Utilization of electric vehicles as an energy alternative to reduce carbon emissions

C Sudjoko1*, N A Sasongko1,2, I Utami1 and A Maghfuri1

1 Energy Security, Indonesia Defence University, IPSC Area, Sentul, 16810, Indonesia
2 Agency for The Assessment and Application of Technology (BPPT), Jakarta 10340, and National Research and Innovation Agency (BRIN), Jakarta 10340, Indonesia

*E-mail: cakrawati.sudjoko@gmail.com

Abstract. Energy has an important role in achieving social, economic and environmental goals, with energy being a driving force for the economy and a form of defense against the state. Because energy supports the supply of fuel, electricity and infrastructure so as to support a stable defense. The increasing needs of the community in the transportation sector and the decreasing availability of fossil energy. The Indonesian government is trying to find alternative energy as a substitute for fuel oil, namely by using electric vehicles. With the development of electric vehicles in Indonesia, it is expected to be a solution and can support the achievement of clean and environmentally friendly energy. Electric vehicles can reduce pollution and exhaust emissions due to the use of fuel oil in two or four-wheeled vehicles. In addition, using electric-fueled vehicles will certainly reduce the energy crisis and import fuel oil. In support of clean and environmentally friendly energy, Indonesia has supported the Paris Agreement policy to reduce carbon emissions in the transportation sector. The author tries to discuss the use of electric vehicles through current policies and applications and is associated with reducing carbon emissions through the use of electric cars. At the end the researcher will provide strategic recommendations related to the use and development of environmentally friendly electric vehicles to be developed in Indonesia in order to reduce carbon emissions in the transportation sector.

1. Introduction

Electric vehicles are an important solution to reduce pollution and exhaust emissions due to the use of fuel oil. The use of vehicles in Indonesia is currently increasing. Batteries have become a part of modern life. Number of products that relying on batteries as a power source nowadays very much. For example computers, cell phones, and EVs [1-10]. Lithium battery is one type of battery that is often used in electrical energy storage media. This type of battery has the ability to store high energy density, high open circuit potential voltage, fast energy charging, low self discharge, and is environmentally friendly. An example of a type battery lithium is lithium polymer. In Indonesia, President Joko Widodo plans to make Indonesia as one of the centers of the world's electric car industry. The Battery-Based Electric Motor Vehicle (KBLBB) program is an accelerated step taken to realize the implementation of electric vehicles in Indonesia
accordance with the planned targets. With the existence of KBLBB, it provides a solution and can assist the government in saving energy costs and dependence on imported fuel, as a means of transportation that is pollution-free and environmentally friendly, as well as alternative solutions to support Zero Emissions in Indonesia [11-17].

2. Material and Method
This research will be conducted using a qualitative method. Where this study conducted more literature studies by reviewing previous research. Data collection techniques using data are carried out using secondary data in the form of descriptive analysis of various references from journals, books, reports, internet and others. This study aims to analyze the use of electric energy in vehicles that are used as an alternative to reduce emissions in the environment and reduce imports of fuel in supporting energy security. In the discussion, the research examines battery materials, supply chains, policies and implementation of electric vehicles in Indonesia. This research is also associated with environmental issues so that the presence of electric vehicles in Indonesia can be a strategic alternative in reducing environmental pollution.

3. Result and Discussion
3.1 Emissions Problems in The Transportation Sector
Climate change has become a serious problem and an important concern for several countries. Alternative energy is currently very much needed in reducing carbon emissions and supporting the existence of energy security now and in the future based on environmentally friendly. Currently, the use of energy that is continuously used can provide various kinds of threats, one of which is the energy crisis and environmental pollution in the form of carbon emissions which are the causes of climate change. The main cause of climate change is the greenhouse effect. The Ministry of Environment (2012) states that Greenhouse Gases (GHG) can consist of various gas compositions including: CO$_2$, CH$_4$, N$_2$O, HFCs, PFCs, SF6. Of all these types of gases, the main GHGs are CO$_2$, CH$_4$, and N$_2$O. Of these three types of gas, the most abundant in the atmosphere is CO$_2$ (carbon dioxide) originating from various sectors. The high CO$_2$ emission clearly proves that the source of CO$_2$ emissions that still come from the dominant energy source comes from the use of fossil fuels can make a real contribution to environmental damage. According to data from the ministry of the environment, there are various factors that cause GHG emissions, one of which is from the energy sector which makes a major contribution to supporting the increase in GHG emissions, as described in table 1 below regarding the amount of emissions generated from the energy sector.

