UTILITY FACTOR ANALYSIS AND COST OWNERSHIP OF THE PLUG-IN HYBRID ELECTRIC VEHICLE (MITSUBISHI OUTLANDER PHEV)

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Abstract

Recently, attention to CO2 or greenhouse gas emissions has increased. The need to reduce it is also increasing in various countries. One of them is by reducing gas emissions from vehicles. Due to increasingly sophisticated technological advances, many vehicle manufacturers worldwide have switched to electric vehicles. In the world, various types of electric vehicle models have been developed, one of which is the Plug-in Hybrid Electric Vehicle or PHEV. In Indonesia, this vehicle is very suitable for your energy conditions because fuel oil is still abundant, and there are many ways to build power plants. The potential of PHEV vehicles to reduce greenhouse gas emissions is highly dependent on the use of the vehicle and its energy sources, namely gasoline and electricity. However, PHEV's specific benefits or impacts ultimately depend on vehicle buying and usage patterns. Some parameters are the value of the utility factor (UF) and the value of expenditure efficiency when owning a vehicle or Total Cost Ownership (TCO). Comprehensive results by calculating the UF value can help users understand the actual energy consumption more clearly and TCO to determine the expenses incurred by PHEV users. This study will show the UF and TCO values of one of the PHEV vehicles in Indonesia, namely the Mitsubishi Outlander PHEV.

Keywords: Plug-in Hybrid Electric Vehicle, Utility Factor, Total Cost Ownership, Mitsubishi Outlander PHEV

Abstrak

menunjukan nilai UF dan TCO dari salah satu kendaraan PHEV yang ada di Indonesia, yaitu Mitsubishi Outlander PHEV.

**Kata kunci :** Plug-in Hybrid Electric Vehicle, Utility Factor, Total Cost Ownership, Mitsubishi Outlander PHEV

1. Introduction

One of the main factors of current carbon dioxide emissions comes from transportation. The transportation sector is also one of the main contributors to anthropogenic climate change worldwide, as it accounts for 23% of total greenhouse gas emissions. Based on Levay's research (Lévay et al., 2017), the transportation sector has the second largest contributor, after the energy industry, as it accounts for almost a quarter of total emissions. Even in 2014, from GHG emission decomposition data or Greenhouse Gases, the transportation sector shows that road transportation has a significant role in greenhouse gas emissions with a value of 73%. Burning oil as an energy source for transportation vehicles is a major cause of carbon dioxide emissions in big cities. A four-wheeled passenger vehicle is one of the most common transportation vehicles in big cities.

Furthermore, Sims (2014) said that by 2050, the current number of passenger vehicles would double. The availability of sawdust can be used as an alternative fuel in Steam Power Plants. The sawdust is used as a coal mix material (cofiring) so that the coal composition is not 100% but can be reduced according to the portion of the mixed sawdust. The calorific value of coal commonly used in Indonesia is at the MRC level of around 17.58MJ/kg to 19.68MJ/kg. At the same time, the calorific value of sawdust is at a value of 6.28MJ/kg to 11.30MJ/kg. Even though the amount is small, the calorific value of this coal powder will affect the mixture's calorific value. In several power plants, co-firing has been tried with a mixture composition of 1% sawdust. The impact of this sawdust mixing after being mixed in coal as cofiring, there was a decrease in the calorific value of the mixture by 0.57% compared to the pure calorific value of coal. This composition will continue to be increased in proportion to support the government's 23% NRE energy mix.

Currently, the most common vehicles used for the transportation sector in urban areas are vehicles with internal combustion engines or commonly called ICE (Internal Combustion Engine). ICE vehicles are vehicles that use fuel oil as a source of propulsion for the vehicle. Due to the many variations and the rapid development of this type of vehicle, it makes people's interest even higher.

In Southeast Asia, Indonesia is the biggest potential for the car sales market. This is because car ownership is still low at 83 cars/1000 people when compared to neighboring countries such as Thailand at 232 cars/1000 people, Malaysia with 405 cars/1000 people, and also Singapore at 150 cars/1000 people (Herman, 2017). With a population of 257 million people, it means that the market potential that can still be fulfilled is 38 million units. This enormous potential must be adapted to long-term planning. But in addition to greenhouse gas emissions, ICE vehicles also cause local noise and air pollution, creating adverse health effects in urban environments.

