

THE EFFECT OF ELECTRIC CAR USE ON GREENHOUSE GAS EMISSIONS IN JAKARTA

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Abstract

Air is an important factor in life, however, in the modern era, in line with the development of the physical development of cities and industrial centers, as well as the development of transportation, has caused air quality to change which causes global warming that is the increase in average temperatures in the atmosphere and surface layers of the earth caused by increased concentrations of greenhouse gases caused by human activity itself. In addition, the increasing use of fuel oil will also lead to less petroleum which results in reduced mobility of transportation using fuel oil. The purpose of this study is to determine CO₂ emissions due to the operation of private cars using The Tier 2 calculation method with vehicle kilometer travelled (VKT) approach. Based on the results of the analysis conducted, CO_{2e} produced by vehicles in Jakarta with an average vehicle mileage of 10,898.69 Km / Year without electric vehicles in 2035 is 34,514,428.11 Tons / Year, while if 30% using electric vehicles emissions produced is 28,974,310.21 Tons / Year or reduced by 16.05%.

Keyword : *Electric Car, Greenhouse Gas, Air Pollution, Fuel Oil and Tier 2*

Introduction

The level of air pollution in Jakarta is increasing every year, according to the Ministry of Environment & Forestry (2021) motor vehicle emissions contribute 70% to nitrogen oxide (NO_x), Carbon Monoxide (CO), Sulfur Dioxide (SO₂) and Particulate (PM) pollution in urban areas. (Kementrian Lingkungan Hidup & Kehutanan, 2021). One of the consequences is an increase in the number of vehicles, based on data from the Central Statistics Agency bps (2020) shows that the growth of motor vehicle use in Indonesia during the period 2017-2020 continues to increase. The largest number of vehicles of motorcycle type, next is passenger car, freight car and the last bus car (BPS DKI Jakarta, 2020).

The increase in the number of vehicles in Jakarta is directly proportional to the increase in fuel oil demand and congestion levels. Based on the type of fuel used, fuel oil and natural gas fuel is the majority of fuel used in DKI Jakarta. Based on its user sector, fuel

in DKI Jakarta is used by the generation sector, manufacturing industry, transportation, household and commercial sectors. The largest energy needs in 2018 were the transportation sector which reached 47.4% of DKI Jakarta's total energy needs, followed by power generation by 31.9%, manufacturing industry by 14.6%, households by 5.2%, commercial by 0.7%, and other sectors by 0.2% (DLH Provinsi DKI Jakarta, 2019). The use of fuel oil in vehicles can produce greenhouse gases in the atmosphere that then envelop the earth so that the earth's temperature is higher. The higher the earth's surface temperature causes climate change and global environmental problems, if the climate changes then more disasters will come (Muhammad et al., 2020). Congestion can also result in too much exhaust gas from motor vehicles, resulting in the effects of greenhouse gases (ERK) and global warming, the gas content can also interfere with health, and bring dangerous diseases. Therefore, there needs to be an investigation to reduce the use of fuel oil and reduce air pollution caused by motor vehicles (Ismiyati et al., 2014).

Therefore, the government through Presidential Regulation (Perpres) No. 55 of 2019 concerning acceleration of Battery-Based Electric Motor Vehicle Program and other derivative regulations related to electric vehicles. One of its derivative regulations is Government Regulation (PP) Number 73 of 2019 concerning Taxable Goods Classified as Luxury In the Form of Motor Vehicles Subject to Sales Tax on Luxury Goods (*PPnBM*). The rules that change the taxation method of most types of vehicles, including electric vehicles such as, the imposition of *PPnBM* by 0 percent, the imposition of local taxes (*PKB and BBNKB*) at the highest of 10 percent of the basic imposition of *PKB or BBNKB*, minimum down payment of 0 percent and light interest rates, discounts on electricity connection, special license plates, and other incentives. The regulation is set for October 15, 2019 and will take effect in October 2021 (Kompas, 2021).

