Market Feasibility Study for Conversion of Diesel-powered into Electric Truck

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Abstract

The challenges of the global climate as well as the increasing needs of transportation and shipping logistics have forced various manufacturers to start transforming the transportation technology from fossil fuel-based to electric vehicles (EVs). The problem is that currently most companies still have a lot of assets in the form of trucks that run on diesel fuel. The conversion process of conventional trucks to electric trucks is solution for the needs of logistics delivery and the limited funds. The conversion process requires a comprehensive analysis of various market aspects before it is truly commercialized. This research focuses on analyzing market aspect in the feasibility study of converting diesel trucks into electric trucks. The purpose of the market aspect analysis in this study is to determine market conditions, market acceptances, and the position of competitors in the electric truck business. Based on the analysis of market aspects on the feasibility, it is concluded that the potential customers of electric truck from the conversion of diesel truck users are quite promising. So far not many direct competitors have played in the electric truck conversion area. The next step is an analysis of the technological aspect.

Keywords
electric vehicle (EVs), feasibility study, market analysis, truck conversion, electric truck

1. Introduction

In the last few decades, issues related to global warming and Greenhouse Gas (GHG) emissions have become emerging issues widely discussed in various fields. PBL Netherlands Environmental Assessment Agency states that, from year to year, GHG emissions in the world are increasing, including in Indonesia. At the end of 2018, the world's total GHG emissions reached 55.6 gigatons of CO2, an increase of 2% from the previous year. CO2 emissions still account for the largest proportion of GHG (around 72%), followed by CH4 (19%), N2O (6%), and F-gases (3%). Indonesia contributed about 0.54 gigatons of CO2 in 2018, three times higher than the emissions in 1990 reported at 0.17 gigatons (Olivier and Peters, 2020).

The world's largest GHG emissions are coming from industrial activities and vehicle exhaust. To deal with these problems, various actions have been taken, including efforts to shift from fossil-based vehicles to electrical vehicles (EVs). However, electrical vehicles are currently not widely commercialized, not to mention the fact that much researches have been done in the related area and it can be observed that the use of EVs shows an increasing trend from year to year (Sun *et al.*, 2017). As a developing country, Indonesia has made various efforts to develop and commercialize EVs. Since 2013, 5 national universities have been selected as EV research consortiums. Along with the development of battery technology and the availability of natural resources, in 2021 the Indonesian government will begin to form a holding company that focuses on the development and production of batteries. This step was taken as a realization of the presidential policy contained in Presidential Decree no. 55 of 2019 concerning the Acceleration of the Battery-Based Electric Motor Vehicle Program.

As an archipelagic country with thousands of islands spread along ± 5,110 km, transportation, and logistics problems have always been a challenge for Indonesia. In terms of distribution of goods between regions, most industries, both small, medium, and large industries, still rely on land transportation using trucks. In this case, trucks are used to transport raw materials to factory warehouses, semi-finished materials, or finished goods that are ready to be

distributed to distribution centers. The problem is, almost all the trucks used are fossil fuel vehicles. To shift to electric trucks, currently, there is only one option for direct procurement through imported electrical trucks from abroad. Which, of course, is not economically profitable for medium or even large industries.

To be able to reduce the amount of GHG emissions that come from transportation and distribution activities, logistics companies can switch to EVs by converting from conventional fossil-fuel trucks to battery-powered electric trucks. The conversion process is considered beneficial for companies that use conventional trucks, because companies can allocate resources (both capital investment and truck assets) more effectively, without interrupting the company's operational activities. The solution to convert from diesel trucks to electric trucks is what creates new business process opportunities in the automotive industry in Indonesia.

Research on the conversion of fossil fuel trucks to electric trucks is still very limited. Most of them discuss the development of new electric vehicle designs, such as research conducted by (Matsuda, Murase and Kawai, 2015). Research on the conversion of fossil-fuel vehicles to electric vehicles only discusses the conversion of passenger cars, trains, and motorcycles (motorcycle). For example, technical experimental analysis has been carried out on diesel-powered passenger cars converted to hybrid-powered passenger cars (Gupte, 2014). In addition to technical aspects, the conversion process often requires a cost analysis to measure the feasibility of the business process (Gujarathi, Shah and Lokhande, 2018).