Apart from that, dependence on petroleum energy will cause concern because it is not renewable energy, so this energy shows a tendency that is prone to scarcity. The demand and growth of energy demand for the transportation sector in Indonesia is almost the same as that of industry. However, the demand for energy in the transportation sector still relies on fuel, making this sector very sensitive to the issue of energy scarcity. Taking into account traditional biomass energy sources, the total national energy consumption is projected to increase to 298 million tons of oil equivalent (TOE) or equivalent tons of oil in 2025 and 893 million TOE in 2050, or an average increase of 4.9% per year since 2013. As for the National Energy Policy (KEN) scenario, consumption in 2025 will increase to 253 million TOE or grow by 3.4% per year. However, when compared with the growth in transportation needs, this growth rate is not sufficient. The transportation sector will experience scarcity if it only relies on conventional fuels and biomass.

One solution to this problem is the use of electric vehicles. In Indonesia, currently the use of electric cars is still very minimal and for a large scale it is only heard that it is still at the planning stage. Although it
has not yet been felt in the car industry in Indonesia, the Indonesian government has actually tried to develop the electric car industry and assigned PLN to provide charging facilities for electric cars. In the 2019-2028 RUPTL, it has also been stated that the use of electric vehicles will become a trend as a means of transportation to replace ICE or conventional cars.

However, because in Indonesia, currently electric cars cannot be realized in the community in general because there is no government effort in procuring electric cars at low prices and also the need for electric loads for charging electric cars has not been fulfilled, so in Indonesia the use of electric cars has not been fully realized. thorough. In addition, because the availability of fuel oil is still abundant, until 2025, it is estimated that the supply of fuel oil will reach 672.55 million barrels, therefore it will be easier to provide fuel oil than electricity supply for charging. In such a context, it means that Indonesia still has to go through the transition phase from the use of fuel oil energy to electrical energy in the transportation sector. One solution is to use a Plug-In Hybrid Electric Vehicle or commonly referred to as PHEV, which is a technological step in the transition between vehicles with fuel oil and Battery Electric Vehicles (BEV), combining the advantages of these two technologies. These vehicles are capable of driving in either charge depleting (CD) mode - pure electric driving mode, or charge sustaining (CS) mode - pure conventional fuel driving mode, depending on the driveline configuration, driving profile characteristics and vehicle charging frequency. A PHEV is basically an HEV with additional battery capacity.

2. Research Methods

2.1. Indonesia Electric Vehicle Growth

In Indonesia, one of the first electric cars created was "Evina", which stands for Electric Vehicle Indonesia. This car was developed by Dasep Ahmadi, which uses lithium-ion batteries (36 pieces) used is 21 kWh and is able to cover a distance of 135 km with a full charge in 5 hours. In addition, several other products were followed, such as Tucuxi, Hevina and Selo and Gendhis.

One of the most famous is the "PiEV" or Pindad Electric Vehicle. This car produced by PT PINDAD is a vehicle for future research and development where PINDAD will contribute to supplying the national electric car drive train. With a payload for only 2 people, this car is designed for a cruising range of 100 km with 21kWh battery energy. The car is driven by a permanent magnet brushless DC (BLDC) type motor with a power of 25kW and a rated voltage of 400V. Apart from companies or agencies, from the academic side, Indonesia has also developed several electric cars, such as from the University of Indonesia there have been 3 models that have been developed (Makara Electric Vehicle 1, 2, & 3). From ITB there has been "Jalak", and UGM with "Arjuna", and ITS which made 3 models (Ezzy 1, Ezzy 2, Loveo Ireng) (Hermawan, 2017).

The government is very serious in encouraging the development of the electric car technology industry. One of the ways is by providing incentives to the industry in the context of accelerating the electric-based or battery-based vehicle program. This is stated in Presidential Decree No. 55/2019 on the Acceleration of the Battery-Based KBL Program for Road Transportation (Aziz et al., 2020). The incentives referred to include import duty incentives on the import of battery-based KBLs called completely knock down (CKD) or incompletely knock down (IKD) or main components for a certain amount and period of time. Other incentives can also be in the form of incentives for Sales Tax on Luxury Goods (PPhBM), namely the exemption or reduction of central and local taxes; import duty on the import of machinery, goods, and materials in the context of investment; suspension of import duty for export; and incentives for import duties borne by the government on imports of raw materials and auxiliary materials for the production process. Furthermore, there are also incentives for the manufacture of general electric vehicle charging unit (SPKLU) equipment, export financing incentives, fiscal incentives for research and development, parking fees, reduction in the cost of charging electricity at SPKLU, support for SPKLU development financing, competency certification for KBL-based human resources. batteries, and product certification and technical standards for battery-based KBL industry companies. The non-fiscal incentives that can be given include exemptions from restrictions on the use of certain roads, delegation of production rights to technology related to electricity-based KBL, and development of operational security in the industrial sector. Finally, there are additional fiscal and non-fiscal incentives for the national branded KBL industry.
Based on information obtained from the Ministry of Energy and Mineral Resources (ESDM), the government has determined that Indonesia will start mass production of electric cars in 2022 [6]. This new policy is referred to as a prelude to the start of the electric car manufacturing process in Indonesia. And electric car technology is being developed in many countries and only recently produced in a few countries (Schmidt, and Huenteler, 2017).

