Examining the relationship of environmental and community well-being towards sustainability of electric vehicles (EV) bus program

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Abstract. The primary objective of this research paper is to examine the environmental impact, community well-being, and sustainability of the Electric Vehicle (EV) Bus Program. The study evaluates three critical factors - sustainability, environmental impact, and community well- being. 117 questionnaires were collected and were useful for analysis. The study discovered a positive and robust correlation between sustainability considerations and environmental impact. Additionally, the research revealed that there is a strong link between community well-being and sustainability. These results offer valuable insights into the essential variables and emphasize the significance of ensuring the sustainability of the Electric Vehicles (EV) Bus Program.

1. Introduction

With over 90% of its energy demand met by fossil fuels, the transportation sector contributes significantly to global carbon emissions (Arias et al., 2021). One of the industries that is contributing to climate change and global warming the fastest, according to Stanley et al. (2011), is transportation. According to the aforementioned claims, fossil fuels account for a sizable amount of the energy needed for transportation, and data implies that the transportation sector is one of the major contributors to global CO_2 emissions (Shen & Feng, 2020). Fuel combustion in this industry generated 8,040 million tons of CO_2 in 2017, placing it in second place among all economic sectors (24.5% of total CO_2 emissions) and contributing to 18% of all emissions that are man-made worldwide, according to International Energy Agency, (2019). To combat this, governments all over the world are putting forward plans to reach net-zero emissions, concentrating on renewable energy, energy efficiency, and electric and hybrid vehicles. In Malaysia, transportation accounted for a significant portion of the GDPand a significant portion of all CO_2 emissions (Solaymani, 2021). By 2030, Malaysia plans to reduce itsGDP emissions intensity by 45% from what it was in 2005. This is made up of 35% that is guaranteed and another 10% that is contingent on receiving climate funds, technological transfers, and capacity building from industrialized nations, with an emphasis on electric vehicles (EVs) (Sun, Li, Wang, & Li,2019). In early 2022, one of the Malaysian Public Sector Agency launched an EV bus program in Langkawi, to support Malaysia's environmental and sustainability goals. This research aims to investigate the sustainability, environmental impact, and community well-being of the EV bus program in Langkawi. By analyzing the program's effects, the study aims to provide valuable insights to improve the policies and programs of the Malaysian Public-sector Agency.

This research paper has two primary objectives. Firstly, it aims to identify the relationship between the sustainability and environmental impact of the EV bus program. Secondly, it will examine the relationship between community well-being and the EV bus program. The research will add to the expanding body of knowledge on the efficacy of EV programs for addressing sustainability, environmental impact, and community well-being. The findings of this research will provide useful recommendations to improve the EV program and contribute to Malaysia's efforts to reduce carbon emissions.

2. Literature Review

2.1. Environmental Impact

The phrase "environmental impacts" refers to alterations to the built or natural environment that are directly related to a behavior that might be harmful to the organisms living in the ecosystem or the air, land, or water. When an action has an adverse effect on the environment, it may create pollution, contamination, or destruction. (Abdallah, 2017). Most adverse environmental impacts also have a direct link to public health and quality of life issues. As such, the increasing adoption of EVs in Europe has attracted significant attention in recent years. By the end of 2018, there were over one million electric passenger cars on the roads of the European Union, the European Free Trade Association countries and Turkey (IEA, 2019). When EV adoption coincides with the decarbonization of power networks, the benefits of transport electrification for combating climate change will be greater. (Jones & Leibowicz, 2019). Studies by Hildermeier et.al. (2019) have emphasized the significance of EVs in creating an ecologically friendly and economically advantageous transportation system. The latter study focused on the health and environmental benefits of EVs in 27 EU countries, and found that the introduction of EVs could result in a reduction of CO_2 emissions and dependence on petroleum products. Additionally, the study highlighted that EVs can help lower greenhouse gas emissions, particularly CO2, and thus have a positive impact on the environment and public health (Omahne, et.al., 2021). In Malaysia, a study by Solaymani (2022) on CO_2 Emissions and the Transport Sector revealed that the transportation industry is one of the primary energy consumers and a significant contributor to greenhouse gas emissions. The study found that the transport sector is the second-largest generator of CO_2 emissions in Malaysia after the production of power and heat, and that road transportation is the subsector that produces the most CO_2. The study concludes that evaluating options for reducing the negative environmental impact of transportation is crucial for advancing social development and environmental improvement.

