The implementation of green transportation towards low carbon city

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Abstract. Green transportation has been introduced to mitigate the global warming and climate change that significantly impact human lives and ecosystems. However, major challenges in green transportation are still driven by the lack of the awareness of the best practices among people or users. The objectives of the study were to identify how much green transportation impact low carbon city and to examine the programme for green transportation in Bandar Penggaram, Batu Pahat. The study was conducted by using mixed method. The data was collected by using questionnaire, document review and observation. The results showed that the green transportation in Bandar Penggaram mostly were from users of plug-in hybrid (PHEV) and hybrid cars. By increasing the number of green transportations, the development of infrastructure for the green transportation is needed in order to encourage users to use this transportation. Besides that, future programmes can be drawn to the government in order to encourage more people to use green transportation. The implications of this study show that people need to give their attention to the incentives that the government have proposed to implement and promote green transportation in Malaysia.

Keywords. transportation, modes of green transportation, programmes of green transportation

1. Introduction

Nowadays, people globally are aware of the issues with climate change and global warming that significantly impact the environment, human and animals on earth. In order to reduce carbon footprint in Malaysia, Low Carbon Cities Framework (LCCF) is one of the government’s initiatives for 2010-2011, aiming to set in motion further initiatives and actions at various levels towards reducing the overall carbon footprint of the country. It is an effective action to reduce their environmental impact and their carbon dioxide (CO2) emission.

Green transportation or clean vehicle is a road motor vehicle that produces less harmful impacts to the environment than the equivalent conventional internal combustion engine vehicles that run on gasoline or diesel. Green transportation is a new concept that aims to be a convenient, safe, efficient, low pollution, humanized and diversified urban transportation system [1]. Furthermore, green transportation can be powered by alternative fuels and advanced vehicle technologies, including hybrid electric vehicles, plug-in hybrid electric vehicles, battery electric vehicle compressed-air vehicles, and hydrogen and fuel-cell vehicles.
This research focused on promoting the green transportation for the low carbon city where it can reduce the carbon production into the environment. The active promotion of green transportation is good for intensive use of road resources, ease of traffic congestion, decreasing energy consumption, improvement of air quality, as well as a return to healthy and leisure lifestyles, which are good for improving citizens’ health. It can also give the awareness to the users on the importance of using green transportation for the healthy environment and future generation. Besides that, this research also promoted the programs that can impact the users, such as car-free day and Earth hour.

Besides that, the implementation of green transportation is difficult when the price to buy the EV, hybrid and PHEV cars is steep, and only a small number of users is able to buy the green transportation [2]. To reduce the effects of gas emission towards the environment, using low carbon transportation is significant to reduce the production of carbon in Bandar Penggaram. This study is important for the industries so that the Malaysian automotive industries can improve their manufacturing towards green transportation. The government can cooperate with other agencies and non-governmental organizational (NGO) to create more awareness campaigns to promote green transportation that is effective in reducing carbon production towards the environment. Furthermore, green transportation is the continuation of sustainable, ecological and low carbon transportation. It symbolizes the fast, safe and comfortable transportation that yields various advantages, such as high efficiency, low pollution and low energy consumption [3].

2. Methodology
This research used the mixed method, including both qualitative and quantitative method. For the quantitative method, this research used questionnaires and observations to collect the data while for qualitative method, this research collected the data by reviewing the planning development proposed by Majlis Perbandaran Batu Pahat (MPBP).

2.1. Selection of Research Methodology
Research is the process of answering questions and problems that are inherent in the environment to understand the nature [4]. According to a study [4], methodology is the systematic and theoretical analysis applied to a field of study. In general, research methodology is used as a guideline for a researcher in the process of gathering and collecting data in order to obtain the result of the research. It is a system of method used in a particular area of study or activity.

Qualitative approach is subjective, emphasizing on the quality as the source in information collection [5]. This research collected the data by reviewing the planning development proposed by the Majlis Perbandaran Batu Pahat (MPBP). By reviewing the document from MPBP, the observation was conducted within 11 roads in Bandar Penggaram, Batu Pahat.

According to a study [5], quantitative approach is a method that acquires the quantity and amount as the benchmarks of the evidence and information. A well-constructed questionnaire titled "The Survey of Implementing Green Transportation towards Low Carbon City" was used to obtain the desired information from the respondents. IBM Statistical Package for Social Sciences (SPSS) was used to analyse the data obtained from the questionnaire. This study also observed the type of green transportation that the users used and calculated the number of green vehicles in Bandar Penggaram.

2.2. Sampling and Population Technique
According to the statistic from a study [6], the number of residents who live and work in Bandar Penggaram, Batu Pahat was 10,000. This city had the higher density of population within Batu Pahat area. Our sample size was 370 people.