This research focuses on the study and analysis of the feasibility of converting fossil fuel (diesel) trucks into battery-powered electrical trucks. Several studies that discuss the feasibility study/analysis of electric vehicles (EV) have been carried out quite a lot. As shown in (Falcão, Teixeira and Sodré, 2017), the feasibility analysis was carried out on both technical and economic aspects. The object of research in (Falcão, Teixeira and Sodré, 2017) is a minibus used to transport passengers in urban areas. In India, an analysis/feasibility study on the technical aspects was carried out for electric city bus vehicles (Agarwal, 2018). Feasibility analysis using technical and economic aspects was also carried out for the development of electric vehicles in the campus area (Schetinger *et al.*, 2020). In a feasibility analysis on the technical and economic aspects was carried out for an electric vehicle that is integrated with solar panels. A technical feasibility analysis was also carried out to measure the penetration of electric vehicles into the market (Al Junaibi and Farid, 2013). In South Korea, the economic aspect is used to measure the feasibility of adopting electric taxis in metropolitan cities (Baek, Kim and Chang, 2016). In addition to technical and economic aspects, environmental aspects are also used as one of the feasibility criteria for developing electric vehicles (Todorovic and Simic, 2019)(Reininger and Salmon, 2015).

The purpose of this study is to get an overview of how the business process of converting from diesel trucks to electric trucks can provide benefits for all parties, especially for manufacturers or companies that carry out the conversion process. Feasibility studies should be carried out comprehensively, covering technical, market, economic and managerial aspect. However, this research limits the study from the market aspect, since the market feasibility study is the first step that should be accomplished before moving to other aspects.

2. Methodology

This study uses two approaches in studying the market feasibility of the electric trucks conversion business. The first approach is to analyze potential customers of electrical trucks. The second is a competitor analysis which is conducted by gathering data of electric truck global companies. Analysis of potential customers of electric trucks is used to get an overview of how is the current trend of electric trucks in the market, both locally and globally. The data used are in the form of electrical vehicle and electrical truck usage data, electrical truck registration data, and truck sales data. The data are obtained from various statistical center web portals, associations, official reports from companies, as well as other credible sources. Competitor analysis is done to get an overview of the position of the electric truck conversion business, and to answer questions whether there are competitors who are already in the same area, are there still opportunities to enter/penetrate the market, and what are the possible prospects in the future. The data is obtained from the competitor's official website portal. The data collected includes product knowledge produced by competitors along with price and specifications.

3. Results and Discussion

3.1. Potential Customer of Electrical Truck

Based on data compiled by the International Energy Agency (IEA), throughout 2020, more than 10 million electric vehicles were on the road, an increase of 43% over the previous year (Figure 1). It is in line with consumer and

government consumption data on electric vehicles. In 2020, consumer consumption of electric vehicles increased by 50% from the previous year to USD 120 Billion. Government consumption used for incentives and tax reductions for electric vehicles also increased by 25% from the previous year to USD 14 Billion.

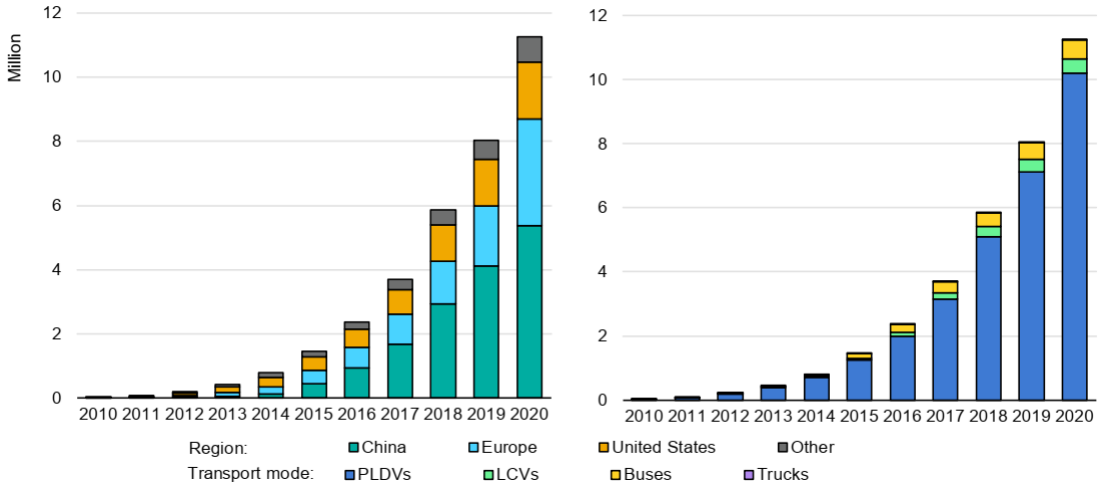

Figure 1. Global electric vehicle stock by region and transport mode (2010 to 2020) (Agency, 2021).