One of the challenges of electric cars in Indonesia is to make people aware of the importance of taking action to reduce CO2 emissions and also adapting to the Indonesian car market which is unique and not the same as the world car market. In addition, providing a deeper understanding of the types of electric cars and how they work, as well as the efficiency of these types of cars is very important to convey to the public.

2.2. The Type of Electric Vehicle

Electric cars can be divided into several types. These types of electric cars can be distinguished based on the energy in the battery or other energy storage. There are several types of electric cars that have passed the demonstration stage to the manufacturing process. According to Shaukat there are 3 types of electric cars, namely Battery Electric Vehicle (BEV), Hybrid Electric Vehicle (HEV), and also Plug-in Hybrid Electric Vehicle (PHEV) (Shaukat et al., 2018). The following is a detailed explanation for each type of electric car.

The BEV type electric car is an electric car with an energy source that comes from a battery only, without the support of a combustion engine. It must be connected to an external power source to recharge the battery. Only relying on the energy stored in the battery pack, the BEV-type electric car can cover a distance of 100 to 250 km on a single full charge. For a higher class, the distance can be further up to 300 to 500 km (Grunditz and Hiringer, 2016). This mileage range is also influenced by the condition and style of the driver's age, road conditions, climate, and battery type. Because it only relies on the power stored in the battery, the BEV-type electric car does not emit emissions such as carbon dioxide (CO2) and other pollutant emissions, such as heavy metals, namely lead (Pb). BEV electric cars have several advantages: no emissions, no oil or gas changes, easy charging at home, fast and smooth acceleration, and low operating costs. However, this car has drawbacks, such as having a shorter mileage for a single battery charge with a full charge.

As the name suggests, this hybrid electric car has two complementary drive systems, namely an internal combustion engine (ICE) and an electric motor with a battery. For how it works, the vehicle engine and electric motor can turn on the transmission at the same time and the transmission then turns the wheels. HEVs cannot be recharged from the grid because all of their energy comes only from gasoline and regenerative braking. For its own advantages, this HEV electric car has a longer mileage for one full refueling. With less gasoline consumption when compared to gasoline vehicles and less emissions when compared to gasoline vehicles. As for the drawbacks, this car still produces emissions, has a complex mechanical system, is expensive to operate, and cannot be charged at home.

The plug-in hybrid electric car uses an electric motor and battery to drive the car, which can be connected to the electrical grid to charge the battery, but also has an internal combustion engine that can be used to recharge the vehicle battery and/or to replace the electric motor when the battery is running. In addition, regenerative braking is also a feature of PHEVs which can also provide alternative battery charging. For the advantages of this PHEV car, when compared to BEV this car still has a longer mileage. As well as less gasoline consumption when compared to gasoline vehicles, fewer emissions, and has a simpler mechanical system. As for the drawbacks of this electric car, this car still produces exhaust emissions from its internal combustion process and also operating costs which tend to be more expensive when compared to BEV electric cars but cheaper when compared to HEV electric cars. However, for PHEVs to replace ICE vehicles, they must penetrate the market and extrapolate these savings to the fleet level (Simpson, 2006).

