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Environmentally-friendly Cars and How to Spread the Populations

Tama A. Syifa[1)], William J.[1)]., Asmarani D. [1a)]., Yokoyama N.[2)] , and Fujiyama I. [2,b)]

[1]*Japanese Department, Faculty of Humanities, Bina Nusantara University, Jakarta, Indonesia 11480.* [2]*Wakayama University, Sakaedani, Wakayama.*

Corresponding author: [1a)] dasmarani@binus.edu, [2b)] mtfuji@wakayama-u.ac.jp

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Abstract. The background of this research is that the level of pollution in the world is increasing every year, and one of the causes is vehicles such as cars. To reduce this, several companies innovate by making environmentally friendly cars. This research will focus on the advantages and disadvantages of hydrogen and electric cars. This research is aimed at the usage of cars in Japan and Indonesia. The purpose of this study are: 1) to study the population and the current development progress of environmentally friendly fuels such as hydrogen and electricity in cars, 2) to provide suggestions for Japanese and Indonesian to market environmentally friendly cars. The method we use for collecting the data is a literature study method sourced from company websites, news, and journals. The results of this study indicate that in the use of environmentally friendly cars, such as hydrogen cars and electric cars, there are various advantages and disadvantages. However, compared to the advantages, there are still more disadvantages in its use. In order to help to overcome these shortcomings, this study will provide some suggestions on how to popularize these environmentally friendly cars.

Keywords: Environment friendly, SDGs, Car, Company

INTRODUCTION

Vehicles like cars, motorcycles, etc, are without any doubts, had become something out of common. People from all over the world have used various cars, and various car models are invented with each year, thus bringing upon more users all over the world. Published by Statista Research Department, the number of vehicles usage in Indonesia was around 17 million units in 2018 and approximately 15.9 million units in 2020. In addition, every year there is an increase in the number of vehicles in Japan. According to a report from Statista Research Department, the number of motorized vehicles in Japan reached around 81.56 million units, then increased in 2019 which reached around 81.79 million units, in 2020 it increased again to 81.85 million units[1].

However, with each usage, vehicles tend to emit harmful gas matter called carbon dioxide (CO2). The emission of carbon dioxides increases rapidly every year and could bring about some serious problems to the global world. The results are shown by The Discrete Grey forecasting Model (DGM) that is used to forecast the CO2 emission in Asia-pacific Economic Cooperation (APEC) member countries showed that for around 5 years, among the 17 predicted country members, only around 4 countries where the number of carbon dioxide emissions are decreasing, while with the rest of the other 13 countries, the number of carbon dioxide emissions increased every time[2]. Below is the figure showing the amount of carbon dioxide emission:

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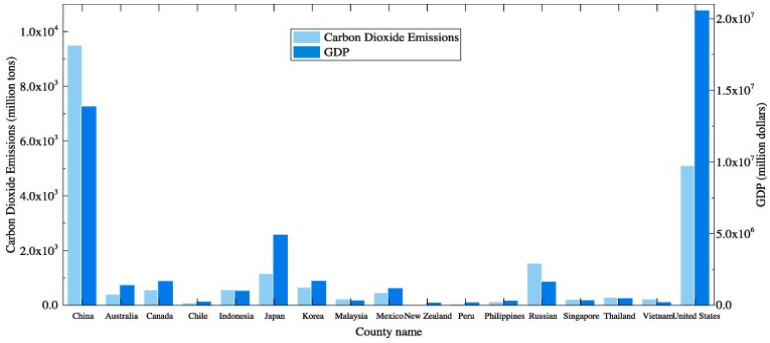

FIGURE 1. The emission of carbon dioxide from around the world.

Along with the continuous emission of carbon dioxide, the greenhouse effect has also become an inevitable problem for human beings, which is harmful to human health and the living environment. According to recent research, the global temperature of the Earth grew steadily in the last 100 years[2].

In this current situation, it is only natural that the citizens need to pay more attention to the current situation of the environment all around the world to ensure people are able to live in more comfortable environments.

