC) allows for quicker charging, making it more suitable for users with high mobility. This fastcharging system is typically available at PEVSC, which are specifically designed to provide fast charging services.

PEVSCs can be operated by Electric Power Supply Business Entities (BUPTL) that have obtained permits from the Ministry of Energy and Mineral Resources or other relevant authorities. SPKLU locations are typically situated in strategic areas, such as shopping centers, rest areas, office buildings, and other public facilities. This infrastructure must meet technical and safety standards, including the type of connectors and the power used, whether for AC or DC currents.

PEVBSS (Public Electric Vehicle Battery Swap Station)

Based on the Minister of Energy and Mineral Resources Regulation No. 1 of 2023, the Public Electric Vehicle Battery Swap Station is a facility that provides battery swapping services for electric vehicles. Unlike the direct charging system, this battery swap system is more flexible as the batteries are stored at PEVBSS facilities, allowing electric vehicle users to simply swap their batteries for fully charged ones at the location.

The battery swapping process at PEVBSS takes less than three minutes per vehicle, enabling users to save time compared to conventional charging. Additionally, users can monitor the availability and condition of batteries at PEVBSS through the provided applications. However, since each PEVBSS facility only serves specific battery brands, users need to adjust the application and battery type they use to access relevant information about battery availability at PEVBSS.

Air Pollution

According to the Minister of Environment Regulation No. 8 of 2023, air pollution occurs when substances, energy, and/or other elements from human activities enter or are released into ambient air, exceeding the established air quality standards. Meanwhile, Emission Quality Standards refer to the maximum limit of air pollutants allowed to be released into ambient air.

The Ministry of Environment and Forestry (KLHK) has revealed that the transportation sector is the largest contributor to air pollution, accounting for 44 percent of total emissions. The industrial sector follows with a 31 percent contribution, manufacturing at 10 percent, residential at 14 percent, and the commercial sector at 1 percent (Victor et al., 2023).

From the above discussion, it is evident that the largest contributor to air pollution comes from the transportation sector. Therefore, a transformation from fuel-based vehicles to electric vehicles is necessary to reduce existing pollution.

METHODOLOGY

This study uses a literature review method by examining various journals and articles related to "Optimizing the Reallocation of Fuel Subsidy Funds to Support Electric Vehicle Programs." The research stages include data collection, analysis, and drawing conclusions to evaluate the benefits of reallocating fuel subsidies to the electric vehicle program in Indonesia.

Data sources were obtained from various platforms such as Google Scholar, ResearchGate, official websites of the Ministry of Energy and Mineral Resources (ESDM), and others.

The primary focus of this research is to analyze the impact of reallocating fuel subsidies to the electric vehicle program, with the aim of reducing fuel consumption, decreasing pollution levels, and increasing the use of electric vehicles in Indonesia.

RESULTS AND DISCUSSIONS

Increasing Incentives for Electric Vehicle Facility Operators

The Minister of Energy and Mineral Resources Regulation No. 1 of 2023 is a strategic government policy aimed at accelerating the implementation of Battery Electric Vehicles (BEVs) in Indonesia. This regulation governs the development of charging infrastructure, including Public Electric Vehicle Charging Stations and Public Electric Vehicle Battery Swap Stations, which are key components in supporting the electric vehicle ecosystem. The primary goal of this regulation is to ensure the availability of reliable, safe, and easily accessible infrastructure, while promoting the use of electric vehicles as part of the transition to clean energy.

The government recognizes that developing PEVCSs and PEVBSSs requires significant investment. Therefore, on September 2, 2021, the government provided a bulk tariff incentive of IDR 714/kWh for PEVCS Business Entities, with a maximum sales tariff of IDR 2,467/kWh (Rida Mulyana, 2021), allowing businesses in this sector to earn a profit margin of up to IDR 1,753/kWh.

In the future, it is possible that the government may shift fuel subsidies (BBM) to the electric vehicle sector. This would allow the bulk tariff incentives to be reduced, for example to IDR 600/kWh or even lower.

Allocating Fuel Subsidy Funds to Electric Vehicle Subsidies

The Minister of Industry Regulation No. 6 of 2023 regulates the Guidelines for Government Assistance for the Purchase of Battery-Based Electric Motor Vehicles for Two-Wheelers, which officially came into effect on March 20, 2023. This regulation is a continuation of the Presidential Regulation No. 55 of 2019, which forms the basis of the electric vehicle transformation acceleration program in Indonesia.

This regulation governs the subsidy distribution scheme for electric vehicles, which can only be provided to specific individuals registered in government assistance programs, such as subsidies for electricity up to 900 VA, wage subsidy assistance, or recipients of People's Business Credit. The subsidy is provided in the form of a discount of 7 million IDR for the purchase of a two-wheeled electric vehicle, with the condition that one National Identification Number is valid for only one electric vehicle.

However, this regulation was later amended by the issuance of the Minister of Industry Regulation No. 21 of 2023, which changed the requirements for subsidy recipients. Previously, subsidy recipients had to be registered in government assistance programs, such as electricity subsidies, wage subsidies, or KUR recipients. Under Regulation No. 21 of 2023, the subsidy eligibility was amended to include Indonesian citizens aged 17 years or older with an electronic identity card. This subsidy can only be claimed with the condition that one NIK is valid for one electric vehicle.

