

The Relevance of Campus Transportation Shuttle to The Realization of Green Economy and Conservation of Universitas Negeri Semarang

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ABSTRACT

The green economy program aims to boost the economy while preserving nature. UNNES has been implementing a green economy program through conservation activities campus transportation shuttle facilities since August 10th, 2022. The research aims to know the the academic community and shuttle manager perception regarding the relevance of the shuttle to the realization of the green economy and UNNES conservation, to know the perceptions of environmental experts and educators about green economy of UNNES, and to know the the relevance of campus transportation shuttles to the green economy and UNNES Conservation. The research method uses library studies, field surveys, observations, and interviews with descriptive analysis and regression. Results of the research obtained an interrelation coefficient of 0.759 means shuttle has a high relevance in realizing the green economy and conservation UNNES programs. On Monday there were 3.4 rhythms, on Wednesday 3.8, and Friday 3.9. The efficiency on Monday was classified as moderate, Wednesday and Friday as high. BBM consumption cost calculation results show that electric vehicles require costs of Rp33.980/100 km, more economical than motor vehicles and conventional cars with costs of Rp35.000/100 km and Rp107.600/100 km. Conclusion, the shuttle has high relevance and high relevance toward UNNES Conservation and green economy based on academics and shuttle manager, UNNES already implementing the concept of a green economy, but it still needs to be improved.

Keywords: Shuttle Campus Transportation, Green Economy, Conservation

INTRODUCTION

Semarang City is the central city in Central Java Province, which continues to develop through multidimensional construction efforts. Semarang is the capital of Central Java Province, with a high population density and activity. Massive development sometimes overlooks environmental aspects, leading to increased pollution and environmental damage. Development is a conscious effort made by humans to utilize the environment in order to meet their livelihoods, leading to improved

living conditions and well-being (Ayu et al, 2022; Version, 2021). Development in Indonesia has both positive and negative impacts (Gatto et al, 2017; Yudhistira, 2018). Development will continue as long as the positive impacts are more dominant than the negative ones, especially for the welfare of the community (Syam & Chandrarin, 2019; Arifin, 2020). Environmental issues are becoming an increasingly complex and serious global problem (Latifah & Abdullah, 2023). sustainable development needed with an environmental focus so as to minimize damage

and improve public awareness (Allifah et al, 2022). However, there is a significant amount of development in Indonesia that tends to exploit natural resources, leading to an imbalance between the economy and the environment, which can result in land degradation (Jizya & Alam, 2017; Alvarado & Toledo, 2017; Kust et al, 2017), one of the efforts to prevent this phenomenon is by implementing a green economy (Swainson & Mahanty, 2018; Hussain et al, 2021).

The United Nations Environment Programme explains green economy refers to economic activities—such as the production, distribution, and consumption of goods and services—that aim to enhance the long-term well-being of society while ensuring that future generations do not face significant environmental problems (Firmansyah, 2022; Söderholm, 2020; Lavrinenko et al, 2019). The green economy is an economic development model based on conservation and sustainability

(Cavanagh & Benjaminsen, 2017), where there are efforts to preserve the environment and resources (Wang et al, 2019; Vita & L. Soehardi, 2022). Semarang is a city that has implemented the concept of a green economy, as evidenced by several programs such as “Gerakan Semarang Wegah Nyampah” initiated by Semarang Mayor Hendrar Prihadi during the 2016-2021 term, who successfully made Semarang the Cleanest Tourist City in Southeast Asia during the ASEAN Tourism Forum from 2020 to 2022 held in Brunei Darussalam (Rahmayani et al, 2022).

The development sector has also become a priority for the Semarang City Government in efforts to enhance the welfare of the community through equitable development (Maulany & Fafurida, 2021), one of the educational facilities in universities such as Universitas Negeri Semarang (Unnes) located in the Gunungpati District.