Table 1 above shows that the resulting high GHG emissions. The transportation sector provides CO$_2$ emissions so that other energy alternatives are needed to support clean energy in Indonesia, namely by using electric-fueled vehicles, it will reduce emissions in the transportation sector in the future. Electric vehicles can help to solve the problem of air pollution in urban areas. The development of electric cars and electric motorcycles has the potential to significantly reduce pollutant emissions (CO, NO$_x$, HC, SO$_2$, and PM). The fuel used for motor vehicles is still dominated by fossil fuels. Burning fossil fuels will produce air pollution due to exhaust gas emissions, such as: carbon monoxide (CO), nitrogen oxides (NO$_x$), hydro carbon (HC), SO$_2$, and particulate matter (PM) which have local impacts and produce GHG emissions in the form of carbon dioxide (CO$_2$) which has a global impact. Currently, the government is encouraging the development of electric vehicles and charging station infrastructure through Presidential Regulation no. 55/2019. Electric vehicles produce far less air pollution and can be said to be close to zero. Electric vehicles are suitable for tackling the problem of air pollution, especially in urban areas.
### Table 1. GHG emissions from the energy sector 2010-2017 (Gg CO$_2$e)

| Source of GHG Emissions | 2010    | 2011    | 2012    | 2013    | 2014    | 2015    | 2016    | 2017    |
|-------------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| By Type of Fuel          |         |         |         |         |         |         |         |         |
| 1. Liquid Fuels          | 210,441 | 243,878 | 262,190 | 255,883 | 271,569 | 223,560 | 220,606 | 215,526 |
| 2. Solid Fuels           | 159,328 | 188,518 | 194,681 | 154,837 | 187,476 | 205,753 | 214,607 | 226,794 |
| 3. Gas Fuels             | 85,083  | 85,797  | 85,302  | 90,935  | 96,795  | 101,066 | 105,334 | 99,018  |
| **Total by type of fuel**| 454,853 | 518,194 | 542,172 | 501,655 | 555,840 | 530,420 | 540,547 | 541,338 |
| By Sector/Sources        |         |         |         |         |         |         |         |         |
| 1. Energy Industries     | 144,526 | 173,803 | 187,631 | 189,860 | 223,213 | 226,278 | 246,851 | 258,041 |
| 2. Manufacturer          | 133,062 | 149,044 | 142,597 | 92,072  | 96,422  | 108,201 | 87,933  | 87,932  |
| 3. Transportation        | 108,264 | 117,570 | 139,271 | 143,243 | 141,520 | 129,187 | 136,407 | 147,230 |
| 4. Commercial            | 3,793   | 3,462   | 4,306   | 4,103   | 3,834   | 4,413   | 2,918   | 3,182   |
| 5. Residential           | 28,299  | 28,674  | 29,663  | 31,313  | 32,303  | 32,720  | 33,164  | 34,863  |
| 6. Non-Specified         | 12505   | 11,848  | 14,670  | 13,501  | 12,443  | 14,258  | 8,853   | 9,095   |
| 7. Fuel Combustion       | 430,449 | 484,401 | 518,139 | 474,092 | 509,734 | 515,056 | 516,124 | 540,342 |
| 8. Fugitives             | 22,786  | 22,955  | 22,280  | 21,938  | 21,408  | 21,250  | 21,901  | 21,901  |
| **Total Sectoral**       | 453,235 | 507,357 | 540,419 | 496,030 | 531,142 | 536,306 | 538,025 | 562,244 |

### 3.2 Utilization of Nickel as The Main Component of Batteries in Electric Vehicles

The figure shows the flow of nickel utilization as the main component of making batteries for electric vehicles.