2.2. Community Well-Being

Community well-being is described by Wiseman and Brasher (2008) as the set of social, economic, environmental, cultural, and political conditions that individuals and communities believe are required for them to flourish and realize their greatest potential. The transportation sector has become one of the most significant and complex sources of greenhouse gas emissions whish effect the community well-being. E-mobility, or EVs, has been identified as a potential solution to the problem (Omahne et. al., 2021). While EVs have a lot of advantages, the perception and acceptance of EVs among the public still requires improvement. In cities, electric buses have the potential to improve air quality and reduce greenhouse gas emissions, particularly if they are powered by a clean energy system. (World Resources Institute,2019). In the future, the implementation of electric bus technologies will become widespread, including in Malaysia. Malaysia has already established policies to support the deployment of electric buses and promote the adoption of innovations and technologies in this area (Al-Ogaili et. al., 2021). The Global Green Growth Institute (2016) has found that electric buses have the potential to provide numerous benefits, including reduced vibration and noise. They can help to reduce high noise levels in urban areas, increase productivity by decreasing sleep disturbance and noise exposure, and reduce reading compression in schools and communities. Boren (2019) also supports these findings and adds that electric buses are beneficial for society and the community because they produce less noise, use less energy, have no emissions, and are cheaper to operate compared to buses powered by combustion engines. In general, the adoption of EVs could bring significant changes to society by not only providing transportation services but also by shifting economies away from petroleum and reducing CO_2 emissions from the transportation sector (Junior, 2021). Electric buses can play a positive role by reducing fuel consumption demand and promoting cleaner technologies and fuels (Global Green Growth Institute, 2016). According to Fadaki, Abbasi, and Esmailzadeh (2018), electric buses are superior to other buses for the health of communities and the environment, reducing respiratory diseases and strokes, and producing lower amounts of particulate matter and nitrogen oxide compared to diesel buses and compressed natural gas. However, the perception and acceptance of EVs among the public still require improvement, and the adoption of low-carbon technologies needs to be accelerated to prevent global warming from exceeding a safe threshold. Therefore, it is important to evaluate options for reducing the negative environmental impact of transportation to advance social development and environmental improvement. The EV Bus Program can contribute to this effort by promoting the adoption of innovations

and technologies in this area and accelerating the transition to low-carbon technologies.

2.3. Sustainability

The ability to meet present demands without compromising the ability of future generations to meet their own needs is referred to as sustainability. (United Nations,1987). In other words, sustainability involves maintaining and preserving natural resources, ecosystems, and human societies for future generations. The sustainability of EVs programs refers to the long-term viability and success of the programs in terms of environmental, social, and economic impacts. The elements that contribute to the sustainability of EV programs have been studied by a number of scholars.

2.4. Sustainability, Environmental Impact and Community Well-being

The relationship between environmental impact, community well-being and the sustainability of EVs programs is complex and interdependent. On the one hand, the environmental benefits of EVs, such as reduced greenhouse gas emissions, are essential for the long- term sustainability of the programs (Buekers et.al. 2020). However, the social benefits of EVs, such as job creation and public health improvement, are also crucial for the programs' sustainability (Global Green Growth Institute, 2016). As such, many studies have focused on identifying the optimal balance between environmental and social benefits in EVs programs. The sustainability of EVs programs is determined by a complex interplay between environmental and community well-being factors. While the environmental benefits of EVs are critical for their long-term sustainability, the social benefits are also crucial. Future researchshould focus on identifying the optimal balance between environmental and social benefits in EVs programs to ensure their long-term viability and success.

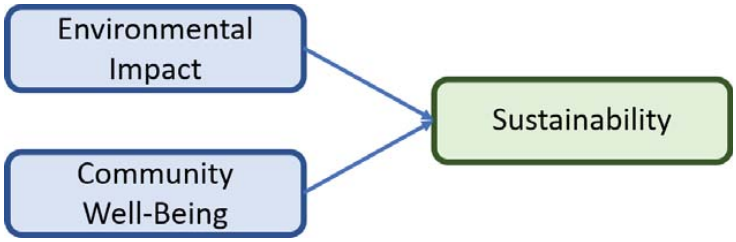

Figure 1. The relationship between environmental impact, community well-being and the sustainability of EVs programs

3. Methodology

This research study's goal is to determine how community well-being and environmental effect relate to the viability of the EV bus program. A cross-sectional research design was used in the study to gather information from 117 participants on EV bus programmed in Langkawi, Kedah. The survey questionnaire is self-administered, and closed-ended questions were used to gather the quantitative data. Purposive sampling is adopted to choose the respondents. Statistical Package for the Social Sciences, or SPSS, was used to analyses the data that had been obtained. Descriptive statistics were used to summarize demographic information, and Pearson's correlation were carried out to examine the relationship between environmental impact and community well-being towards the sustainability of theEV bus program. The study will adhere to ethical principles, and the participants will be fully informedof the main objective of the study and provide informed consent. The data collected will be kept confidential, and the participants will remain anonymous.