The fossil fuels used for typical conventional gasoline cars are environmentally harmful and the fossil fuel itself is unable to be renewed, multiple environmentally friendly and renewable energies are sought as a solution for this, including in the form of *electric vehicles and fuel cell/hydrogen powered cars*[3]. This environmentally-friendly car is in development in hopes to reduce the amount of carbon dioxide emission. Ranging from Hyundai, Toyota, Honda, etc., various car manufacturers have developed the concept of *environmentally friendly cars*[4]. However, the production of this environmentally friendly car is no easy task. There are multiple factors that challenge the development process like high-production cost and uncertainties regarding the technological standout such as the fair lack of gas stations that enable the refill of the fuels for hydrogen powered cars. Also, the popularity of these environmentally friendly cars apparently is still not yet high due to fairly low interest and doubts from the citizens.

This paper is aimed to provide possible suggestions of how to spread the population of these environmentally friendly cars. Thus, this paper includes various explanations such as the advantages and the disadvantages of the hydrogen powered car, the current state of the population of those environmentally friendly cars and how to come up with the solutions to spread said population. The research will involve both Indonesia's side and Japan's side.

LITERATURE REVIEW

Environment friendly is often dubbed as Go Green: what this means is that the term environmentally-friendly is the act of saving the earth from the damages caused by the greenhouse effect and consequently, global warming, created by human activity[5]. One of the environment friendly actions is the act to reduce the pollution on air caused by the emission of harmful substances caused by technologies such as vehicle emissions that emit carbon dioxide (CO2). One of the ways to apply the go green act is to develop a car that runs on environmentally friendly fuels that emits zero carbon dioxide (CO2) in order to reduce the greenhouse effect and global warming.

According to Smart Alternative Fuels (Marketing, B. 2020)[6], various fuels that are popularly referred to as environmentally-friendly fuels have been kept an eye of as potential use of environmentally-friendly cars that utilize the alternative energy, such as Bioethanol which is made from waste materials: developing an energy source this way instead of using the typical gasoline energy like what is popularly used in modern days is advantageous, because not only it effectively decreases the carbon dioxide emissions, but also decrease the air pollution in the surrounding environment, which brings about two advantages to the environment. Biodiesel is also among one of the widely-known energy sources that utilize edible oils such as vegetable oils and even animal fat, that can be used on boats. Dimethyl ether, known by its other name DME, that are often made from methanol, can be used as a substitute for chlorocarbons. Currently, there have more ways to create DME with natural gas, which improves its versatility.

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Natural Gas is one of the most common green fuels and also among one of the most versatile because it can either work on its own or be combined with other fuels to create new types of fuel, including the aforementioned Dimethyl Ether. Electricity is one of the most common sources of energy used in modern days due to its extremely high versatility and high efficiency. Over the years, more and more uses of electricity have been expanded throughout the world and subsequently, becoming the most invaluable energy source around the world. The possibility of using electricity as an energy source is almost limitless and will possibly keep expanding more, with one of those uses is as one of the top candidates for the fuels for environmentally-friendly cars, which is the electric-powered cars and hydrogen-powered cars, with the later otherwise known as fuel-cell cars.

According to the U.S. Department of Energy, the electric cars were supposed to be dominating the vehicle market in comparison to the now more common gasoline powered cars due to their ease of use, environmentally friendly while also emitting much less noise, and on top of that was also easier to charge the electric cars' engine in comparison to the gasoline powered cars[22]. However, it was with the innovation of Henry Ford's mass-produced Model T introduced in 1908 with its cheaper cost that shafted electric cars' popularity[16]. In the same year, Charles Kettering introduced the electric starter, eliminating the need for the hand crank and giving rise to more gasoline-powered vehicle sales. By the 1920s, the U.S. had a better system of roads connecting cities, and Americans wanted to get out and explore. With the discovery of Texas crude oil, gas became cheap and readily available for rural Americans, and filling stations began popping up across the country. In comparison, very few Americans outside of cities had electricity at that time. In the end, electric vehicles completely disappeared by 1935 and around the next 30 years after that, the gasoline gas is even more widely available and cheaper. Around 35 years after the electric car populations were nothing but gone, there were still attempts to push the popularity for quite a bit, but falls short over the more widely popular gasoline cars, and eventually, electric cars were nothing but a name among the history until recently, more reconsiderations are being made to revive the use of the electric cars due to the ever-growing concerns for the carbon dioxide emissions[7].