2.3. Data Analysis Technique
A well-constructed questionnaire titled "The Survey of Implementing Green Transportation toward Low Carbon City" was used to obtain the desired information from the respondents. The IBM Statistical Package for Social Sciences (SPSS) was used to analyse the data obtained from the
questionnaire. The responses were tabulated and analysed in the form of mean, percentage and standard deviation for the descriptive analysis by using SPSS. The reliability test of the questionnaire for the Likert scale questions was analysed using Cronbach Alpha.

2.4. Pilot Test:
In the pilot test, 30 respondents were involved in this research including residents who lived nearby the 11 roads. The 30 sets of questionnaires were distributed equally within the 11 roads and 5 to 10 minutes were required for the respondents to answer the questionnaire.

Table 1. The reliability analysis from the pilot test

| Variables | Cronbach’s Alpha | Cronbach’s Alpha based on Standardized Items | Number of Items |
|-----------|------------------|---------------------------------------------|-----------------|
| Simple    | 0.738            | 0.749                                       | 3               |
| Comfort   | -0.880           | -0.485                                      | 3               |
| Journey   | 0.394            | 0.380                                       | 3               |
| Cost      | 0.584            | 0.600                                       | 3               |
| Preference| 0.823            | 0.829                                       | 4               |

Based on the Table 1, the reliability was low, unacceptable for the instrument ‘Comfort’ and poor for instrument ‘Journey’. Only three characteristics were reliable for real data collection.

3. Result and Discussion
This chapter contains the analysis of the data and results of studies conducted using the quantitative method, with a purpose to achieve the second objective which is to examine the programmes for green transportation in Bandar Penggaram. The questionnaire forms were distributed specifically to communities or residents in Bandar Penggaram.

The test of reliability method is one of the simple ways of testing the stability and reliability of an instrument over time. Reliability is synonymous with the consistency of a test, survey, observation or other measuring methods. A reliable coefficient is the statistic of choice in determining the reliability of a test. Cronbach’s alpha is a measure of internal consistency to show how closely related a set of items are as a group. The higher the value of Cronbach Alpha, the greater the reliability.

Table 2. Cronbach’s alpha internal consistency

| Cronbach’s Alpha | Internal consistency          |
|------------------|-------------------------------|
| \( \alpha \geq 0.9 \) | Excellent (High-stakes testing) |
| \( 0.9 > \alpha \geq 0.8 \) | Good (Low-stakes testing)     |
| \( 0.8 > \alpha \geq 0.7 \) | Acceptable                    |
| \( 0.7 > \alpha \geq 0.6 \) | Questionable                  |
| \( 0.6 > \alpha \geq 0.5 \) | Poor                          |
| \( 0.5 > \alpha \) | Unacceptable                  |

The value of Cronbach’s alpha was computed according to each instrument. There were 16 questions included in the questionnaire and separated into 5 instruments from the characteristics of simple, cost and preference.
I think that the price of the green vehicle is cheap and affordable. I think that other transportation modes after the green vehicle operation is easy and comfortable. I think that the method of payment for the green vehicle is convenient. I think that the green vehicle can reduce my transshipping between different kinds of transportation.

| Instruments     | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | Internal consistency |
|-----------------|------------------|---------------------------------------------|----------------------|
| Simple          | 0.708            | 0.719                                       | Acceptable           |
| Cost            | 0.659            | 0.663                                       | Questionable         |
| Preference      | 0.930            | 0.931                                       | Excellent            |

Table 4. Level of mean measurement

| Mean score  | Scale |
|-------------|-------|
| 1.00-2.49   | Low   |
| 2.50-3.50   | Moderate |
| 3.51-5.00   | High  |

Table 5. The result of Simple Characteristics

| Simple                                                                 | Mean     | Std. Deviation |
|-----------------------------------------------------------------------|----------|----------------|
| I think that the green vehicle operation is easy and comfortable.    | 4.204    | 0.64812        |
| I think that the green vehicle can reduce my transshipping between different kinds of transportation. | 3.196    | 0.93008        |
| I think that the method of payment for the green vehicle is convenient. | 3.864    | 0.66277        |
| I think by using green vehicles are simpler than conventional vehicles. | 4.156    | 0.86641        |
| I feel that the process of using green vehicle is comfortable and it supports the reduction of carbon towards environment. | 3.784    | 0.80245        |
| **Overall**                                                          | **3.841**|                |

Table 6. The result of cost characteristics

| Cost                                                                 | Mean     | Std. Deviation |
|---------------------------------------------------------------------|----------|----------------|
| I think that the green vehicle can help me to successfully arrive at my destination with low cost and low carbon emission. | 4.2      | 0.84549        |
| I think that the charging stations of the green vehicle are set up properly. | 3.828    | 0.91749        |
| I think that there are multiple choices to transfer to other transportation modes after the green vehicle | 3.4      | 0.90957        |
| I think that the price of the green vehicle is cheap and affordable. | 3.912    | 0.92286        |
| I think that the green vehicle can reduce my gasoline expense every month. | 4.9192   | 0.86641        |
| **Overall**                                                          | **3.8992**|                |