4. Results & Discussion

4.1. Descriptive Analysis

Table 1. Mean and standard deviation for sustainability, environmental, and community well-being

	N	Minimum	Maximum	Mean	Std. Deviation
SUSTAINABILITY	117	1.00	5.00	3.9520	.83745
ENVIRONMENTAL	117	1.40	5.00	4.2600	.77854
COMMUNITY WELLBEING	117	1.00	5.00	3.8040	.87364
Valid N (listwise)	117				

Table 1 disclosed three key variables, which is Sustainability, Environmental impact and Community Wellbeing were being analyzed using descriptive statistics. The results showed that the mean value of sustainability are 3.9520 with a SD of .83745. This indicates majority of the respondents in high agreement on sustainability of EV bus program in Langkawi, Kedah in general. Furthermore, respondents performed well in terms of Environmental impacts with a mean score of 4.26 and standard deviation of .77854, indicating consistent performance. Finally,the respondents also in relatively high agreement on community wellbeing with a mean value of 3.8040 and standard deviation of .87364. The study used a five-point internal scale to measure the variables and had a valid N of 117. Low, moderate, and high levels can be assigned to the mean values. The study provides valuable insights into the performance of the four key variablesand highlights areas for improvement.

Table 2. Category level and the mean range value

Category level	Mean range value
Low	1.00 to 2.33
Moderate	2.34 to 3.66
High	3.67 to 5.00

Based on Table 2 above; the mean score ranges of 1.00 to 2.33 is low, 2.34 to 3.66 is considered moderate, and between 3.67 to 5.00 is high.

Questionnaires items on sustainability (Dependent) and Environmental impact (Independent) indicates the mean scores of all items fall within the high category range scores for both items between 3.900 to 4.400. It can be sums up that the respondents have a high level of belief in the positive impact of electric vehicle transportation on long-term sustainability, the Malaysian economy, social demand, the socioeconomic environment, and competitiveness in the economy. In addition, the respondents are also in agreement that EV Bus transportation benefits environmental such as improved air quality, preservation of the local environment and reduced dependence on fossil fuels, reduced noise and minimal waste generation. As for mean scores for Community Well Being the results of a survey showed that the majority of respondents had also a high level of belief on community well-being aspect towards electric public transportation. The mean scores of majority items fall within the high category range scores for both items between 2.180 to 4.140. Most of the respondents believed electric transportation contributes to a healthy environment and improved quality of healthy life and is reliable for daily use. However, on accessibility of EV bus transportation is still lacking behind especially in the rural area such as in Langkawi, Kedah. Furthermore, most of the respondents are also concern on the safety of EV bus transportation. The arguments are focusing on the distance coverage, durability of the battery and lack of charging stations in their location. In contrast, the passengers had a comfortable experience on electric public transportation. The study suggests that while the overall level of community well-being towards electric public transportation is high, there are still areas for improvement and further research is needed.

4.2. Cronbach's Alpha

Cronbach's alpha is a statistical measure used to determine the reliability and internal consistency of a test or questionnaire. It indicates the extent to which the items in the test measure the same underlying construct. A high value of Cronbach's alpha is desirable as it shows consistency between the items, while a low value suggests inconsistency and raises questions about the reliability and validity of the results. Cronbach's alpha is widely used in various fields such as psychology, education, sociology, and marketing and is especially important in large-scale assessments. In conclusion, Cronbach's alpha is a crucial tool in research to ensure the quality and validity of the results obtained from a test or questionnaire.

Table 3. Cronbach's alpha analysis

Variables	Items	Cronbach's Alpha (α)
SUSTAINABILITY	5	0.901
ENVIRONMENTAL	5	0.921
COMMUNITYWELL BEING	5	0.925

Table 3 presents the outcome of a reliability evaluation utilizing Cronbach's alpha for three distinct variables, which is Sustainability, Environmental impact and Community Wellbeing. Each variable was assessed using five items. The Cronbach's alpha scores for Sustainability, Environmental, and Community Wellbeing were calculated to be 0.901, 0.921, and 0.925, respectively, indicating high reliability and consistency in measuring a common underlying factor. These results support the validity of these scales in research and analysis.