Based on the type of electric vehicle used, passenger light-duty vehicles (PLDVs) still dominate with a market share of nearly 50% of total global sales, followed by light commercial vehicles (LCVs), buses, and trucks. The market share for truck-type vehicles is still very low, which is below 1% of the total electric vehicles in circulation.
However, the growth of the world's use of electric trucks is increasing every year. In 2020, the number of registered heavy-duty electric trucks reached 7,400 units, an increase of 10% compared to the previous year. The largest contributor to the number of registrations of heavy-duty electric trucks is China, followed by Europe, and the United States, as shown in Figure 2 (Agency, 2021).

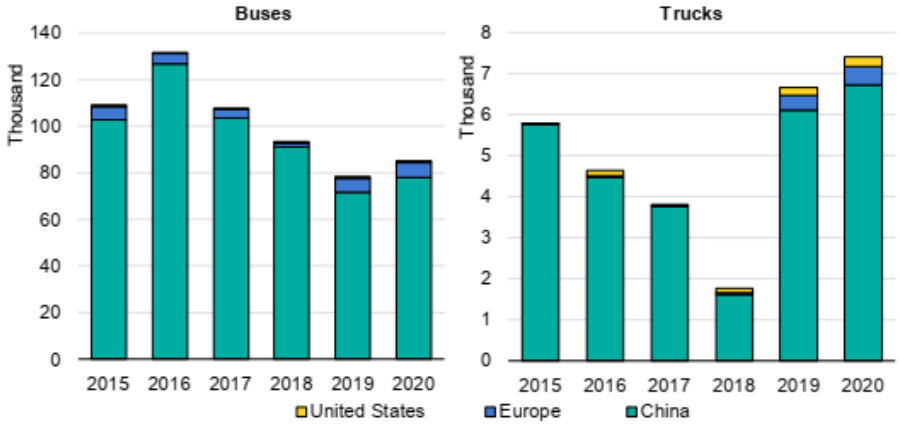

Figure 2. Electric bus and truck registrations by region (2015 to 2020) (Agency, 2021).

Based on Figure 3, it can be seen that for the last 5 years, the number of registered electric trucks is still very few when compared to electric buses. However, the trend of their use is different. The trend to use electric trucks is higher than electric buses. The need for large demand as well as regulations/policies in each country has encouraged manufacturers to design more diverse models and produce a greater number of electric trucks. The outlook for the growth of globally developed electric truck models is shown in Figure 3.

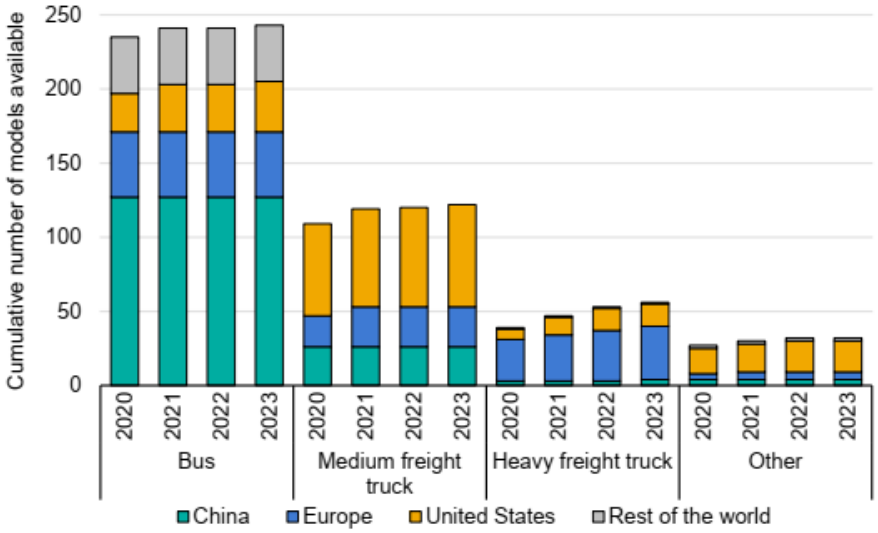

Figure 3. Outlook of announced electric bus and truck models (2020 to 2023).