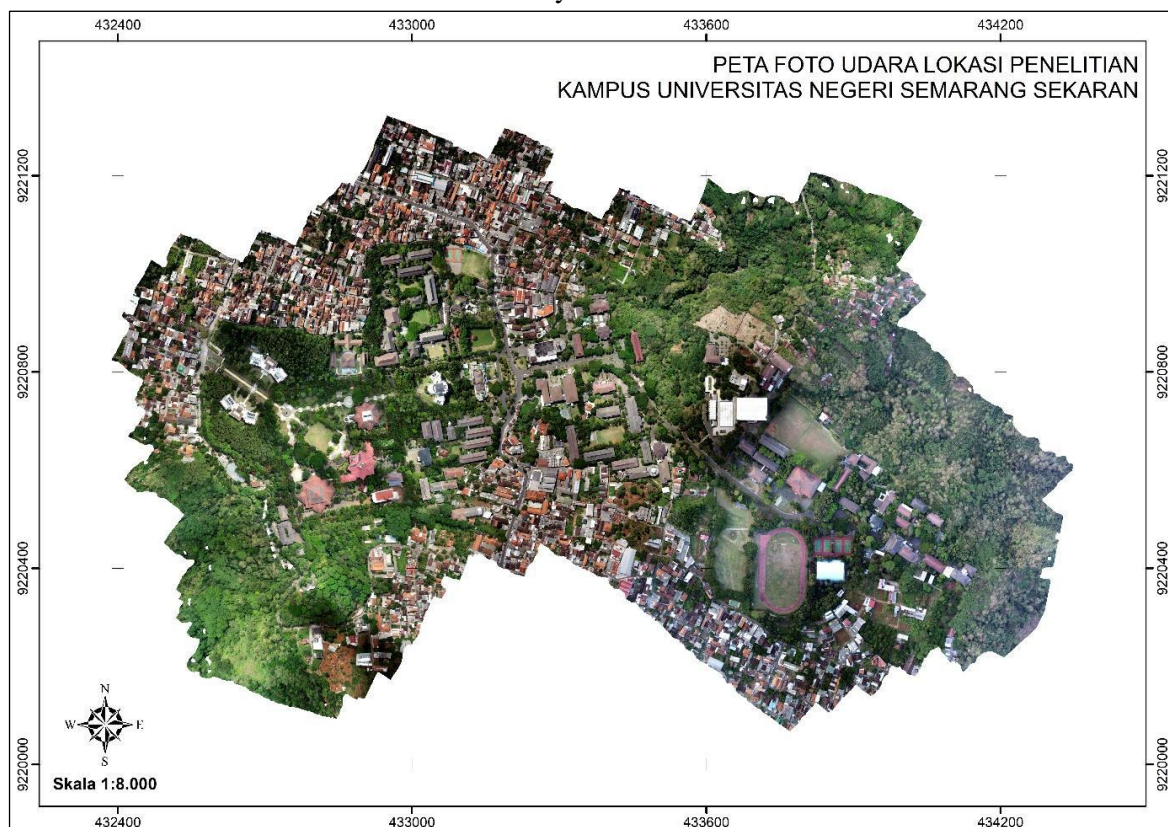


Figure 1. Research Location Map
Source : Primary data, 2023

UNNES is an educational area in the city of Semarang, with its main campus located in

Sekaran Village, Gunungpati, where there are many buildings that serve as student housing and

supporting facilities for lectures. Conservation is necessary to balance the ecosystem as a result of development.

Environmental issues such as climate change and global warming are increasingly being discussed today, especially among students (Clayton & Karazsia, 2020). Initially, before 1990, Unnes was located in the downtown area of lower Semarang. However, for further development and equitable distribution, Unnes was moved to the upper Semarang area (Sekaran Village). This phenomenon triggered the growth of the surrounding area, marked by an increasing demand for land for housing, transportation networks, commerce, and more. As an educational institution with an academic focus, Unnes should be able to have a positive impact on the surrounding community, particularly reflected in its vision and mission as a conservation-oriented university.

UNNES also upholds conservation as outlined in the document "Konservasi Berkelanjutan Kampus UNNES 2023" which includes various programs related to conservation. Among these, there are five programs under the natural resource pillar: waste management behavior, green architecture and internal transportation behavior, clean energy behavior, biodiversity behavior, and environmental stewardship behavior as conservation ambassadors.

The implementation of UNNES in supporting a green economy is evident in the provision of public transportation services, as the transportation sector is a major contributor to fossil fuel consumption, which is known to produce greenhouse gas emissions, specifically CO₂. This initiative is part of the efforts to reduce risks and slow down climate change by developing alternative, environmentally friendly, and sustainable resources. The campus shuttle service, which is operated by UNNES, is considered a form of green transportation with a capacity for 12 passengers. Currently, there are five shuttle vehicles in operation, with plans for more to be added as needed in the future. Several shuttle stops have been established at each

activity center on campus. The shuttles operate Monday through Friday from 6:00 AM to 5:00 PM WIB. This service is expected to assist the UNNES academic community in reaching the campus without relying on fossil fuel-powered personal vehicles. Therefore, the provision of shuttles aligns with the realization of a green economy and conservation efforts at UNNES.

The research problem to be investigated in this study is the relevance of campus shuttle transportation to the realization of a green economy and conservation at Unnes. with the research question such as:

1. How are the Academic Community and Shuttle Manager Perceptions regarding the Relevance of the Shuttle to the Realization of the Green Economy and UNNES Conservation?
2. How are the Perceptions of Environmental Experts and Educators about the Green Economy of UNNES?
3. How The Relevance of Campus Transportation Shuttles to the Green Economy and UNNES Conservation?

The aim and benefit of this research is to know the relevance of campus shuttle transportation to the realization of a green economy and conservation at Unnes, with details according to the research question.

METHODOLOGY

This research has been completed in the area of UNNES Main Campus, which is administratively located in Sekaran Village, Gunungpati District, Semarang City. The research is focused on the shuttle operational route from West Campus (UNNES Main Gate) to East Campus to obtain information related to the effect of shuttle operations on the environment around the campus. This research uses a mixed methods approach by combining qualitative and quantitative approaches. Data collection techniques in this study used questionnaires, observations, and interviews. The sample in this study was the academic community, especially shuttle users, who were selected through purposive sampling technique.

The research sample was shuttle users, lecturers who are environmental experts, and shuttle drivers. The reason for choosing respondents who use shuttles is to find out how often UNNES students or academics use shuttles in activities around campus. Environmental expert lecturers provide views on how UNNES shuttle can be implemented to support Green Economy and Conservation and shuttle drivers to find out the operational activities of the UNNES shuttle in a day, both in terms of shuttle passenger capacity, energy charging time, shuttle battery capacity, and shuttle cruising range in one energy charge.

Data collection in this study used several methods, including questionnaire surveys, observations and interviews as well as field observations to obtain quantitative and qualitative data. The sample in this study was the academic community, especially shuttle users, who were selected through purposive sampling technique. The purposive sampling technique was used to ensure that the respondents involved had a deep connection and understanding of the topic under study. Surveys and questionnaires were conducted to determine the perception of the academic community regarding the relevance of the shuttle to the realization of UNNES green economy and conservation. From the results of the questionnaire, a comparison of the costs required by students when using private vehicles with students who use shuttles in doing activities in the campus environment will be obtained. Observations conducted in this study were carried out on the operation of the shuttle, such as the utilization and influence of the shuttle operation on the environment around the UNNES campus. Interviews with relevant stakeholders such as UNNES shuttle managers and environmental experts were conducted to explore further information regarding the relevance of the shuttle to UNNES' green economy and conservation concepts.