Table 7. The result of preference characteristics

| Preference                                                                 | Mean     | Std. Deviation |
|---------------------------------------------------------------------------|----------|----------------|
| I am interested and willing to use the green vehicle.                      | 3.8278   | 0.91749        |
I highly prefer the green vehicle rather than conventional vehicles.  
Green vehicles have the characteristics that I need if I want to buy the vehicle in future.  
I will recommend the green vehicle to my friends and relatives.  

| Simple                                                                 | Percent % | Interpret   |
|------------------------------------------------------------------------|-----------|-------------|
| I think that the green vehicle operation is easy and comfortable.      | 55.2      | Agree       |
| I think that the green vehicle can reduce my transshipping between different kinds of transportation. | 36.4      | Neutral     |
| I think that the method of payment for the green vehicle is convenient. | 55.6      | Agree       |
| I think by using green vehicles are simpler than conventional vehicles. | 46.4      | Strongly Agree |
| I feel that the process of using green vehicle is comfortable and support the reduction of carbon towards environment. | 66        | Agree       |

**Table 8. The distribution of mean for simple characteristics**

| Preference                                                                 | Percent % | Interpret   |
|--------------------------------------------------------------------------|-----------|-------------|
| I think that the green vehicle can help me to successfully arrive at my destination with low carbon emission. | 45.6      | Strongly agree |
| I think that the charging stations of the green vehicle are set up properly. | 33.6      | Agree       |
| I think that there are multiple choices to transfer to other transportation modes after the green vehicle. | 44.8      | Neutral     |
| I think that the price of the green vehicle is cheap and affordable.     | 38.8      | Neutral     |
| I think that the green vehicle can reduce my gasoline expense every month. | 46.4      | Strongly agree |

**Table 9. The distribution of mean for simple characteristic**

| Preference                                                                 | Percent % | Interpret   |
|--------------------------------------------------------------------------|-----------|-------------|
| I am interested and willing to use the green vehicle.                    | 33.6      | Agree       |
| I highly prefer the green vehicle rather than conventional vehicles      | 32.4      | Neutral     |
| Green vehicles have the characteristics that I need if I want to buy the vehicle in future. | 39.6      | Neutral     |
| I will recommend the green vehicle to my friends and relatives.          | 46.4      | Strongly agree |
Table 11. The initiative in implementing green transportation

| Items                                         | Frequency | Percent |
|-----------------------------------------------|-----------|---------|
| Lack of awareness among the residential in Bandar Penggaram | Unselected 42 | 16.8 |
|                                               | Selected 208 | 83.2 |
| Financial initiatives from financial funding/loan | Unselected 150 | 60.0 |
|                                               | Selected 100 | 40.0 |
| Commitment and cooperation from all parties   | Unselected 176 | 70.4 |
|                                               | Selected 74 | 29.6 |
| Lack of knowledge about green transportation   | Unselected 82 | 32.8 |
|                                               | Selected 168 | 67.2 |
|                                               | Unselected 76 | 30.4 |
| Lack of campaign                              | Selected 174 | 69.6 |

Table 12. Types of organization

| Items                              | Frequency | Percent |
|------------------------------------|-----------|---------|
| Federal government                 | Unselected 91 | 36.4 |
|                                    | Selected 159 | 63.6 |
| State government                   | Unselected 95 | 38 |
|                                    | Selected 155 | 62 |
| MPBP                               | Unselected 86 | 34.4 |
|                                    | Selected 164 | 65.6 |
| Developer                          | Unselected 239 | 95.6 |
|                                    | Selected 11 | 4.4 |
| Government and private agency      | Unselected 202 | 80.8 |
|                                    | Selected 48 | 19.2 |
| Resident association and NGO       | Unselected 201 | 80.4 |
|                                    | Selected 49 | 19.6 |
| Industry                           | Unselected 164 | 65.6 |
|                                    | Selected 86 | 34.4 |