4.3. Correlation

A statistical method known as correlation is used to assess the relationship between two or more variables when collecting data. It helps to identify the relationship, make predictions, and understand cause-and-effect relationships between variables. A correlation coefficient, which runs from -1 to 1, is used to quantify the correlation. where 1 indicates a perfect positive correlation, -1 indicates a perfect negative correlation, and 0 indicates no relationship. Correlation is used to test hypotheses about the relationship between variables and to make predictions. It helps researchers to understand the relationships between variables and make informed decisions.

Table 4. Correlations between environmental & sustainability

		ENVIRONMENTAL	SUSTAINABILITY
ENVIRONMENTAL	Pearson Correlation	1	.780**
	Sig. (2-tailed)		.000
	N	117	117
SUSTAINABILITY	Pearson Correlation	.780**	1
	Sig. (2-tailed)	.000	
	N	117	117

**. Correlation is significant at the 0.01 level (2-tailed).

The data in Table 4 shows a strong positive correlation between the variables Environmental impact and Sustainability with a correlation coefficient of .780. This indicates that as one variable increases, sodoes the other. The significance level of .000 shows that the correlation is statistically significant at the 0.01 level, meaning there is a less than 1% chance that it's due to chance. The sample size of 117 observations provides a solid basis for making inferences about the relationship between the two variables. Overall, the data suggests that there is a strong association between environmental considerations and sustainability.

Table 5. Correlations between community well-being & sustainability

		COMMUNITY WELL BEING	SUSTAINABILITY
COMMUNITY WELL BEING	Pearson Correlation	1	.813**
	Sig. (2-tailed)		.000
	N	117	117
SUSTAINABILITY	Pearson Correlation	.813**	1
	Sig. (2-tailed)	.000	
	N	117	117

**. Correlation is significant at the 0.01 level (2-tailed).

The information in Table 5 shows how Community Wellbeing and Sustainability are related. The Pearson correlation coefficient, which can vary from -1 to 1, is a measurement of the linear relationship between two variables. A coefficient of 1 denotes a perfect linear link between the two variables, a value of -1 denotes a perfect linear relationship between the two variables, and a coefficient of 0 denotes no relationship at all. The association between Community Wellbeing and Sustainability in this data is strongly positive, with a Pearson correlation coefficient of.813. The link is statistically significant at the level of 0.01 according to the significance (2-tailed) of.000. For both variables, there are 117 sample members. In conclusion, the findings point to a significant beneficial association between Community Wellbeing and Sustainability**.** The present study examined the relationship between environmental impact and community well-being towards the sustainability of electric bus program. The study analyzed three key variables - sustainability, environmental responsibility and community well-being. The results provided valuable insights into the performance of these variables and highlighted areas for improvement. The data collected on the dependent variable of sustainability indicates that the respondents have a high level of belief in the positive impact of EV transportation on long-term sustainability, the Malaysian economy, social demand, the socioeconomic environment, and competitiveness in the economy. The data suggests a strong positive correlation between environmental considerations and sustainability, where an increase in one variable is likely to result in an increase in the other. The data also suggests a positive view towards the environmental benefits of electric public transportation. The majority of respondents showed high agreement on the environmental advantages of electric public transportation. The study found a strong positive correlation between the variables of Environmental and Sustainability. The study highlights the importance of considering the spread of data when evaluating the performance of the variables, with relatively high standard deviations for Sustainability and Community Wellbeing. Regarding community well-being, the study showed that the majority of respondents had a high level of agreement between community well-being towards electric public transportation. The passengers had a comfortable experience on electric public transportation, and the majority believed that electric transportation contributes to a healthy environment and is reliable for daily use. However, respondents felt that accessibility and safety still needed improvement. The data suggests a strong positive relationship between Community Wellbeing and Sustainability.

5. Conclusion

In conclusion, the findings of this study contribute to a better understanding of the factors that contribute to the sustainability of EV transportation. The data suggests environmental and community well-being considerations are strongly associated with the sustainability of EV transportation. Moreover, the results of the study suggest areas for improvement in financial considerations that may have a positive impact on sustainability. Overall, the results of this study provide valuable insights into the performance of the key variables analyzed and highlight the importance of considering the spread of data when evaluating the performance of sustainability programs.

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