The results of data acquisition in this study will use descriptive and regression analysis. Descriptive analysis is carried out to

analyze the acquisition of data from observations and interviews to obtain an overview of the collected data. While the regression used in simple linear regression. Simple regression analysis is done to find causality between one dependent variable and one independent variable. In this context, regression analysis helps in interpreting the extent of the influence of variables such as the use of shuttle as campus public transportation on the realization of UNNES green economy and conservation. Data X (Campus Transportation Shuttle) was obtained using a Questionnaire to shuttle operational staff. Data Y (Attitude) was obtained using a Questionnaire to UNNES academicians from 9 Faculties and 1 Postgraduate Program.

RESULTS AND DISCUSSION

RESULT

This question is data about the number of UNNES students who use the shuttle as a means of campus transportation. The results of this questionnaire show the opinions of respondents who are shuttle users regarding the condition of the shuttle and what respondents feel when using the shuttle and so on. Then it was calculated whether there was a correlation between the use of the shuttle and the realization of a green economy and conservation at UNNES.

Interviews were also conducted with experts in the environmental field from UNNES lecturers. These results explain and strengthen the concept of green economy, air conservation and confirm that there is a correlation between the use of shuttles and the realization of green economy and conservation at UNNES.

Apart from that, observations were made to determine the ability to carry passengers and the number of shuttle routes per day as well as a comparison of the costs incurred between motorized vehicles and electric vehicles (shuttles).

Apakah saudara menggunakan shuttle transportasi kampus?
140 jawaban

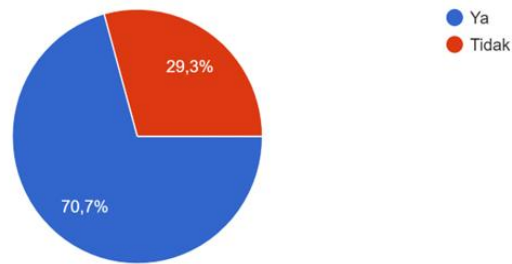


Figure 2. Shuttle User Data
Source : Primary data, 2023

Results of the Academic Community Perception Questionnaire regarding the Relevance of the Shuttle to the Realization of the Green Economy and UNNES Conservation

Based on the questionnaire that was distributed, there were 140 answers which were divided into two, namely 70.7% or 99 students

used the shuttle as transportation and the remaining 29.3% or 41 of them did not use the shuttle. Then respondents were asked further questions, namely whether students used the shuttle as campus transportation effectively or not. This will show the intensity of students in efforts to realize conservation and a green economy at UNNES.

Jika Ya, seberapa sering saudara menggunakan shuttle transportasi kampus dalam sehari?
140 jawaban

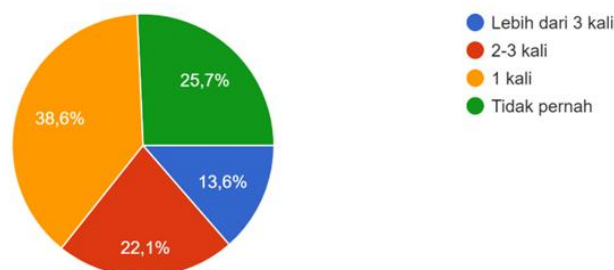


Figure 3. Data on how often respondents use the shuttle
Source : Primary data, 2023

Based on this data, it is known that 38.6% of respondents only use the shuttle once a day, and the least, namely 25.7%, never use the shuttle in a day. Meanwhile, 13.6% of

respondents used the shuttle more than 3 times a day as a means of transportation. This question is aimed at finding out whether the shuttle as a means of campus transportation is easy to access or not.

Seberapa mudah saudara menggunakan shuttle transportasi kampus halte-halte yang sudah ditentukan?

140 jawaban

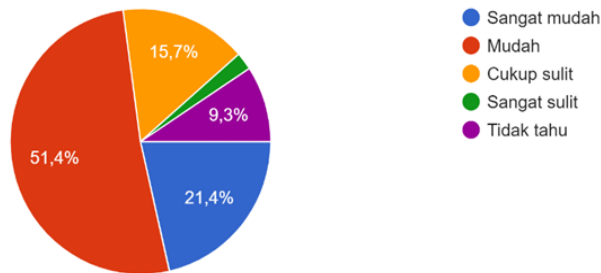


Figure 4. Data on the ease of using the shuttle from the designated stop
 Source : Primary data, 2023

Based on this data, 51.4%, namely 72 respondents, felt it was easy to use the shuttle via the stops provided. Meanwhile, 2.1% of respondents felt it was very difficult to use the

shuttle from the designated stop. As an effort to realize conservation and a green economy, the availability of easily accessible bus stops supports UNNES' efforts in implementing conservation and a green economy.

Apakah Anda merasa terdorong untuk menggunakan shuttle transportasi kampus sebagai bagian dari upaya menciptakan lingkungan yang lebih bersih?

140 jawaban

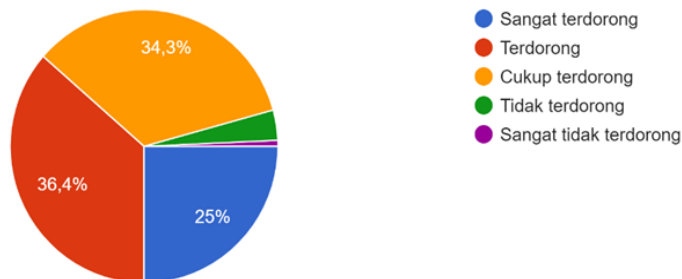


Figure 5. Data on Efforts to Create a Clean Environment
 Source : Primary data, 2023

Based on this data, it is known that 25% of respondents felt very encouraged and 36.4% of respondents felt encouraged to create a clean environment through the use of the shuttle. Meanwhile, only 0.7% or 1 person felt very

unmotivated regarding efforts to create a clean environment. The shuttle as the embodiment of campus transportation which has the concept of conservation and a green economy must provide comfort and safety to its users.

