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Reducing Carbon Dioxide (CO₂) Air Pollution with Electric Vehicles to Overcome Climate Change

Shinta Widyaningrum^{1, a)}, Evvy Kartini^{1, b)}, Martin Taylor²

¹National Battery Research Institute
Edu Center Building 2nd Floor Unit 22260 Kav Commercial International School Lot. 2 No.8
BSD- City - Indonesia

²Swinburne University of Technology John St, Hawthorn VIC 3122, Australia

^{a)}Corresponding author: shinta.w@n-bri.org

^{b)}evvy.kartini@n-bri.org

Abstract. Climate change has become an important issue since 196 countries in the world agreed to sign the Paris Agreement at COP21 in 2015. This is an important issue because Climate change has a wider impact in the long term such as rising air temperatures, increasing volume of sea water, extreme and unpredictable weather changes, shifting populations and wildlife habitats and affecting human health. One of the causes of climate change is air pollution produced by burning conventional vehicles or we can call Internal Combustion Engine (ICE). For this reason, various countries in the world are innovating by converting fossil-based vehicles into electric vehicles with the main raw material being batteries. As a result, several countries in the world such as Japan, Brazil, Germany, France and Sweden have succeeded in reducing their emission levels in the 2015-2018 period by starting to develop electric vehicles. This paper was conducted through literature study and in-depth analysis using qualitative research methods. This paper aims to analyze whether the transformation from an internal combustion engine-based vehicle to an electric vehicle is able to reduce the level of emissions in a country in order to overcome the problem of climate change. In addition, this paper also analyzes other supporting factors to find the right solution to overcome the problem of climate change. **Keywords:** *Climate Change, Carbon Dioxide, Electric Vehicles.*

INTRODUCTION

Climate change has a broad impact over a long period of time. This has resulted in many ways for example increased air temperature, seawater volume, weather events, shifting wildlife populations and habitats. Climate change causes weather patterns to be less predictable. This issue is so important that 197 countries in the world agreed to sign an agreement called the Paris Agreement at the COP21 event on 12 December 2015 in Paris. Within the agreement focuses controlled within the Paris Agreement, countries within the world have a target to preserve worldwide temperatures so that they don't 2°C over pre-industrial levels and restrain the temperature as much as conceivably up to most extreme of 1.5°C over pre-industrial levels [1]. During the last 50 years, the earth's temperature has increased due to greenhouse gases (GHG) which are 95% produced by humans. GHG is meant for example chlorofluorocarbons (CFCs), carbon dioxide (CO₂), water vapor, nitrous oxide (N₂O), and methane (CH₄) nitrous oxide (N₂O) [2] Greenhouse gases are needed to keep the earth's temperature stable. However, the increasing concentration of greenhouse gases makes the atmosphere layer thicker. Basically, the sun enters the earth through the atmosphere and is then absorbed by the earth to provide a warm temperature. Earth has a role to reflect some of the heat out of the atmosphere. However, the increase in greenhouse gases in the atmosphere as a result of human activities causes a thickening of the atmosphere. The thickening of the climatic layer causes the sum of geothermal warm caught within the earth's air to extend, coming about in an increment within the earth's temperature, which is called worldwide warming.

According to the analysis of scientists, CO₂ is the main and most common contributor. The GHG produced by 55% is GHG that has long-term effects, so NASA gave the nickname for CO₂, namely Global Warming Potential no One (GWP) [3]. The largest CO₂ emissions come from burning fossil fuels, for example combustion produced from power plants, oil refineries and industrial facilities. The biggest contributor, which is 24%, comes from burning in the transportation sector or ICE. [4]. Assessing the enormous impact of CO₂ on climate change, many countries in the

world are developing vehicles based on renewable energy [5]. Vehicles called Electric Vehicles (EVs) are electric-based vehicles with 80% of their main power source coming from batteries. In electric vehicles the main components are the battery, inverter and controller so that no combustion takes place. If there is no combustion, then there are no chemical gases such as CO, NO_x, HC and PM like the results of combustion in ICE.

For this occasion, this paper aims to analyze whether the transformation from an internal combustion engine-based vehicle to an electric vehicle is able to reduce the level of emissions in a country in order to overcome the problem of climate change. In addition, this paper also analyzes other supporting factors to find the right solution to overcome the problem of climate change. The method used on this paper is literature study and data analysis to get valid results.

METHODOLOGY

The type of research used in this data is analysis qualitative. Qualitative research aims to comprehend social processes from the perspective of the participants [6]. The definition of qualitative research is research that is used to examine the conditions of natural objects, where the researcher is a crucial instrument of data collection techniques such as triangulation (combined), inductive data analysis, and qualitative research results emphasize meaning rather than generalization. Nonetheless, the information gathered in this investigation can be analyzed [7]. In addition to using qualitative methods in viewing the phenomena discussed, this paper also uses analysis of various secondary data and sources which are then processed into one complete data.

The purpose of this paper is to present an explanation of various data about how a social phenomenon occurs. Following its purpose, explanatory writing seeks to find causes and effects and reasons why something happens to be analyzed to produce evidence to support an explanation or prediction.

Sources of data used on this paper such as photos, pictures, and numbers are secondary data by researching the form of literature study, aiming to obtain information by the theme under study. Meanwhile, other information is obtained through books, research reports, scientific journals, theses, articles, and other written sources in print and from the references.