Nickel is used as a major component in the manufacture of electric vehicles because it is more efficient, cheaper and has high energy storage capabilities. Therefore, the need for nickel for batteries will be important. In addition to the needs of electric vehicles, nickel is an important material in the manufacture of lithium-ion batteries (Li-ion batteries or LIBs) used in drones, micro-robots, smartphones, laptops, medical equipment, power plants, etc. LIBs have several types. The main difference between these batteries lies in their cathode chemistry. Two of the most common types of LIBs used today are Lithium Nickel Cobalt Aluminum (LiNiCoAlO2 or NCA) and Lithium Nickel Manganese Cobalt Oxide (LiNiMnCoO2 or NMC). Both are widely used for the needs of various electronic equipment and EVs. It is estimated that the world's nickel demand will increase significantly due to the growth of the LIBs industry. Because it is more economical and has a higher energy density level (AEER, 2021).

The trend of increasing production of electric vehicle batteries is followed by an increase in demand for battery material, the most expensive part of electric vehicles. The shift in battery technology that uses more nickel can be seen from the projected battery types that will be used in electric vehicles in 2025 such as NMC 811 NMC 622, or NMC 532 where the numbers are percentages of the materials used. The number 811 means that it consists of 80% Nickel, 10% Manganese, 10% Cobalt. In 2019 it is estimated that 48% of new batteries for electric vehicles using cathodes contain at least 50% nickel (AEER, 2020). With competitive supply chain advantages, 35% of EV components can be from local batteries. In support of the KBLBB program, a BUMN battery holding company has been formed, namely Holding named Indonesia Battery Corporation (IBC). The formation of the Electric Vehicle (EV) battery holding has been agreed upon by the four members, namely the mining holding MIND ID, PT Aneka Tambang Tbk (Antam), PT Pertamina (Persero) and PT PLN (Persero). Tbk (Antam), PT Pertamina (Persero) and PT PLN (Persero).
3.3 Sustainable Electric Vehicle Development to Reduce Carbon Emissions

The automotive industry has become one of the most important industries worldwide, not only on an economic level, but also in terms of research and development. With the increasing number of vehicle users, the level of air pollution in the urban environment is increasingly dirty and polluted with pollutants such as nitrogen oxides (NO\textsubscript{X}), CO, sulfur dioxide (SO\textsubscript{2}), etc. According to a European Union report, the transport sector is responsible for almost 28% of total carbon dioxide (CO\textsubscript{2}) emissions, while road transport is responsible for more than 70% of the transport sector's emissions. Therefore, other alternatives are needed in the field of transportation to support the reduction of carbon emissions. The contribution of the transportation sub-sector is important in supporting zero emission in Indonesia. In addition, this sub-sector can be used as an important planning consideration for the Government of Indonesia in the long term. The use of electric vehicles releases lower emissions than conventional vehicles that use fossil fuels. By utilizing energy, electric vehicles can be 3-5 times more efficient than conventional vehicles. Authorities of most developed countries encourage the use of Electric Vehicles (EV) to avoid concentrations of air pollutants.
pollutants, CO$_2$, and other greenhouse gases. Efforts to increase the use of electric vehicles are sought by promoting sustainable and efficient mobility through various initiatives, especially through tax incentives, purchase assistance, or other special measures, such as free public parking or free use of highways.