Menurut anda, apakah waktu operasional shuttle transportasi kampus saat ini sudah dilakukan apakah sudah cukup?

140 jawaban

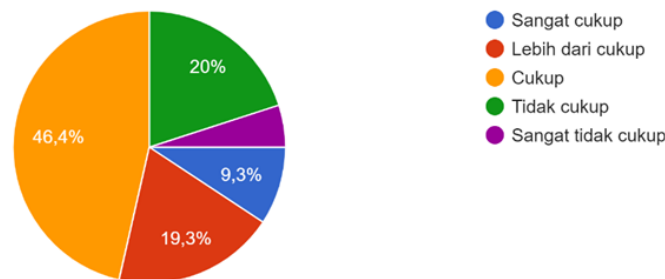


Figure 6. Shuttle Operational Time Data
Source : Primary data, 2023

Based on this data, it is known that 46.4% of respondents felt that the shuttle operational time was sufficient to reach respondents, even 19.4% of respondents felt that this was more than sufficient. Meanwhile, only

5% of respondents felt that this time was not enough. The shuttle as the embodiment of campus transportation which has the concept of conservation and a green economy must provide comfort and safety to its users..

Seberapa nyaman dan aman pengalaman Anda dalam menggunakan shuttle transportasi kampus?

140 jawaban

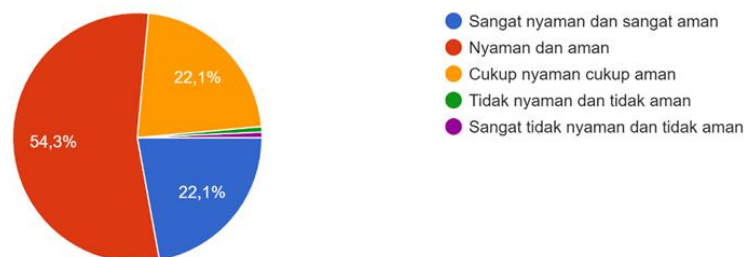


Figure 7. Shuttle Facility Data
Source : Primary data, 2023

Based on this data, it is known that 54.3% of respondents felt comfortable and safe using the shuttle facilities, even 22.1% of respondents felt very comfortable and safe about this. Meanwhile, there were 0.7% who felt

uncomfortable and unsafe. Then, there were also 0.7% who felt very uncomfortable and unsafe. In order to support comfort in using the shuttle, the operating conditions of the shuttle must of course be comfortable so that more students use the shuttle.

Bagaimana kondisi fisik Shuttle Bus yang saat ini beroperasi?

140 jawaban

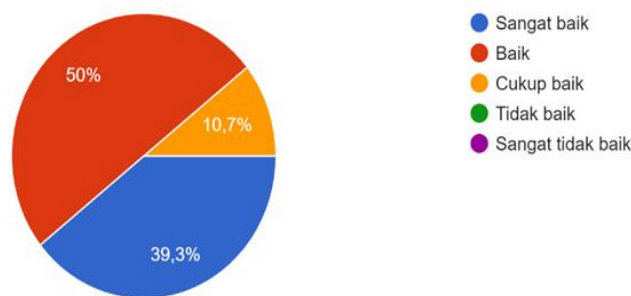


Figure 8. Data about the physical condition of the bus
Source : Primary data, 2023

To determine the effectiveness of the shuttle as a means of campus transportation that supports conservation and the green economy at

UNNES, calculations were carried out. Based on this data, it is known that 50% of respondents think the shuttle facilities are good, even 39.3% of respondents think the facilities are very good.

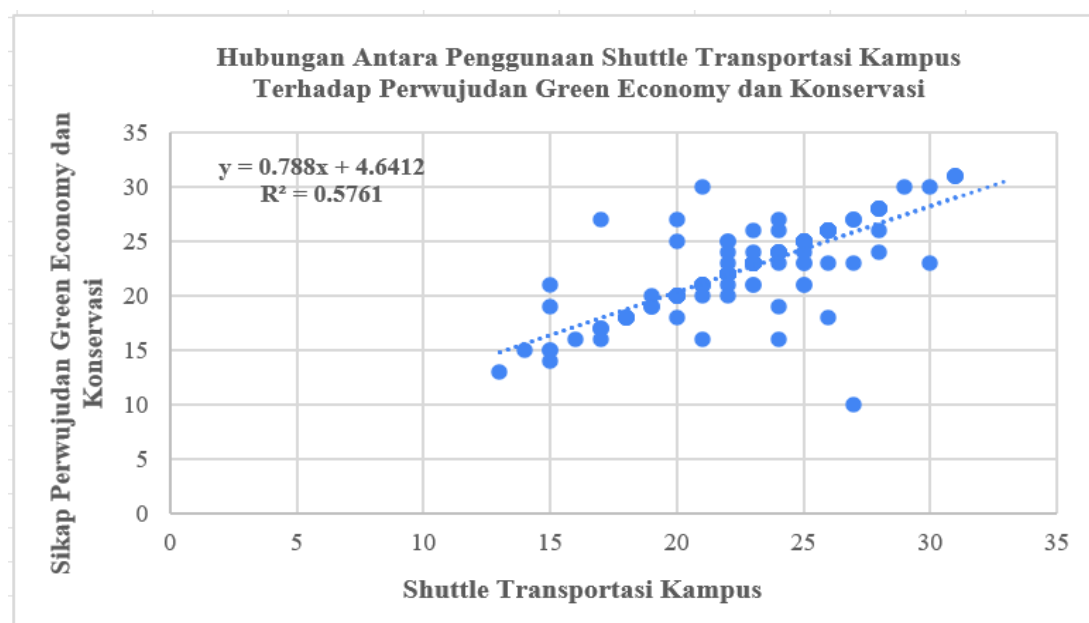


Figure 9. The relationship between the use of campus transportation shuttles to the realization of green economy and conservation.
Source : Primary data, 2023

Data X = Campus transportation shuttle

Data Y = Attitude of the realization of green economy and conservation.