Method

The basic method used in this study is quantitative method using Tier 2 calculation method with Vehicle Kilometer Travelled (VKT) approach. This tier 2 calculation method limitation is used on CO₂e gas. By using the required secondary data, namely, car mileage data per year, average vehicle fuel consumption, number of vehicles and

emission factors, secondary data obtained from relevant agencies such as the Central Statistics Agency (BPS), Global Fuel Economy Initiative (GFEI), Ministry of Energy and Mineral Resources (ESDM) and the results of previous research. This research was conducted in Jakarta as the city with the largest contributor of air pollution in Indonesia due to transportation modes.

To obtain the results of total emissions (E) from passenger cars, the total kilometers traveled by passenger cars in Jakarta (n) is obtained from the multiplication of the number of vehicles in Jakarta with the average kilometers of vehicles traveled by each vehicle. Then, n multiplied by the average fuel consumption of the car (K). It is then converted from Liter to Kilo Liter and changed again to Terajoule, then multiplied by emission factor (EF).

$n = \text{Number of Vehicles} \times \text{Vehicle Kilometers Traveled}$

$\text{Fuel used} = n \times K$

$E = ((n \times K) / 1000) \times EF$

Where :

$E = \text{Number of emissions (Ton CO}_2\text{e / year.km)}$

$n = \text{Vehicle Kilometers Traveled in Jakarta (km/year)}$

$VKT = \text{Vehicle Kilometer Traveled (km/year.unit)}$

$EF = \text{Emission factor (Ton CO}_2\text{e / TJ)}$

$K = \text{Fuel Consumption (liters / km.unit)}$

Calculation of pollutant source emissions using tier 2 method, based on kilometers of vehicles traveled (VKT) requires data Number of vehicles with the type of passenger car, average fuel consumption data, CO₂ emission factor data and data on electric power interconnection emission factors. The required data are as follows:

Total Motor Vehicle Data

The number of vehicles used in this research method is the number of motor vehicles by vehicle type (unit) in DKI Jakarta Province:

Table 1 Number of Motorized Vehicles by Type of Vehicle (units) in DKI Jakarta Province

Transportation type	Number of Motorized Vehicles by Type of Vehicle (units) in DKI Jakarta Province		
	2018	2019	2020
Passenger car	2789377	2805989	3365467

Source : (BPS DKI Jakarta, 2020)

The government in this case the Ministry of Industry, targets the development of Low Carbon Emission Vehicle (LCEV) vehicles as follows:

Table 2 LCEV Production Target

Target Percentage Low Carbon Emission vehicle (LCEV) (%)			
year	2025	2030	2035
Percentage LCEV (%)	20	25	30

Source : (Ministry of Industry of the Republic of Indonesia, 2019)

Average Fuel Consumption Data

Emissions from road vehicles must be associated with the country where the fuel is sold, therefore the fuel consumption data must reflect the fuel sold within the territory of the country. (IPCC, 2006). The average fuel consumption data is 0.073 liters/km based on global fuel economy initiative (GFEI) and assumed that all vehicles in Jakarta are classified as All New Car, City Cars and Medium Cars (GFEI, 2016).

CO2 Emission Factor Data

The default CO2 emission factor assumes that 100% of fuel carbon is oxidized into CO2. This regardless of whether carbon was originally emitted as CO2, CO, NMVOC or as particulate matter. For Tier 2, emissions are estimated using country-specific and fuel-specific emission factors available (IPCC, 2006). In this study, it was assumed that the emission factor of all cars used ron 92 fuel, with Tier 2 emission factor of 72.6 Ton Co2/TJ. (Ministry of Energy and Resources, 2017).

Electricity Interconnection Emission Factor Data

The result of calculation and update of emission factors for several electrical power interconnection systems in 2016 in Java-Madura-Bali is Ex-Ante 0.862 Ton CO₂e/MwH (Directorate & Ministry of Energy and Mineral Resources, 2016).