Along with the increasing demand, various truck manufacturers such as Daimler, MAN, Renault, Scania, and Volvo have expressed their commitment to continue to develop electric truck models and encourage production in a larger number. Although Figure 3 indicates that the outlook for the number of electric bus models is still higher than that of electric trucks, the number of models is not the only benchmark in measuring healthy market competition. The smaller number of available electric truck models may be caused by the fact that trucks can be applied more generally than buses. Mostly, buses require more specific models to be applied.

In Indonesia, the need for the use of trucks is relatively large. Based on data compiled by the Association of Indonesian Motor Vehicle Industries (GAIKINDO), which is shown in Table 1, it is noted that the market share for trucks is still quite large compared to other types of vehicles. During the last 4 years, the trend of market share growth for pickup/truck types is still higher than other types of vehicles. This indicates that society and industry in Indonesia still rely a lot on this type of truck to support various economic activities.

Table 1. Sales and Market Share for Wholesale Vehicles by Type, in Indonesia (2018 to the 2nd quarter of 2021)

Type of Vehicle	Annual Sales (units)				Market Share (%)			
	2018	2019	2020	Jan - Jun 2021	2018	2019	2020	Jan - Jun 2021
Sedan	6,704	6,412	4,856	3,039	0.6	0.6	0.9	0.8
4 X 2	634,380	557,613	276,034	212,906	55.1	54.1	51.8	54.1
Affordable Energy Saving Cars 4 X 2 (LCGC)	230,443	217,454	104,650	73,609	20	21	20	19
4 X 4	3,150	4,060	3,726	1,636	0.3	0.4	0.7	0.4
Bus	3,519	3,774	1,971	490	0.3	0.4	0.4	0.1
Pick Up/Truck	257,382	228,977	133,413	95,804	22.4	22.2	25.1	24.3
Double Cabin	15,730	11,836	7,757	5,975	1.4	1.1	1.5	1.5

Table 1. Sales and Market Share for Wholesale Trucks by Type, in Indonesia (2018 to the 2nd quarter of 2021)

Type of Trucks	Annual Sales (units)				Market Share (%)			
	2018	2019	2020	Jan - Jun 2021	2018	2019	2020	Jan - Jun 2021
Pick Up (GVW < 5 ton)	143,473	135,383	90,733	66,521	56	59	68	69
Truck (GVW 5-10 ton)	76,810	64,755	33,412	22,771	30	28	25	24
Truck (GVW 10-24 ton)	7,274	7,938	2,761	1,803	3	3	2	2
Truck (GVW > 24 ton)	29,825	20,901	6,507	4,709	12	9	5	5

Based on the distribution of sales and market share for each type of truck (see Table 2), it can be seen that the light-medium type/category truck still dominates the market share and continues to record an increase over the last 4 years (GAIKINDO, 2021).