Table 1. Calculation of Correlation Interval and Classification of the Relationship Between the Use of Campus Shuttle Transportation and The Realization of a Green Economy and Conservation

Table 1.1 Summary Output	
Regression Statistics	
Multiple R	0.759003961
R Square	0.576087013
Adjusted R Square	0.573015179

Regression Statistics			
Standard Error	2.53462007		
Observations	140		

Table 1.2 Anova

	df	SS
Regression	1	1204.824253
Residual	138	886.5685941
Total	139	2091.392857

Continuous

	MS	F	Significance F
Regression	187.5385045		1.70141E-27
Residual			
Total			

	Coefficients	Standard Error	t Stat
Intercept	4.641156463	1.329289568	3.491456319
X	0.787981859	0.057540151	13.69446985

P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
0.000645608	2.01274791	7.269565434	2.012747491	7.269565434
1.701412625	0.67420703	0.901756203	0.674207516	0.901756203

Table 2. Correlation interval and classification of the relationship between the use of campus transportation shuttles to the realization of green economy and conservation

Correlation Interval	Classification
0,80-1,000	Very strong
0,60-0,799	Strong
0,40-0,599	Strong Enough
0,20-0,399	Low
0,00-0,199	Very Low

Source: Primary data (2023).

Based on the results of the regression calculation, it is known that the R square result is 0.576, rounded to 0.58. This means that the contribution of the influence of variable X, which is the campus shuttle transportation, is 58%. The correlation coefficient is 0.759, which, based on the classification calculated earlier, falls into the strong category, specifically within the second highest interval of 0.60-0.799. This indicates that a high level of campus shuttle transportation significantly influences the realization of a green economy and conservation efforts. The calculation results

show that the shuttle has a high relevance to the green economy and conservation.

DISCUSSION

1. Perceptions of the Academic Community and Shuttle Manager Perceptions regarding the Relevance of the Shuttle to the Realization of the Green Economy and UNNES Conservation

a. Perceptions of the Academic Community regarding the Relevance of Campus Transportation Shuttles to the Realization of Green Economy and UNNES Conservation

Based on the results of the questionnaire that was distributed to the Semarang State University academic community, there were 140 respondents from 8 faculties. 70.7% of respondents who filled out the questionnaire were female and 20.3% were male. In the questionnaire there are 7 questions related to shuttle transportation. Question 1 related to shuttle transportation as campus transportation and 70.7% of respondents used the shuttle as campus transportation while 20.3% did not use the shuttle as campus transportation.

Question 2 related to how often respondents use the shuttle as campus transportation in a day, it was found that 38.6% used it once a day then 22.1% used it 2-3 times a day. Respondents who answered more than 3 times were 13.6% and 25.7% of respondents had never used the shuttle as campus transportation.

Question 3 related to the ease of respondents in using the shuttle at each designated bus stop. 51.4% of respondents answered that it was easy to reach and access. Respondents who answered very easily were 21.4%, then 9.3% of respondents answered they didn't know. Respondents who answered very difficult were 2.1% and respondents who answered quite difficult were 15.7%.

Question 4 related to using the shuttle as an effort to create a cleaner environment found that 36.4% of respondents answered that they were encouraged, then 25% of respondents answered that they were very encouraged.

34.3% of respondents answered quite encouraged and 3.6% of respondents answered not encouraged and 0.7% answered very not encouraged.

Question 5 related to respondents' comfort and safety in using the shuttle, found that 54.3% of respondents answered that it was comfortable and safe. 22.1% of respondents answered that it was very comfortable and very safe. 22.1% of respondents answered quite comfortable and quite safe, while for each criterion it was not comfortable and safe and very uncomfortable and safe at 0.7%.

Question 6 regarding shuttle operational times found 46.4% of respondents answered sufficient. 19.3% of respondents answered more than enough. 9.3% of respondents answered very well. 20% of respondents answered not enough and 5% of respondents answered very not enough.

Question 7 related to the physical condition of the shuttle in operation, 50% of respondents answered good. 39.3% of respondents answered very well and 10.7% of respondents answered quite well.

Based on the results of the questionnaire, it was found that most respondents tended to use shuttle transportation for campus mobility. The shuttles used are in good and comfortable condition, meaning many respondents use shuttles that can be reached and accessed easily at each stop that has been designated as a drop out point.

b. Perception of the Campus Transportation Shuttle from the UNNES Campus Transportation Shuttle Manager

Shuttles are electric-powered mass transportation with the initial aim of being used as seasonal transportation, such as for invited guests at graduations and other large events. The shuttle has been operating since 2019, but in the odd semester of 2020 it began to be used by the public.

The number of shuttles available is 5 with details of 3 operating and 2 as backup, during college holidays only 1-2 shuttles operate. The shuttle operates from 6 am to 5 pm with a break

at 12-13, each shuttle carries 13 passengers. The interval between shuttles in operation is 10 minutes between shuttles.

Regarding service and shuttle procurement, GSG is available as a garage and place to recharge energy.

2. The Perceptions of Environmental Experts and Educators about the Green Economy of UNNES

a. Green Economy Concept

In general, the concept of a green economy is an effort to process raw materials by minimizing residue without reducing profits while preserving the environment.

Based on the explanation of Prof. Dr. Zaenuri Mastur, SE, M.Si, Akt. as a Professor in the Department of Mathematics, Faculty of Mathematics and Natural Sciences (FMIPA) UNNES as well as Deputy Chancellor for Academic and Student Affairs, Semarang State University, explained that the green economy concept, in life there must be input > process > results. Based on the second law of thermodynamics, it is stated that no system has 100% efficiency, meaning that in every process there must be residue. The greater the residue, the worse the process. There is no zero emissions. So, green economy is an effort to process raw materials by minimizing residue without reducing profits while preserving the environment.