RESULT AND DISCUSSION

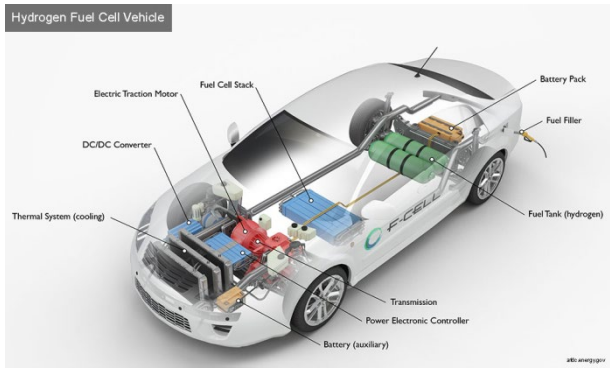

FIGURE 2. The key components for the hydrogen powered car (DoE, U. S., 2019)

DoE, U. S. specifically states that the key components of the hydrogen powered car are as following[8]:

- In an electric drive vehicle, the low-voltage auxiliary battery provides electricity to start the car before the traction battery is engaged; it also powers vehicle accessories, in tandem with the high-voltage battery that stores energy generated from regenerative braking and provides additional power to the electric traction motor. Alongside this, there is a converter device that converts higher-voltage Direct Current power from the traction battery pack to the lower-voltage Direct Current power needed to run vehicle accessories and charge the auxiliary battery..

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- Using the power generated from the fuel cell and the traction battery pack, the Electric Traction creates kinetic energy that spins the vehicle's wheels.
- There is the Fuel cell stack that comprises electrodes that combines hydrogen and oxygen to produce electricity. There is also a nozzle from a fuel dispenser that is attached to the receptacle on the vehicle to fill the tank. The hydrogen tank also stores hydrogen gas on board the vehicle until it's needed by the fuel cell for use..
- The Power electronics controller (FCEV) is responsible for the management of the electrical energy flow that is delivered by the fuel cell and the traction battery, making it the center for controlling the speed of the electric traction motor and the torque it produces. There is also a thermal system that manages the temperature range for the overall components of the hydrogen-powered car..
- Finally, the electric transmission transfers mechanical power from the electric traction motor to create feedback that allows the vehicle's wheels to spin, enabling the vehicle to be operated.

The hydrogen-powered vehicles also called as fuel cell vehicles (FCV) or fuel electric vehicles (FCEV) is the type of car of an electric vehicle that is equipped with a fuel cell instead of a battery or in combination with a battery or a supercapacitor for supplying an onboard electric motor[9].

- It can be used as a fuel in a traditional engine, which is combusted in a chamber, or used in fuel cells to generate energy that drives an electric motor.
- The energy uses the H_2O energy with the binding of H_2 and O_2.
- Hydrogen-powered vehicles are considered to be the cleanest environment in the world for cars.

Japan's Prime Minister, Shinzo Abe has dubbed hydrogen the "energy of the future, and hopes it will help Tokyo meet the modest emissions targets it has set ahead of a UN climate change conference[10].

Advantages and Disadvantages:

(+) The hydrogen powered car can cover a longer distance than the usual conventional gasoline car.
(+) Zero carbon dioxide emission means the car is environmentally friendly.
(+) Compared to the electric car, the hydrogen powered car is less time consuming to refuel.
(-) Currently, the amount of gasoline stations needed to refuel the hydrogen powered car is still low, particularly in Japan, there are only around 157 gasoline stations for hydrogen powered cars throughout only 5 prefectures within Japan as of January 2021.
(-) Currently, the hydrogen production itself isn't entirely environmentally friendly as it still relies on fossil fuels.
(-) High manufacturing cost leads to high sales cost. The Japanese government had subsidized the manufacturing cost in order to lower the sales cost, but even then, the overall price for the hydrogen powered car is still on par with the luxury cars.

Here below is an overall functionality of an electric-powered car:

Nugrahadi A specifically states that according to the Omazaki Group, below is the functionality for the component within the Battery Electric Car[11]:

- When the pedal is stamped, the controller will adjust the electric flow from the traction battery and the inverter.
- With the adjustments from the controller, the inverter will send the electrical force from the battery into the electric motor as adjusted and needed.
- After the motor receives the electrical force, the motor will then convert the electrical energy into mechanical energy in the form of rotation[19].