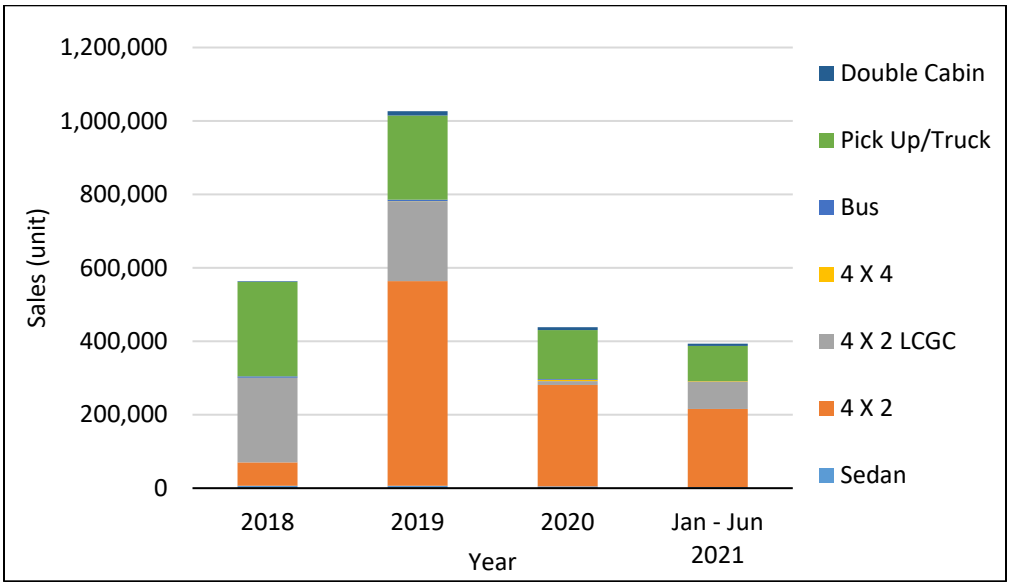

Figure 4. Annual sales of each type of trucks, in Indonesia (2018 to the 2nd quarter of 2021).

With the increasing trend of electric vehicles, and supported by large and increasing demand every year, the option in the electric truck conversion can be a promising business opportunity. However, the market potential from the results of this analysis needs to be further analyzed by considering the position of existing competitors in the market.

3.2 Competitor Analysis

Currently, several electric truck products can be found on the market. Most of them are specially designed and developed new electric truck models, not from diesel trucks conversion, as shown in table 1. The electric truck models have gone through an adequate research and development process from the start and have been produced in large enough quantities. These types of trucks are usually used by well-established and large-scale industries.

Based on competitor data for electric truck manufacturers from Table 3, it can be seen that there are quite some electric truck models on the market. Most electric trucks are medium and heavy-duty. Medium trucks are usually used for delivery and local public services, with a power output range of 200 to 300 hp and battery modules in the range of 200 to 300 kWh. Meanwhile, heavy trucks are usually used for the delivery of large tonnage goods between regions, with a power output range of 300 to 700 hp and battery modules in the range of 200 to 700 kWh. For light-duty trucks, there are currently the E-Transit brand from the Ford manufacturer and the C1000 from the Workhorse manufacturer. This type of truck is usually used for delivery of goods in close routes. The capacity of the battery module used is not too large, in the range of 50 to 110 kWh.

Based on the results of competitor analysis for electric truck products, it can be concluded that the potential for penetration into the light-type electric truck market is quite promising, which can be seen from the relatively small number of players in this market. However, the current condition is that there are still many companies (both small, medium, and large) scales, that still have a lot of conventional (fossil-fueled) truck assets, especially in Indonesia (referring to the vehicle sales data for 2018-2021 in Table 2).

Table 2. Comparison of Electric Truck Global Competitors

Manufacturer	Model	Type by Size	Country	Horsepower (Hp) / Usable Capacity (kWh)	References
Daimler Trucks	Freighliner eM2	Medium	USA	180 - 300 Hp / 315 kWh	(Daimler, 2021)
Ford	Ford E-Transit Regular	Light	USA	266 Hp / 115 kWh	(Ford, 2021)
Nikola Motors	Nicola Tre	Heavy	USA	645 Hp / 753 kWh	(Nikola, 2021)
Volvo	VNR Electric Straight Truck	Heavy	USA	455 Hp / 264 kWh	(Volvo, 2021)
Workhorse	C1000	Light	USA	unknown / 70 kWh	(Workhorse, 2021)
DAF	DAF CF Electric	Heavy	Netherland	326 Hp / 210 kWh	(DAF, 2021)
Mitsubishi	e-Canter	Light	Japan	unknown / 81 kWh	(Mitsubishi Fuso Truck and Bus Corporation, 2021)
Renault	RD Wide Z.E.	Medium	France	unknown / 200 kWh	(Trucks, 2021)
Mercedes Benz	eActros	Medium	Germany	536 Hp / 240 kWh	(Mercedes Benz, 2018)