The next understanding of the green economy concept is based on the explanation from Dr. Andhina Putri Heriyanti, S.T., M.Si, Green Economy or green economy is integrated from the economy, environment and also social. Green economy is based on development activities carried out to fulfill survival which should not be too focused on the material or financial things that will be obtained, but environmental friendliness or environmental indicators are one of the environmental indicators to be taken into consideration when carrying out development activities. In this case, according to Trida Ridho Fariz, S. Si., M. Sc., there is an addition to the concept of green

economy, namely from the social aspect itself there is no conflict or it is inclusive.

According to Ervando Tommy Al-Hanif, M. T, technically a green economy is said to be a low-carbon economy or economic activities with activities that significantly reduce carbon-generating activities which must be balanced with saving resources and being socially inclusive for society.

In its application, a green economy certainly has complex challenges, because apart from using economic principles, it must also pay attention to the environment and social issues, in this case the lives of people who are directly or indirectly involved in these economic activities.

Semarang State University, in theory and practice, has implemented this green economy. In theory, it has been implemented through conservation education and can be seen from the three pillars of Unnes conservation. Then, in practice it can be seen by the use of campus transportation shuttles, periodic tree planting which can be monitored on the SIMON application.

There is reinforcement from Dr. Andhina Putri Heriyanti, S.T., M.Si, If you look at UNNES's vision, it is a university with a conservation perspective, which during the learning process also applies conservation principles such as preserving and maintaining not only the environment but also character and culture. If we look at environmental resources, there are several activities that have been carried out, such as using solar cells as renewable energy, processing waste as an application of waste management.

In reality, living habits such as saving electricity use, turning off the AC after use. Students' awareness is still small about the use of air conditioning, lights that are sometimes not turned off when they finish lectures, which must be supported by teaching staff. As well as slogans that have not been too massive. Apart from that, according to M. Fikri Amrullah, S. Pd., M. Pd, the implementation of the green economy through shuttles has been good, however, it has not been able to cover all the academic community at Unnes. In theory,

conservation education has been good, but its implementation has not been fully implemented. Apart from that, there are no economic activities that fully implement the green economy, although there are some such as concentration in canteens and KWU, then there are shuttles. If implemented fully, this can be done through planting your own sources of processed materials such as agriculture and hydroponics. The concept is good but the implementation is not.

b. Air Conservation Concept

The concept of conservation itself is one of the efforts made by humans to preserve and protect nature. Air conservation can be interpreted as an effort or action taken to preserve air. Cutter (in Fandeli, 2004) classifies air as a natural resource whose presence or supply is constant/relatively constant regardless of the amount used, even though air is always available and is a very important resource. According to Soemarwoto (2004), air is a mixture of gas, steam, water and dust.

Conservation is very necessary to preserve the surrounding environment, especially in this case the air. Exploitation activities of natural resources and the environment should fulfill human needs and ensure the fulfillment of the needs and survival of future generations. Air conservation is very necessary if humans want to breathe clean air, live healthily and enjoy the beauty of nature.

If you look at the explanation from Prof. Zaenuri said that air conservation refers to the concept of conservation related to safeguarding what we have as wisely as possible. Protecting the air through conservation activities can be done by planting trees so that it is expected to produce clean air. Air conservation means wisely protecting the air in our environment, one way is by planting trees.

M. Fikri Amrullah, S. Pd., M. Pd said that air conservation is about how to protect the air. Air protection can be done by paying attention to sustainable development activities. Sustainable development itself is development that meets the needs of the current generation

without reducing the ability of future generations to meet their living needs.

The concept of air conservation according to Dr. Andhina Putri Heriyanti, S.T., M.Si when linked to the existence of the UNNES shuttle is a nature and environmental conservation effort carried out to reduce greenhouse gases. As for air conservation, or protection of the air, this can be done by not using motorized vehicles in the campus area, even though in reality it is difficult to avoid using motorized vehicles in the campus area.

Trida Ridho Fariz, S. Si., M. Sc said that the concept of air conservation when linked to activities at UNNES itself does not produce exhaust emissions or does not produce smoke. The TPS (Trash Disposal Site) at UNNES is in Banaran which is managed organically. By managing waste organically, it helps nature to maintain healthy air because it is not contaminated by smoke from burning waste. This organic waste management is also a way to conserve air.

According to Ervando Tommy Al-Hanif, M. T., air conservation is managing and returning it to be the same or better than before. An example is installing a buffer zone or green open space using good plants. For activities, you can use low-emission vehicles, for example electric vehicles, bicycles, horseback riding.

Air conservation can be done in many ways, in the UNNES campus area, something that is already underway is the existence of electric-based vehicles called shuttles. The shuttle itself is used to help student mobility on campus. With this vehicle, it is hoped that it can reduce the use of fossil fuel vehicles. Apart from that, air conservation can also be done through replanting critical land. Trees themselves are one of the largest oxygen producers, so reforestation or replanting can help conserve air. In fact, there are many ways that can be done to help air conservation, from simple to complex things, it just requires human awareness to maintain the environment so that it can work properly and optimally.

c. Concept and Causes of Air Pollution

The definition of pollution or air pollution according to Ervando Tommy Al-Hanif, M. T. is air pollution that enters and introduces substances beyond its capacity into an environment which eliminates the carrying capacity of the environmental balance. Meanwhile, according to Tarra Z & Ririh Y (2022) air pollution is a complex mixture of particulates and various gas components in the air. The composition of the amount of air pollution contained depends on the source, emission level and ventilation conditions. Carrying out daily activities certainly causes air pollution such as exhaust gas, tobacco smoke, pesticides, solvents, cleaning materials, particulates, dust, mold, fibers and allergens (Mannan and Al Ghamdi, 2021)

According to Vardoulakis et al (2020), the causes of indoor air pollution in each region are different, this is due to different determining factors such as community activity patterns, climate, season, residential and occupant characteristics, location, arrangement and variability in buildings. (Tarra Z & Ririh Y, 2022). In general, in Semarang City, the causes of air pollution come from industrial activities and motorized vehicles. Talking about vehicles, in Indonesia there are many motorized vehicles that are more than 5 years old, usually having higher emissions than new vehicles. So it can be predicted that air pollution levels will be high.