Data Vehicle Kilometers Traveled

In tier 2 method to get vehicle mileage data (VKT) is done by survey. The result is an average kilometer of vehicles traveled for passenger cars is 10,898.69 Km / year.

Discussion and Research Results

With Scenario 1 that all cars are assumed to use internal combustion, the resulting emissions are 12,223,799.29 Tons of CO₂e and use 4,375,546.08 KL/Year fuel in 2025, produced emissions of 20,553,641.89 Tons of CO₂e and used 7,357,238.54 KL/Year in 2030 and produced 34,514,428.11 Tons of CO₂e and fuel use of 12,354,544.37 KL/Year by 2035. While with Scenario 2 in accordance with the target of the Ministry of Industry, namely in 2025 it is assumed that 80% of cars use internal combustion and 20% of electric cars, the emissions produced are 10,915,722.39 Tons of CO₂e with a decrease of 10.70% and fuel use of 3,500,436.87 KL/Year, in 2030 it is assumed that 75% of cars use internal combustion and 25% of electric cars, the emissions produced are 17,804,318.26 Tons of CO₂e with a decrease of 13.38% and fuel use of 5,517,928.90 KL/Year, in 2035 it is assumed that 70% of cars use internal combustion and 30% of electric cars, the emissions produced are 28,974,310.21 Tons of CO₂e with a decrease of 16.05% and fuel use of 8,648,181.06 KL/Year.