RESULTS AND DISCUSSION

According to the distribution of CO₂ emission produced by the transportation sector in 2018, passenger vehicles contributed the largest CO₂ emissions, amounting to 45.1 percent. The second position is occupied by the vehicle used in shipping (freight) by 29.4 percent. This type of transportation is generally an internal combustion engine (ICE), which is a vehicle that uses fossil fuels as its main fuel. Then, following by aviation sector (11.6 percent), shipping (10.6 percent), and other (3.2 percent). ICE is one of the major contributors to the increase in CO₂ because the combustion in ICE produces dangerous chemical compounds, namely CO, NO_x, HC and PM [9]. For that, if we replace ICE with EV it will really help reduce one of the triggers of climate change.

Some countries that have increased EV production still do not reduce CO₂ emissions. One example is in developed countries such as the United States, China, India, Italy and Australia. The United States takes the first place for this anomaly. Raised 600,000 EV sales in 2018, but the amount of carbon emission is increased to 1760 MtCO₂e/Gt from 1760 MtCO₂e/Gt back in 2015. Such trends also followed by China (1.8 million of EV sales in 2018) in which they have significant amount of carbon pollution by 940 MtCO₂e/Gt at the same year. Also, India produces carbon emission up to 90 points in four years range by 310 MtCO₂e/Gt in 2018. Same year with the peak of Indian EV sales on 9,000 units in 2018. Last but not least, Australia, the growth of EV sales is linear with the carbon emission production as detrimental effect of industry. 94 MtCO₂e/Gt in 2015, Australia's carbon emission is measured on 100 MtCO₂e/Gt in 2018 in which, at the same time, the Australian EV sales is soared to 5000 units.

It shows that the increase in CO₂ emissions from the countries continues to show an increase. While they have increased EV production and can be said to be included in the category of developed countries. This shows that there are other factors that must be improved by these countries to reduce their CO₂ emissions.

On the other side, countries such as Japan, Brazil, Germany, France, Italy and Sweden were able to reduce CO₂ emissions by increasing sales of EVs during the 2015-2018 period. In Japan, the emission reduction is nearly 200 MtCO₂e/Gt in 2018 with the EV sales reached up to 1 million unit. Another impressive data also comes from Brazil. They have 300 unit of EV sales in 2018 with the dwindle carbon emission is on 20 points (from 200 MtCO₂e/Gt in 2015 to 180 MtCO₂e/Gt in 2018). The positive trends also hit in the European countries. Germany with 1 million unit

of EV sales in 2018 has successfully reduced the carbon emission up to 12 points in just two years (164 MtCO₂e/Gt in 2017 to 152 MtCO₂e/Gt in 2018). France also has the same trends, in which they can reduce the carbon emission significantly in just two years. 130 MtCO₂e/Gt in 2017 to 120 MtCO₂e/Gt in 2018 with soared of EV sales on 500 unit from 2017 to 2018. Italy with 1.3 million unit of EV sales in 2018 has 100 MtCO₂e/Gt of carbon emission compared to 120 MtCO₂e/Gt in 2015. Even Sweden, as one of the countries with impressive policy on sustainable living and green transition, has the massive amount of carbon emission reduction due to the increase of EV sales. This shows that EVs can be a solution to reduce CO₂ emissions in an effort to deal with climate change problems.

When it analyzes more deeply, it found that there are other factors that have caused developed countries such as the United States, China, India, and Australia to still be unable to reduce the CO₂ emission levels that occur in their countries even though it has been accompanied by an increase in sales of EVs. Many factors can be the background of increasing CO₂ emissions in several countries even though they are in line with the production and development of their EVs. Several factors that can be used as an outline are government regulations, population, area with different number of industries in each country [11].

The number of populations also causes a lot of emissions produced by a country. By 2018, United States with 327.2 million of population raised 1762.23 MtCO₂e/Gt of carbon emission. China (1.393 billion of people) produced 917.92 MtCO₂e/Gt followed by India (1.353 billion of people) with 305.33 MtCO₂e/Gt emission. Other countries that should be highlighted are Australia (24.98 million of population) with 99.64 MtCO₂e/Gt emission. Japan (126.5 million of people) with 204.56 MtCO₂e/Gt carbon emission, Brazil (209.5 million of population) with 191.66 MtCO₂e/Gt emission, Germany (82.79 million of people) with 158.3 MtCO₂e/Gt of carbon emission, France (66.97 million) with 125.42 MtCO₂e/Gt of carbon emission, Italy (60.48 million) with 100.2 MtCO₂e/Gt of carbon emission, and 16.49 MtCO₂e/Gt of carbon emission from 10.12 million population of Sweden.

As previously mentioned, the emissions produced by each country come from activities carried out by humans on a daily basis. Therefore, the more the population, the household needs will also increase, this of course will be directly proportional to the use of vehicles which is one of the main factors causing emissions in various countries. Despite huge number of population, there are another factors such as government policies, infrastructure readiness, resources, circumstances, geography, and so on, all influence to EVs' failure to reduce emission rates in these countries [12]. If this data examined closely, the countries that have not succeeded in reducing their emissions even though the EV market is increasing are developed countries with fast industrial developments. This shows that industry also has an important role that contributes to the emission of a country.

To overcome this problem, it is necessary to have policies from a country and even a region. For example, regional policies imposed in countries that are members of the European Union. Countries in the European Union have started implementing the Renewable Energy Directive (RED II) policy to address emissions problems in the European Union and reduce the effects of greenhouse gases (GHG). Meanwhile, in an even larger scope, countries in the world are implementing the Paris Agreement in order to reduce the rate of climate change caused by the increasing number of emissions in the world.

CONCLUSION

Electric Vehicles (EVs) are able to be a solution to reduce carbon dioxide (CO₂) emissions as an effort to overcome climate change problems. In addition to population, other factors such as government policies, infrastructure readiness, economy development, resources, conditions, geography, etc. are supporting factors for the lack of success of EVs in reducing emission rates in these countries.

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