UNNES Environmental Science Lecturer, Trida Ridho Fariz, S. Si., M. Sc said that in Gunungpati sub-district, especially the UNNES area, the cause of air pollution comes from motorized vehicles. However, the widespread use of vehicles in the UNNES area is uncertain and it is quite difficult to control the development of vehicle use. Many students still assume that UNNES must be responsible for the increasing growth of built-up land and vehicle use. In fact, this is not necessarily because of UNNES, but because of the Semarang City government's policy of shifting settlements to the south of the city, namely Mijen and Gunungpati. As a result, many residential areas

have grown in the area, causing a lot of population mobility.

This is reinforced by the opinion of Dr. Andhina Putri Heriyanti, S.T., M.Si. The increase in population is closely related to the increase in activities carried out and the increase in the number of motorized vehicle users. Moreover, with the ease of access to new motorized vehicles, this has resulted in an increase in road users. This is also related to the provision of slightly inadequate public transportation by the government. If the existing public facilities are good, the rules have been made, it remains for the government to be able to direct the public to enjoy public facilities properly. Road access needs to be improved further, apart from that, enforcement of binding regulations needs to be made and implemented well.

3. The Relevance of Campus Transportation Shuttles to the Green Economy and UNNES Conservation

a. Campus Transportation Shuttle Route Capabilities

Routine calculations are needed to determine the ability of campus transportation shuttles to transport passengers. In one round the campus transportation shuttle covers a distance of 3.4 km passing 18 stops and drop offs including LPPM, Cultural Village, FBS, GSG, FIPP, gas station, FIK, FIK 2, FT, FH, FIS, FEB, KWU, FMIPA, Musrek, PKMU, PKMU Parking and LPPP. Observations on campus transportation shuttle routines were carried out between 11-15 September 2023. These observations were carried out using purposive sampling where observations were carried out on Mondays, Wednesdays and Fridays, observations were carried out at three times, namely 7-8 am, 12-13 noon, and 3-4 p.m. Based on the results of the rotation calculations, the campus transportation shuttle is capable of carrying out an average of 19 routes. This shows that the average campus transportation shuttle can operate 19 rounds a week on average and in a year it can make 965 rounds on average.

b. Campus Transportation Shuttle Transport Capability

Carrying capacity calculations are needed to determine the average ability of campus transportation shuttles to carry passengers during operation. The campus transportation shuttle has a capacity of 15 passengers.

The calculation results show that on average the campus transportation shuttle is able to carry 278 passengers a day, or the equivalent of the carrying capacity of 140 motorbikes and 70 cars. In 1 working week the campus transportation shuttle is able to carry as many as 1,392 passengers. This transport capacity is equivalent to the ability to transport 698 motorbikes and 348 cars in 1 working week. This reality shows that the campus transportation shuttle as a mode of mass transportation in the campus environment is very efficient in overcoming traffic jams and air pollution in the UNNES campus environment.

c. Comparison of Fuel Costs between Motorcycles, Conventional Cars and Electric Vehicles (Battery Electric Buses)

Motorcycles

Motorcycles are a mode of transportation that is widely used by the UNNES academic community, both students, lecturers and employees. Motorcycles were chosen because they are efficient, fast and can break through traffic jams rather than four-wheeled vehicles. In general, the average motorbike consumes 2.5 liters of fuel oil (BBM) in a distance of 100 km. The price of Pertamina fuel in October 2023 is IDR 14,000. The operating route of the campus transportation shuttle has a track length of 3.4 km.

The results of these calculations show that over a distance of 100 km, a motorbike costs IDR 35,000 in fuel or IDR 350/1km. If the motorbike passes the campus transportation shuttle route which is 3.4 km long, the fuel costs incurred are IDR 1,190. On average, the daily campus transportation shuttle is capable of making 19 trips or if converted it is equivalent

to a distance of 64.6 km. If a motorcycles makes as many trips as the campus transportation shuttle then the daily fuel costs incurred are IDR 22,610. If 140 motorbikes do 19 routes a day, the fuel costs required are IDR 3,165,400 or IDR 15,827,000.

Conventional Car

In the process of operating conventional cars, they rely on the drive system in the internal combustion engine, which is transmitted to drive the wheels. Cars with a capacity of 4 passengers are the choice of many people as vehicles for their small families because they are minimalist, efficient, elegant, and can protect against various weather obstacles. In general, conventional cars can cover a distance of 13 km by consuming 1 liter of fuel. The price of Pertamina in October 2023 is IDR 14,000/liter.

These calculations show that in covering a distance of 100 km a conventional car costs Rp. 107,692 in fuel or Rp. 3,662 if it covers a distance of 3.4 km.

The average carrying capacity of the campus transportation shuttle in a day is 278 passengers, equivalent to the carrying capacity of 70 conventional cars. If the 70 conventional cars do as many routes as the campus transportation shuttle in a day, the fuel costs incurred are shown in the table below.

The calculation results show that if 70 conventional cars carry out a cycle 19 times a day, the fuel costs that must be incurred are IDR 4,869,846 or in one week the fuel costs can be IDR 24,349,231.