2.3. Mitsubishi Outlander PHEV

The Mitsubishi Outlander PHEV is the world's first plug-in hybrid SUV. The Outlander PHEV represents a fusion of EV technology developed by MMC (Mitsubishi Motors Corporation) for models such as the i-MiEV, 4WD technology honed in the Lancer Evolution, and SUV know-how acquired from Pajero (Montero or Shogun in some countries). The result is an innovative new model that brings together the
superior environmental performance and quietness of an EV, the stability and handling of 4WD, and the practicality of an SUV, so drivers can enjoy the benefits of:

- Eco-friendly electric operation for daily use and motor-powered hybrid operation for longer trips
- Excellent motive performance from its Twin Motor 4WD System
- Unique functionality enabled by the high capacity battery, and Battery Charge Mode which allows the battery to be charged by the machine either at rest or in motion

For the driving mode, the driver can choose the desired driving mode according to his needs. The driver can select the driving mode by operating the mode switch on the car dashboard. The Outlander PHEV car driving mode is divided into several modes, such as:

**EV Mode**
EV Mode generally only uses power from the electrical energy contained in the battery. Here the engine or generator is not used at all. The front wheel motor and the rear wheel motor only run from the battery. This mode is usually used for road conditions in the city only or road conditions that are not sloping.

**Series Hybrid Mode**
This mode is usually used when the remaining energy in the traction battery drops to a predetermined level or other conditions such as the driver accelerates suddenly, the system will command the gasoline engine to generate electrical energy. In this mode, the combustion engine does not turn the wheels directly but an electric motor is the only means of providing power to the wheels. When electricity is needed in large quantities, the motor will draw electricity from the battery and generator. Series hybrid configurations have been around for a long time, for example: diesel-electric locomotives, hydraulic earthmoving machines, diesel-electric power groups. This mode is usually used when going uphill or when speeding suddenly. Or this mode can be used when the battery condition is low.

**Parallel Hybrid Mode**
This mode is used when the vehicle speed is higher, because the car requires the support of a gasoline engine that operates more efficiently when compared to an electric motor at high speed. When overtaking at a higher speed or in other situations that require faster acceleration, the system will switch to the motor in the front wheel and the motor at the rear wheel to provide additional power and assist the gasoline engine to provide high acceleration. In this condition the generator also produces electrical energy.

2.4. **Utility Factor Parameter**

The utility factor (UF) is defined as the ratio of mileage in CD mode to all mileage. As previously mentioned, Plug-In Electric Vehicles (PHEV) is an intermediate technological step between conventional fuels (ICE) and Battery Electric Vehicles (BEV) or Electric Vehicles (EV), combining the advantages of both vehicle technologies. These vehicles are capable of driving in two different modes namely Charge Depleting (CD) mode and Charge Sustaining (CS) mode. CD is pure electric driving mode and CS is pure conventional fuel driving mode, depending on driveline configuration, driving profile characteristics and vehicle charging frequency. The PHEV can operate in charge-depleting (CD) mode, where little or no fuel is consumed. Once the CD range is exhausted, the PHEV can continue to operate in charge-sustaining (CS) mode, running on gasoline, in much the same way as a hybrid electric vehicle (HEV) (Wu et al., 2015). The division between CD and CS related to the total distance traveled determines the impact of the vehicle's performance on the environment. And this is usually expressed as the Utility Factor (UF). This UF value can range from 0, i.e. conventional vehicles or HEVs driving only in conventional fuel mode, to 1, i.e. PHEV and BEV driving only in electric mode.

Based on the SAE J2841 report [12], if the CD range is known, the UF value for PHEV vehicles can be defined by the equation:

\[
UF(R_{cd}) = \frac{\sum_{i=1}^{n} \min(d_i, R_{cd})}{\sum_{i=1}^{n} d_i}
\]
Where UF \( R_{cdi} \) is the UF value based on the given CD range, \( R_{cdi} \); \( d_i \) is the distance traveled on the \( i^{th} \) day, and \( n \) is the number of days traveled in the experiment. The method shown in the above equation is referred to as the standard SAE method, meaning that every day the vehicle leaves the house with a fully charged battery and is not charged again that day before returning home at night (Wu et al., 2015).

2.5. **Total Cost Ownership**

The concept of TCO is to summarize all current and future costs and revenues of an investment. This provides a more realistic picture of the economic value of an investment than the sole consideration of the purchase price. This is important for EVs because the savings associated with lower fuel costs do not arise at the time of purchase, but over the period of ownership. We calculate the TCO of each vehicle as follows:

3. **Results And Discussion**

A. **Utility Factor Measurement**

Only by completing a Factor Utility or UF analysis can one determine "how electric" an electric vehicle is using. As is known, from the data taken, the vehicle travels a certain distance from leaving the house and returning home. The experiment was carried out with 10 trips from house to house for each vehicle. However, only 8 experimental data were used from each car, so a total of 16 data on the distance from house to house were used. From the data obtained in the experiment, the utility factor calculation process is carried out using the previously mentioned method. And the data obtained are as follows:

![Figure 1. Graph of utility factor data of the Outlander PHEV A](image-url)
For the first vehicle unit or called PHEV A, after traveling a distance of 462 Km, the CD or Charge Depleting value is 389 Km with an average of 48,625 Km in one trip. From this data, the Utility Factor value is 0.8419 or about 84%.