Table 3. Comparison of Electric Truck Conversion Kits Manufacturers

Company/ Manu-facturer	Old Car Model		Type by Size	Country	Conversion Kits	Price	Ref
General Motor	K5 Blazer-E	 Source: (Loveday, 2020)	Light	USA	200 Hp motor; 400-volt EV battery pack (60 kWh)	up-coming 2021	(Loveday, 2020)
DIYev	All model (up to GVW 17.5 ton)	 Source: (DIYev, 2019)	Light-Medium	USA	AC Permanent Magnet Motor 210 Hp motor;16 modular battery (@9.2kWh);210 kW Controller System; 6 Speed Gearbox with Ratio	un-known	(DIYev, 2019)
Ecotuned	Ford F 150	 Source: (Ecotuned Automobile, 2021)	Light	Canada	214 Hp; 2 Speed Automatic; 400-volt Ev battery pack (86 kWh)	USD 40,000 (kit only)	(Ecotuned Automobile, 2021)
Lightning Repower	Chevrolet 6500XD Low Cab Forward	 Source: (EMOTORS, 2021)	Medium	USA	295 Hp motor; 128-192 kWh Battery Capacity	USD 85,000 (include truck)	(EMOTORS, 2021)

Therefore, the opportunity to develop a completely new electric truck, apart from generating substantial research costs, is certainly feared that the market will not be able to absorb it optimally. Then, it becomes important to conduct a competitor analysis for companies/manufacturers that develop truck conversion kits from fuel to electric power. The results of competitor analysis for light-medium type electric truck conversion kits shown in Table 4.

Based on Table 4, it can be seen that the companies that offer kits for electric truck conversions are still dominated by the United States. The conversion kits offered by these companies also vary, including the motor type, battery capacity, and packages offered. For example, General Motors provides conversion kits specifically for the K5 Blazer-E mini truck. The conversion kits are planned to be released to the market by the end of 2021. DIYev, a company that focuses on developing kits for converting electric vehicles (including trucks), provides a wide range of specifications for converting conventional trucks to electric trucks depending on the type. Ecotuned, a Canadian company with a vision to bring energy efficiency, also offers a special conversion kit for the Ford F 150 product. The kit costs around USD 40,000 excluding the vehicle. Other competitors, such as Lightning Repower from the United States, provide electric truck conversion kits including the vehicle. The package is priced around USD 85,000.

In Indonesia, currently, no manufacturer that specifically produces conversion kits for conventional trucks to electric trucks. Looking at the existing condition, the potential for penetration into the business is quite promising, considering the market needs are still very large and there are no competitors in the Indonesian market. Although consumers can still import conversion kits from abroad, the procurement costs will be much higher, not to mention the shipping costs and taxes that also need to be considered.

4 Conclusion

Addressing the issue of climate change over the last few years/decades, vehicle manufacturers have responded by developing fewer emission vehicles, which are electric vehicles. Trucks are one of the modes of land transportation that are still used by many manufacturing companies. Even in Indonesia, the demand for trucks is still quite high from year to year. Due to the high number of conventional truck assets currently owned by companies, the opportunity to enter the electric truck conversion kits business can be a profitable option. However, before actually doing the business, it is necessary to study the feasibility of the business through comprehensive research from both markets, technology, management, environmental, as well as economic aspects.

Based on an analysis of global market conditions and the Indonesian market, as well as an analysis of the electric truck manufacturers' competitors, several conclusions can be drawn. First, the market demand for electric trucks, both worldwide and in Indonesia, is still very large. Supported by several data included, the increasing annual truck sales, the global trend in the annual use of electric vehicles, including types of trucks, is still increasing significantly. Although the use and number of registered brands are still less compared to other types of electric vehicles, electric trucks have consistently increased with a positive trend from year to year. Based on data compiled by Gaikindo, the demand for truck-type vehicles in Indonesia is still considerably large, with a consistent trend every year.

Secondly, there are currently no competitors that can meet market needs, so the opportunity to enter the electric truck conversion business is still wide open. Most competitors are dominated by companies and manufacturers in the United States. Currently, several large manufacturers have developed electric truck models, but the potential for these manufacturers to absorb market demand, especially in Indonesia, is still very low. With the economy still largely supported by the micro, small and medium sectors, it is difficult for Indonesia’s company to procure a completely new vehicle. Therefore, a promising business opportunity is a company that produces electric truck conversion kits. From the results of competitor analysis in electric truck conversion kits, it is concluded that there are still no direct domestic competitors that can meet market needs.

Finally, a great opportunity is to develop an electric truck conversion kits business. Electric truck conversion kits need to be designed and developed according to market requirements specifications. In the future, it is necessary to conduct a feasibility study on technological aspects, management aspects, environmental aspects, and economic aspects to ensure that electric truck conversion kits should be properly planned and designed optimally before launched into the market on a massive scale.

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Biographies

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