There are many benefits that can be felt, namely Electric vehicles produce very low air pollution and have the potential to significantly reduce greenhouse gas emissions, this type of vehicle does not emit exhaust pollutants, CO$_2$, or nitrogen dioxide (NO$_2$). Also, the manufacturing process is more environmentally friendly with a simpler engine and fuel. The number of elements of an Electric Vehicle (EV) engine is smaller, which leads to much cheaper maintenance, as well as being more comfortable to use because it does not cause excessive vibration. Below are the types of electric vehicles that will be used as an alternative to environmentally friendly energy in reducing carbon emissions. There are 5 types of electric vehicles being developed around the world, namely using electric fuel, batteries, hybrid technology which is considered safe and environmentally friendly and using engines and technologies that produce far less emissions than using conventional fossil fueled vehicles.

Based on the type of electric vehicle, it uses environmentally friendly technology and fuel so that it provides fewer emissions than conventional vehicles. By supporting the acceleration of the development of electric vehicles, so that it can help achieve the achievement of reducing carbon emissions in the transportation sector. According to IESR, the use of electric vehicles can support efforts to reduce Indonesia's GHG emissions from the transportation sector. Taking into account only emissions from fuel combustion for vehicle operations, the penetration of electric vehicles in an ambitious scenario could reduce emissions by 8.4 million tons of CO$_2$ in 2030 and 49.5 million tons of CO$_2$ in 2050. According to the Climate Action Tracker (CAT) 2021, suggests To achieve the GHG emission reduction target in accordance with the Paris Agreement, Indonesia must rapidly increase its energy mix by around 15 to 20% in 2030 and towards 100% by 2050. Electric vehicles are an effort to transition energy from fossil energy use to electricity which must improved in realizing a cleaner environment.

4. Conclusion

Indonesia is currently experiencing an energy crisis with the depletion of fossil energy every day. Meanwhile, the needs and use of the Indonesian people for transportation is very high, causing a decrease in fossil energy and an increase in carbon emissions from conventional vehicles. In dealing with the problem of carbon emissions, the Indonesian government is looking for other alternatives to support the availability of domestic energy in the transportation sector, namely by using electric vehicles which are currently being developed in various countries including Indonesia. Electric vehicles are considered a safe, environmentally friendly, cost-effective and easy-to-use alternative energy so that they can reduce carbon
emissions and can assist the Indonesian government in overcoming fuel imports. Plus, there are many components and raw materials for making electric cars in Indonesia, one of which is Nickel, Cobalt and Aluminum, which are very numerous in Indonesia. So that it can support the manufacture of batteries for electric vehicles. currently the government is also accelerating the manufacture of electric vehicles by implementing the KBLBB policy with established regulations, namely through Presidential Regulation no. 55/2019. From these regulations, making electric vehicles an important aspect to be developed and accelerated. With the realization of electric vehicles in Indonesia, it will support the availability of domestic energy supplies, so that Indonesia no longer needs to import fuel oil and can make Indonesia energy independent in the transportation sector. In addition, electric vehicles are made with safe and sophisticated technology so that they can utilize electricity into alternative fuels that are safe, environmentally friendly and low in emissions. So that it can support the reduction of carbon emissions that have been targeted by Indonesia.

5. Recommendation

Indonesia has a great opportunity in creating electric vehicles in order to reduce emissions in the transportation sector. By cooperating in various fields such as government, private sector, state-owned enterprises, researchers and universities. So with this collaboration, it will create an electric car made in Indonesia. In addition, it can be seen that the raw materials for the manufacture of batteries and electric vehicles are mostly sourced in Indonesia, so it is a great opportunity for Indonesia to optimize these components into electric vehicles. In developing electric vehicles, an adequate supply of electricity is needed. Therefore, an adequate additional energy alternative is needed. Currently, the most adequate source of electrical energy to support electricity supply is by utilizing nuclear power into electricity, so that using nuclear energy can support clean and environmentally friendly energy. The next thing that needs to be done is to make a real realization of the Roadmap that has been developed. So with the realization of the roadmap, it will facilitate the development of electric cars by achieving existing targets.

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