For the second vehicle unit or called PHEV B, after traveling a distance of 464 Km, the CD or Charge Depleting value is 388 Km with an average of 48.5 Km in one trip. From this data, the Utility Factor value is not much different from PHEV A, which is 0.8362 or about 83%.

From this experiment, two different UF values were obtained from each unit. And from this we can conclude that the Utility Factor or UF value of the Mitsubishi Outlander PHEV vehicle in this experiment is 0.839 or 83.9%, where the vehicle has an average distance of 57.875 Km in one trip. This value is strongly influenced by the distance to drive using a full battery. If the distance we usually do is further this will make the UF value smaller and vice versa.
As mentioned in Wu et al (2015), with several UF measurement experiments, UF values were found between 0.78 – 0.91. This means that the experimental results obtained by the author here can be said to be suitable for PHEV vehicles.

B. Total Cost Ownership

The calculation of the total expenditure efficiency or cost efficiency on the Outlander PHEV vehicle is calculated by getting some data first. Here the vehicle TCO value will be calculated to include additional costs and benefits, such as depreciation and fuel cost savings.

The price per unit of Outlander PHEV under normal conditions in 2021 will reach 1,322,700,000 rupiah (P = Rp 1,322,700,000, -). From the available data, the average incentive during 2021 is 439,507,143 rupiah. Then the Incentive value or S value can be entered in the TCO formula for the average value (S = Rp 439,507,143, -). The value of VAT and other taxes in Indonesia is included in the unit selling price or called the On the Road (OTR) price so that the value of VAT and Tc can be considered zero. Moreover, outlander PHEV has a value of 14,721,000 rupiahs for the annual tax. Furthermore, because this TCO calculation assumes four years of use, the Tr value is 58,884,000 rupiah (Tr = 58,884,000).

For the calculation of the cost of fuel and electricity costs used by PHEV vehicles is provided in the form of assumptions. Where the value of fuel costs and electricity costs is taken in 2021 and is assumed to be the same within 4 years during the TCO calculation and the vehicle is assumed to cover a distance of up to 12,000 km per year (Levay, 2017). If it is assumed that the driver travels 40 km per day and the driver needs to recharge after two days of use. For the use of the battery itself, from a fully charged condition or 100% to full it can travel approximately up to 50 km and the battery has a capacity of 13.8 kWh. This value is taken from the average of the experimental data, although there are actually many factors that influence this value such as the speed of the vehicle, the condition of the street crowd, and the mode of the vehicle used. If the vehicle is charged once, it can travel 50 km, meaning that there is a remaining 30 km that must use power from gasoline. From the experimental results, it is found that the average value of PHEV vehicles will cover a distance of 16.8 km per liter. This value is not much different from that done by Fullatron. He mentioned that during the period from May 30, 2016 to October 31, 2021, PHEV vehicles were recorded to have traveled 78,462 km (48,754 miles) and consumed 3880.84L of gasoline. The data shows the average fuel consumption is only 4.95L/100km, or about 20.2 km per liter (Fullarton, 2021). If you follow the price of Pertamax Plus in 2021, which is 11,200 rupiah per liter and the price per kWh is 1,500 rupiah, then the calculation will be as follows:

Table 1. Table of calculation of total energy expenditure of PHEV vehicles in 4 years.

<table>
<thead>
<tr>
<th>Energy</th>
<th>Distance per month</th>
<th>Energy per km</th>
<th>Energy Needed</th>
<th>Energy cost</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery</td>
<td>600 km</td>
<td>50 km/13.8 kWh</td>
<td>165.6 kWh</td>
<td>1500 kWh</td>
<td>Rp 248,400</td>
</tr>
<tr>
<td>Fuel</td>
<td>400 km</td>
<td>16 km/ 1 kWh</td>
<td>25 liter</td>
<td>11200/liter</td>
<td>Rp 280,000</td>
</tr>
<tr>
<td>Total per Month</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rp 528,400</td>
</tr>
<tr>
<td>Total per Year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rp 6,340,800</td>
</tr>
<tr>
<td>Total in 4 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rp 25,363,200</td>
</tr>
</tbody>
</table>