Table 3 Comparison of CO₂e Emissions in Scenario 1 and 2

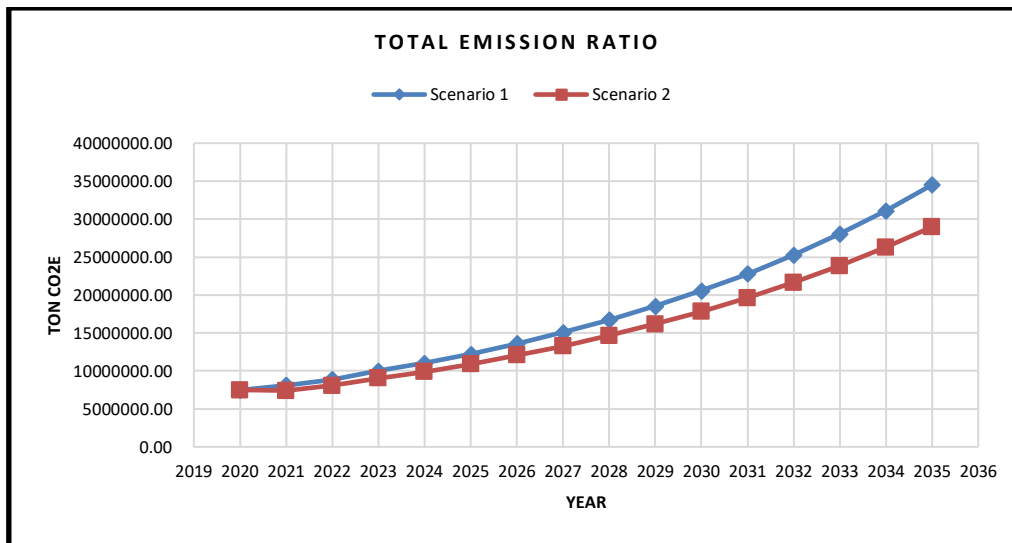


Table 4 Comparison of Fuel Consumption in Scenario 1 and 2

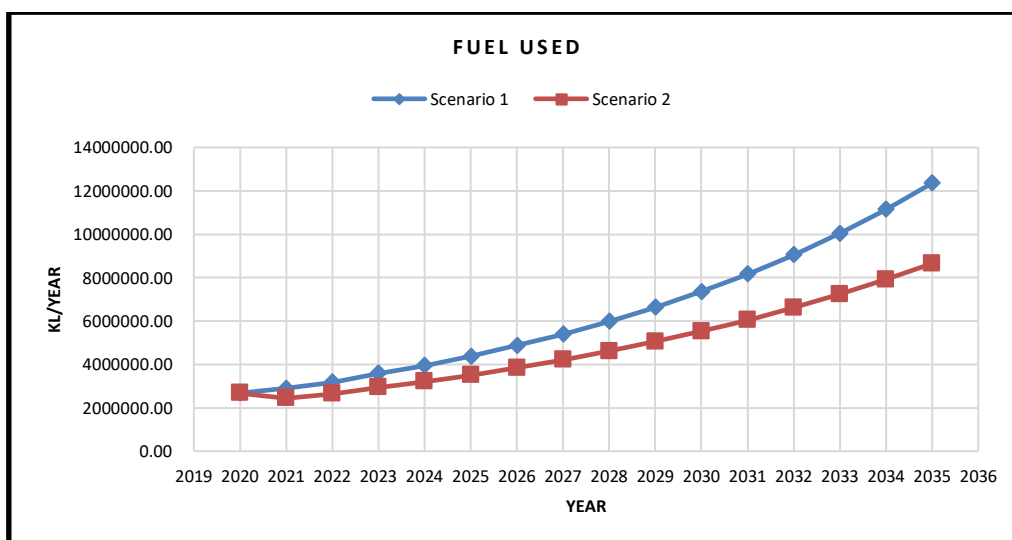
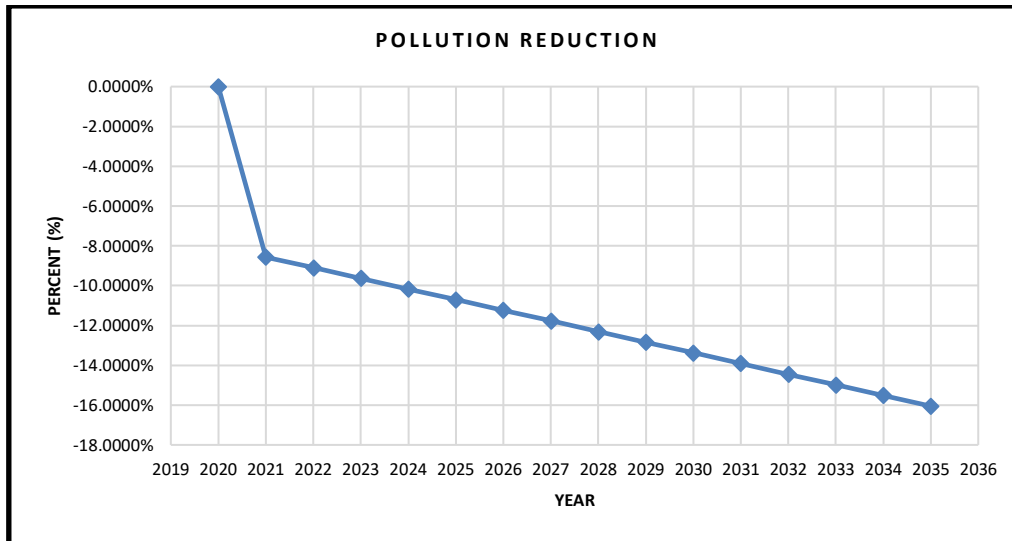


Table 5 Electric Car Effect



Conclusion

Based on research conducted, electric vehicles have a significant effect on CO₂e gas emissions produced in the city of Jakarta. Based on the graph above, if using scenario 2 or according to the target of the Ministry of Industry in 2025 (20% electric cars) the reduction in CO₂e emissions is 10.70% or 1,308,076.90 tons of CO₂e, in 2030 the reduction in CO₂e emissions is 13.38% or 2,749,323.63 tons of CO₂e, and in 2035 the reduction in CO₂e emissions is 16.05% or 5,540,117.90 tons of CO₂e.

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