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- The rotation from the motor will create the adjusted transmission to move the car's wheels.

Advantages and Disadvantages according to Prima A[12]:

(+) Zero carbon dioxide emission; the usage of Electric Vehicles is also said to be more effective since it doesn't emit any harmful substances when it is on the run.

(+) Doesn't produce much sound when it runs and thus, less sound pollutants are produced.

(+) Since it runs with electricity, it creates less hassle on the maintenance compared to the conventional gasoline cars.

(-) Long recharging time.

(-) The number of battery recharging stations is still small.

(-) At its current state, the Electric Vehicles are still relatively expensive.

The Current Situation with the Environmentally Friendly Cars (Japan)

The European Union (EU) has been ambitious with the current decarbonization, and thus had created multiple regulations in an attempt to make sure the decarbonization is a success. The political motivation to reform the energy sector with decarbonisation in mind is visible in EU legislation from the 2020 Climate and Energy Package, the 2030 Climate and Energy Framework to the recent Energy Union and the "Clean Energy for all Europeans" package (also known as "Winter Package") of 2016. What the European Union is trying to do in order for the decarbonization attempt to success, they attempt to create a new regulation where in 2035 onwards, the sales of vehicles will all be the Electric Vehicle (EV) which means all the sales of the conventional fossil fuel cars and even Hybrid cars are completely abolished, and thus, banned[13].

However, Japan is not without any challenges in this regard. There are several major points to be pointed out:

- Japan is struggling to produce and promote the more cost effective fuel cell cars. The cost for the first hydrogen powered car aired around 2014, dubbed *Mirai* which means "Future", is around 6.7 million yen, or about $55,000, nearly double a comparable electric car. Multiple attempts to ease out the manufacturing process have been given a subsidy, but even then, the price of the fuel cell cars are still on par with the luxury gasoline cars. However, the second generation of Mirai, which launched on December 9th, 2020, is estimated to be 300,000 yen cheaper than the first generation[14].
- Producing the hydrogen itself is no easy feat, and is not entirely green to the environment, as the production of the hydrogen itself still requires the factory that also happens to rely on fossil fuels. Multiple attempts to develop more effective methods to produce hydrogen are being made, and one of them is the process called *Electrolysis,* where the electricity comes from renewable sources such as water, solar or hydraulic, as opposed to gas or oil. However, such ideas are still left with certain doubts, as it yet again boils down to the resources cost that might be put during the process[15].
- The gasoline stands for the hydrogen powered cars are still not well spread throughout Japan, particularly there are only around 157 of them and only in around 5 prefectures[16].

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FIGURE 3. The amount of hydrogen refueling stands in Japan as of Japan 2021.

- The Japanese typically prefer the small cars dubbed as *Keijidōsha* (*Light Car*). One of the reasons for that is because light cars are typically cheaper and more fuel efficient[17].

The Current Situation with the Environmentally Friendly Cars (Indonesia)

As of Indonesia, the government had pushed and encourage the development of the environmentally friendly car in the form of Electric Vehicle (EV) strongly, starting from the first regulation made from the *Peraturan Presiden (Perpres) No. 55 Tahun 2019* regarding the acceleration of the battery based Electric Vehicle that was made effective from August 12th, 2019. Perpres 55/2019[18].

However, even though the potential of renewable energy usage is high, Indonesia's usage of renewable energy itself is considered to be still fledgling when compared to Japan. This caused several hampers on environmentally friendly car development (however, it has been said that Indonesia's usage of renewable energy is bound to increase)[19]. Thus, Indonesia is still relying mostly on imported products from other countries. However, it is not just the imported electric cars, Indonesia also needs to rely on other countries such as China for other things such as the battery for the electric car. Just like the hydrogen powered car in Japan, Indonesia is still facing difficulties on the price balancing of the Electric Car in order to make sure it is affordable by the customers; currently, the electric car model branded *Hyundai Ioniq*,a product from Korea, is being sold in Indonesia, which is currently one of the cheaper electric car model available in Indonesia, has two variations; one is the *Ioniq Prime*, which costed IDR 637 million, and *Ioniq Signature*, which costed IDR 677 million[20]. However, recently the market interest for the Electric Vehicle in Indonesia has been increasing steadily. According to a survey done in Southeast Asia, there are three major factors on how the Electric Car could garner more interest from the national customers: one is the refueling facility in their close surroundings[21]. There are several predictions for the electric car usage in Indonesia: one of them is where the electric cars will be expected to be on sale around 2030, but stemming from the slow development process and current lack of customer interest, said usage is said to be booming only after the incoming 20 ~ 30 years[22].