From the data above, we can conclude that the value of Fuel and/or Electricity Cost is 25,363,200 rupiah for every four years (F = Rp 25,363,200, -). From several used car online buying and selling sites, it can be seen that the selling price of the 2019 Outlander PHEV vehicle is already at 660 million. After 3 years, the price depreciation has reached 45%. From this it can be assumed that in 4 years the price of the vehicle
will depreciate 60%. If the selling price is taken in 2021, then the selling value after 4 years or the value of R, is estimated to be worth 529 million rupiah (R = Rp. 529,000,000, -).

From the calculation value above, the Total Cost Ownership value of Outlander PHEV vehicles in Indonesia for 4 years assuming a distance of 48000 km, the price of electricity is 1500 rupiah per kWh, and the use of pertamax is 11,800 rupiah, has a value of 438,440,057 rupiah.

From the calculation of TCO value, the Total Cost Ownership value of Outlander Sport ICE vehicles in Indonesia for 4 years assuming a distance of 48000 km and the use of Pertamax is 11,800 rupiah, has a value of 180,053,846 rupiah.

From the two TCO values obtained, it can be seen that the Outlander PHEV TCO value is still 258 million. Or when compared in percent is still worth 244%. This can happen due to several factors, such as government regulations for importing vehicle components such as lithium batteries, which are still subject to high taxes. From the experiments carried out by Levay (2017). In several countries in Europe, PHEV vehicles have various TCO values, which are between 70% - 200% when compared to their ICE vehicles. His research shows that the bigger the PHEV, the higher the sales and the lower the TCO compared to its ICE counterpart. Small PHEVs have the lowest relative sales and the highest relative TCO, while large PHEVs have the highest relative sales and the lowest relative TCO. And the TCO value of Outlander PHEV when compared to its ICE is still below 150% with the highest position in Italy, followed by Denmark, France and the United Kingdom. Meanwhile, below 100% are in Norway and the Netherlands.

From the examples of writings made by students, researchers can see that students already understand the pattern of simple present tense sentences. From the three tests, it was seen that there was an increase in students' understanding in making positive, negative, and interrogative sentences in the simple present tense. In the tryout test, only 13 out of 27 students (48%) answered correctly using the simple present tense sentence pattern. At the time of the data collection test after the students received a re-explanation of the simple present tense sentence pattern, there were 20 of 27 students (74%) who answered using the simple present tense sentence pattern correctly. Before the researcher explained the simple present tense sentence pattern material, only 48% of students made the simple present tense sentence pattern correctly. After being given a clear explanation by the researcher, 74% of students made sentences using the simple present tense sentence pattern correctly. Therefore, it can be said that there has been a 26% increase in understanding of simple present tense sentence patterns among students.

4. Conclusions

Referring to the results of the analysis that has been carried out to determine the value of ownership expenditure and the utility factor value of the Mitsubishi Outlander PHEV vehicle, it can be concluded that the Utility Factor Value obtained in this study is 0.839 or 83.9%. This value is close to the UF value for PHEV vehicles carried out in the SAE J2841 report and the study conducted by Wu et al. (2015). This means that the UF value obtained for road conditions and PHEV vehicles in Indonesia already resembles the UF value in general for PHEV vehicles. Many factors affect the utility factor value, such as the mileage or odo meter value of the vehicle used, the weight of the vehicle used (in this case, the condition of the passenger sheet or vehicle gas tank), as well as the characteristics of the vehicle battery charging.

Moreover, the value of Total Cost Ownership (TCO) of the Outlander PHEV vehicle is worth 438,440,057 rupiahs, or about 244% greater than the TCO value of the ICE vehicle, namely the Outlander Sport, which is only worth 180,053,846 rupiahs. The calculation of TCO will contribute to our understanding of interactions between fiscal incentives and sales figures. Incentives can play an essential role in breaking through the PHEV market in Indonesia. Nevertheless, PHEV vehicles can achieve higher marketing value at competitive prices than ICE vehicles. The comparative methodology between PHEV and ICE in this experiment can provide new thinking regarding the need for spending to own a PHEV vehicle. The conclusion of this research for the value of TCO is to provide qualitative guidance for buyers on the importance of reducing CO2 emissions or the government as a regulator who wants to consider changing the incentive scheme for PHEV vehicles or other electric vehicles.
Bibliography