Table 13. Types of alternative fuels

| Items     | Frequency | Percent |
|-----------|-----------|---------|
| Hybrid    | Unselected 69 | 27.6 |
|           | Selected 181 | 72.4 |
| Electric  | Unselected 33 | 13.2 |
|           | Selected 217 | 86.8 |
| Diesel    | Unselected 250 | 100.0 |
|           | Selected     |       |
| Battery   | Unselected 79 | 31.6 |
|           | Selected 171 | 68.4 |
| Natural gas | Unselected 217 | 86.8 |
|           | Selected 33 | 13.2 |
| Biodiesel | Unselected 40 | 16.0 |
|           | Selected 210 | 84.0 |
Table 14. The facilities that can be provided in Bandar Penggaram

| Items                                           | Frequency | Percent % |
|------------------------------------------------|-----------|-----------|
| Public charging station for EVs and PHEVs       | Unselected | 54        | 21.6     |
| Parking zone for green transportation for NGV’s | Unselected | 67        | 26.8     |
| Refueling stations                              | Unselected | 182       | 72.8     |
| Public transport such as taxis and buses        | Unselected | 45        | 18       |
| Public bicycle and pedestrian walking zone     | Unselected | 57        | 22.8     |
|                                                | Selected  | 196       | 78.4     |
|                                                | Selected  | 183       | 73.2     |
|                                                | Selected  | 68        | 27.2     |
|                                                | Selected  | 205       | 82       |
|                                                | Selected  | 193       | 77.2     |

3.1. Document Review
The Johor Public Transportation master plan (PAJ) contains policies that include the guidelines for the development of action plans and green technology in urban areas concentrated in Johor Bahru. Bandar Penggaram is one of the main attractions of the people in Batu Pahat as there are many facilities that include schools, government buildings, private buildings and recreational parks. Increasing the number of people who own private vehicles will increase the carbon dioxide in the environment.

4. Conclusion
Based on the research analysis in the previous chapter, the data analysis was conducted to discuss whether the objectives of this research which is to identify the green transportation for low carbon city and to examine the programmes for green transportation in Bandar Penggaram have been achieved.

4.1. Objective 1: To identify the green transportation towards low carbon city
For objective one, the users in Bandar Penggaram showed their interest to use green vehicles, such as hybrid and plug-in hybrid. Furthermore, the observation showed that the hybrid car has been gaining popularity among the users in Bandar Penggaram. From the document review, the State Government has drawn the strategies in adopting the green technology. One of the strategies is to provide the greenway and special parking zone for the hybrid and electric car users. Moreover, the plug-in hybrid vehicle (PHEV) is also gaining popularity among the users whom are interested with the development of green transportation besides using the hybrid car. Nevertheless, based on the observation, there was no other modes of green transportation that the users used in Bandar Penggaram besides green vehicle and bicycle.

4.2. Objective 2: To examine the programmes for green transportation in Bandar Penggaram
Objective two examined the programmes for green transportation, including a few programmes that can be made to introduce and promote the green transportation in Bandar Penggaram. The campaign to introduce the electric bus highlights the efficiency of this vehicle towards the environment in the future. The campaign to introduce the electric vehicles in the future is also important as people lack the knowledge about the electric vehicle transportation. Introducing E-bus gives many advantages including the design of an electric bus that is simpler and easy to maintain because the engine oil does not require change. In addition to that, the campaign can include the green vehicle such as hybrid, plug-in hybrid and natural gas vehicle so that all the generations will be exposed to these types of green vehicles, and gradually they can increase their knowledge towards the transportation.

The results of the findings identified the green transportation in Bandar Penggaram. Only two kinds of green vehicle were used, which were PHEV and HEV. Moreover, the implementation of electric
buses can improve the quality of public transportation for Bandar Penggaram in the future. The implementation of green transportation in Bandar Penggaram can improve the environment by reducing the carbon emission in Bandar Penggaram to achieve a Low Carbon City status in 2030.

In order to achieve this target, cooperation from all the parties involved is needed. In conclusion, we have successfully achieved the main objectives of this research to identify the green transportation for the low carbon city and to examine the programmes for the green transportation in Bandar Penggaram. Hence, this research can benefit the development and improvement of the transportation sector in Bandar Penggaram so that this city can achieve the Low Carbon City status in 2030.

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References
[1] Chen B, Yang J, Tan S, Hashim H, Lee C, & Yan J 2016 *A holistic low carbon city indicator framework for sustainable development*. Applied Energy 185(2017) 1919–1930.
[2] Study A N E, Ahmed Z, Alhayali M, Chew B C, & Salleh N 2017 *Implementation of Renewable Energy Concept in the Automotive Industry in Malaysia*. 04(01) 96–115.
[3] Li Y P, Liu H Y, Qu J H, Cao L H, & Li Z P 2018 *Research on green traffic evaluation based on grey fuzzy comprehensive evaluation method*. Advances in Transportation Studies an International Journal 2 85–97.
[4] Igwenagu C 2016 *Fundamentals of research methodology and data collection* 1–47.
[5] Dawson R, Hancock & Bob Algozzine 2006 *Doing Case Study Research: A Practical Guide for Beginning Researchers*.
[6] Majlis Perbandaran Batu Pahat 2010