According to the Chairman of the Budget Committee of the Indonesian House of Representatives, Said Abdullah (2024), the fuel and LPG subsidies for the 2025 fiscal year are estimated to be IDR 113.6 trillion, with a volume of 8.17 million metric tons of LPG and 19.41 million kiloliters of fuel (Aji Nugroho, 2024). If this budget were to be redirected to the electric vehicle subsidy program in 2025, the funds would be sufficient to subsidize a significant number of electric vehicles, as shown in the following table:

Table 3. Calculation of the Allocation of Fuel and LPG Subsidy Budget to Electric Vehicle Subsidy of 7 Million IDR per Unit

Fuel Budget for 2025	Persentage	Result	Total of Electric Vehicles Subsidy
Rp. 113,6 Trilion	1 %	Rp 1,316 trillion	188.000 Vehicles
Rp. 113,6 Trilion	3%	Rp 3,408 trilion	487.714 Vehicles
Rp. 113,6 Trilion	5%	Rp 5,68 trilion	811.428 unit Vehicles

Source: Processed by the researcher (2024)

From the data above, if the government can allocate just 1% of the BBM subsidy budget, the two-wheeled electric vehicle subsidy program for the 2025 fiscal year could continue to accelerate the transformation of electric vehicles in Indonesia.

Potential Carbon Emission Reduction

The Electric Vehicle Transformation Policy will have a significant impact on reducing greenhouse gas (GHG) emissions in Indonesia. According to the Directorate of Energy Conservation in the Sharing Session on the Potential Implementation of the Carbon Market in the Battery-Based Electric Motor Vehicle Sector (2024), 1 liter of Pertalite fuel can cover a distance of 10 km while producing approximately 2.4 kg of CO_2 per day. However, by using electric vehicles, users only need 1.3 kWh per 10 km without generating any CO_2 emissions.

Referring to the target calculations in Table 3, if the government reallocates 5% of fuel and LPG subsidies to electric vehicle subsidies, a total of 811,428 two-wheeled electric vehicles would receive subsidies. Based on this figure, if we calculate the potential daily CO_2 reduction, the amount of CO_2 that could be reduced per day is:

$$\text{Emmision Reduction} = 811.428 \times 2{,}4 \text{ Kg CO2}$$
$$= 1.947.427 \text{ Kg CO2}$$

Based on the above calculations, it can be concluded that the potential reduction in carbon emissions resulting from the optimization of fuel subsidy reallocation to the electric vehicle subsidy program, with a 5% reallocation of fuel subsidy funds, could reduce CO_2 emissions by 1,947,427 kg per day.

The potential sale of carbon credits

Continuing the previous discussion on the potential for carbon emission reduction, with 811,428 electric vehicles currently in circulation in Indonesia due to government subsidies, a significant reduction in carbon dioxide (CO_2) emissions of 1,947,427 kg CO_2 per day has been achieved.

Based on previous calculations, each conventional vehicle using RON 90 fuel produces approximately 2.4 kg of CO_2 per day. Therefore, by replacing these conventional vehicles with electric vehicles, which produce no emissions at all, the total reduction in emissions reaches 1,947,427 kg CO_2 per day.

$$1000\ Kg = 1\ Ton$$
$$1.947.427\ Kg = 1.947\ Ton$$

From these figures, it can be seen that 811,428 electric vehicles can contribute to an emission reduction of 1,947 tons of CO_2 per day. Furthermore, 1 ton of CO_2 is equivalent to one carbon credit certificate, which is valued at $10 if sold under the Voluntary Emission Reduction (VER) scheme (Net0, 2024). Therefore, the potential revenue that can be generated is $19,470 per day.

Use of Applications as a Requirement for Subsidized Fuel Purchases

The Indonesian government, through Presidential Regulation No. 117 of 2021 on the Provision, Distribution, and Retail Sale Prices of Fuel (BBM), has established a policy to ensure that BBM subsidies are more targeted to specific

consumers. As part of the implementation of this policy, the government has partnered with Pertamina to develop the My Pertamina app, which functions to enhance monitoring and management of subsidized BBM distribution in a more controlled, data-based manner.

The My Pertamina app allows for the registration and verification of subsidized BBM users, such as RON 90 (Pertalite). The app also records subsidized fuel transactions in real-time, enabling the government to monitor its distribution transparently and reduce the potential for misuse, such as large-scale purchases for illegal resale.

Consumers wishing to obtain subsidized BBM through this app are required to register and upload vehicle data and identity documents, such as a photo of their ID card, photos of the vehicle registration certificate (STNK) front and back, photos of the vehicle from the front and side, and the vehicle's license plate number (Pertamina, 2024).

Currently, the use of the My Pertamina app for accessing subsidized BBM is mandatory only for four-wheeled vehicles in the regions of Java, Madura, and Bali. Meanwhile, for areas outside Java, Madura, and Bali, the process is still underway and is expected to be fully implemented by November 2024 (Maulandy Rizky, 2024). The application for two-wheeled vehicles has not yet been strictly enforced, so further action is needed to ensure that subsidies for two-wheeled vehicles are better monitored.

CONCLUSIONS AND RECOMMENDATIONS

To accelerate the transformation to electric vehicles, reallocating 5% of fuel subsidy funds has the potential to expand subsidy coverage to 811,428 two-wheeled vehicles and achieve a carbon emission reduction of 1,947,427 kg CO_2 per day. Additionally, converting the reduced emissions into carbon credit certificates could generate $19,470 per day.

Furthermore, several proposals for the government to accelerate this electric vehicle transformation program are as follows:

1. Utilize the reallocated fuel subsidy funds to provide additional incentives for electric vehicle infrastructure developers, aiming to increase investor interest in this sector.
2. The government can also encourage the use of digital applications in the distribution of subsidized fuel to ensure more targeted subsidies and reduce the potential for misuse.

FURTHER STUDY

This research focuses on reducing the use of fossil fuels, which will significantly impact reducing air emissions in Indonesia and enhance national energy security.

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