As of now, Japan's automobile companies such as Toyota are still developing the means to produce cheaper and more affordable Hydrogen-powered cars in order to be more in line with *European Union*'s regulation of abolishing the sales of the conventional gasoline powered cars. The second generation of Hydrogen powered car model, Mirai, being 300,000 yen cheaper than the first generation, is the first start of the cheaper and more affordable Hydrogen powered cars. However, even when not looking from having to develop cheaper Hydrogen powered car, there are several factors that cannot be overlooked such as the production of more gasoline stations that can refuel those cars, which also comes with other challenges such as developing a technology to produce hydrogen more effectively and

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totally green; as the current hydrogen producing method itself still requires fossil fuels and thus still ends up emitting CO_2, the hydrogen producing itself is still not entirely green. Multiple attempts for this have been made, and one of them is through the method called *electrolysis.*

Indonesia with the electric powered cars also faces the similar challenges like in Japan with the hydrogen powered cars, namely the difficulty of distributing cheap and affordable electric powered cars, and in the relative lack of the recharging stations for recharging the electric powered car. However, Indonesia's president, Ir. H. Joko Widodo, has been pushing the electric powered cars and has set several regulations regarding the usage of the electric powered cars. According to a recent survey, the electric powered car has garnered more market interest in Indonesia as of recently. Compared to Japan, Indonesia's usage of renewable energy within the nation is still really low, so Indonesia has a lot of setbacks in comparison, such as unable to develop its own battery recharging station, in which it has to rely on other countries such as China in order to get the battery supply. As a result, Indonesia may need even more time to properly popularize the Electric Powered car; if Japan manages to promote the hydrogen powered car in 2035, Indonesia may take years after that (may around 20, or even 30 years), and still needs to rely more from other foreign countries to realize the electric vehicle.

SUGGESTIONS

Indonesia in its current state is still highly lacking in terms of recharging stations needed for recharging the electric car, but the nation itself still relies on imported products. However, said imported products are key to realize the usage of the electric-powered cars, including the car itself. In order to bypass this, Indonesia needs to be more cooperative with other foreign countries: including to build more battery recharging stations is a priority. According to *Gabungan Industri Kendaraan Bermotor Indonesia (Gaikindo)*, the priority of focusing towards battery production is not out of no reason; the investment to build more battery industry is needed; this is aimed to reduce the reliance towards other foreign countries for more battery source. Electric vehicles also suffer from time-consuming charging time, thus the quick charging stations meant for emergency use may also be needed in order to save the users' time[23]..

A majority of people in Japan prefer the light car, with one of the reasons behind that is because of the fuel efficient and low maintenance cost. Hydrogen-powered cars are said to be both fuel efficient and have a relatively low maintenance cost, so this could be the first step towards the popularization of the car. For the suggestions from Japan's side: the development of more green and more cost effective technologies to produce hydrogen is needed; in order to achieve this, Japan's automobile companies (Toyota, Honda, etc) need to cooperate more with the hydrogen energy producing companies. This is also aimed to reduce the investment cost to build hydrogen refueling stations that was said to be also expensive on top of being able to build more of them in the future.

CONCLUSION

As of now, both Indonesia and Japan are still struggling with the development of environmentally-friendly cars for varying reasons, such as an unusually high production cost leading to these environmentally-friendly cars having an unusually high cost that is on par with a lot of luxury cars, which further leads to low interest from customers. However, both countries are pushing towards the production process of the environmentally-friendly cars, in order to make sure that the emission of CO_2 will be reduced drastically, and hope to eventually reach zero CO_2 emission. The electric vehicles themselves in Indonesia have also garnered more marketing interests throughout the nation, and this could be the first step towards the popularization.

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