4.6.3. Electric Vehicles (Battery Electric Buses)
The MD12E model battery electric bus has a battery capacity of 259.2 kWh, and charging the battery takes up to four hours to fully charge. Once full, electric buses can cover a distance of up to 250 km (Firmansyah, 2019 in Listyaningrum, 2019).

This comparison uses electric vehicles, namely electric buses, because the specifications of the campus transportation shuttle are unknown. Electric vehicles can consume 2 kWh/km. The price of electricity per kWh is IDR 1,699.53. The calculation results show that

per 1 km an electric bus requires 1.04 kWh or 3.53 kWh per campus transportation shuttle route. The cost for an electric bus to make one trip is IDR 5,991. The daily cost of doing 19 routines is IDR 113,830 and in a week it costs IDR 569,149.48.

d. The Relevance of Campus Transportation Shuttles to the Green Economy

Shuttles are an environmentally friendly form of transportation that uses electrical energy which is actually cheaper than using gasoline as fuel. According to Prof. Zaenuri, Shuttle is a mass vehicle so it is included in maximizing the process by minimizing residue through fuel so that it is included in the green economy. Shuttles, which are on-campus transportation for students, can reduce the use of motorized vehicles for mobility on campus. Even though the shuttle cannot completely reduce zero waste, the efforts made by Semarang State University in creating zero waste are a good step in the future.

M. Fikri Amrullah, S. Pd., M. Pd said that shuttles can support and maximize the green economy if students, lecturers or other academics are able to use them. Shuttles can be required as campus transportation but will cause congestion at some point. So, if it is related to the green economy concept, it can be taken from protecting the environment, but the economic aspect cannot yet be achieved.

According to Dr. Andhina Putri Heriyanti, S.T., M.Si, green economy applies the concept of zero waste, which means no waste is thrown away, but reprocessed. The existence of this shuttle indicates that Semarang State University is trying and implementing a green economy.

Before the shuttle operated at Semarang State University, the Campus Bus was implemented first. However, the operation of Campus Buses has many disadvantages such as high operational costs. One campus bus consumes quite a lot of diesel fuel a day, causing large costs. The existence of campus buses that

use fossil fuels, namely diesel, is contrary to conservation values. Campus buses using diesel fuel will certainly emit large emissions, so this is contrary to the conservation values of Semarang State University. However, Campus Buses have the advantage of more effective service and are able to transport more passengers in one trip.

Prof's opinion Juhadi, M.Si said that the existence of this shuttle is very good in terms of vehicle conservation. However, their presence must be increased so that private vehicle traffic is reduced. Private vehicles can be used as public parking spaces where mobility between buildings and faculties can be served by shuttles for the academic community.

The results of comparative calculations of fuel costs between motorbikes, conventional cars and electric vehicles (electric buses) show that electricity-based public transportation modes such as electric buses and campus transportation shuttles have high relevance to the realization of a green economy. The campus transportation shuttle can economically carry up to 278 passengers every day. This transport capacity is equivalent to the operation of 140 motorbikes and 70 cars with a capacity of four passengers. In terms of fuel costs, it shows that public transportation modes, especially electric vehicles, are more fuel efficient than conventional vehicles that are used en masse. The calculation results show that an electric bus only costs daily IDR 113,830 or IDR 569,149 a week, while 140 motorbikes cost IDR 3,165,400 or IDR 15,827,000 in fuel a week, and 70 conventional cars cost IDR 4,869,846 or IDR in fuel. 24,349,230 in a week.

e. The Relevance of Campus Transportation Shuttles to UNNES Conservation

In 2010, Semarang State University declared itself a conservation university. UNNES has three pillars of conservation, namely 1) values and character, 2) arts and culture, and 3) natural resources and the environment. Conservation is one of the main focuses in UNNES's vision, namely to become a

university with a conservation perspective and an international reputation. The vision of becoming a conservation-oriented university is realized in various policies, one of which is the use of shuttles as a mode of transportation between faculties from the west campus to the east campus.

According to Trida Ridho Fariz, S.Si., M.Sc. The use of shuttles as a mode of transportation between faculties already has relevance to the UNNES conservation pillar of natural resources and the environment. This is because the shuttle uses electrical energy instead of fuel oil (BBM), so it can be said to be more environmentally friendly because in its operation it does not produce air pollution. Opinion of Trida Ridho Fariz, S.Sc., M.Sc. This is confirmed by research conducted by Cakrawati Sudjoko in 2021, where electric vehicles have the potential to reduce pollutant emissions (CO, NOx, HC, SO2, and PM) quite significantly. Electric vehicles have advantages compared to Internal Combustion Engine (ICE) based vehicles in reducing greenhouse gas emissions and air pollution. Electric vehicles such as shuttles produce minimal residual air pollution and can be said to be close to zero when compared to vehicles based on Internal Combustion Engines (ICE) (Sudjoko, 2021).

According to Prof. Dr. Juhadi, M. Si. The presence of the shuttle as a mode of mass transportation between faculties really supports UNNES's vision as a conservation-oriented university. However, according to him, the current number of shuttle fleets is still very insufficient to support the mobility of the UNNES academic community. Currently there are 5 shuttle fleets, where on effective college days 3 shuttle fleets are in operation while 2 shuttle fleets are in reserve and during college holidays only 1-2 shuttle fleets are in operation. Currently the government is encouraging the development of electric vehicles and charging station infrastructure through Presidential Regulation no. 55/2019.

Campus transportation shuttles as a mode of public transportation can effectively accommodate more passengers than

conventional motorbikes and cars. During the day, the campus transportation shuttle route is able to carry an average of 278 passengers (1392 passengers a week). That is equivalent to using 140 motorbikes and 70 conventional cars in a day. The use of campus transportation shuttles for mobility within campus is able to reduce greenhouse gas emissions from motorized vehicles by 3,733.95 Kg CO₂ ek in a day or 194,165.29 Kg CO₂ ek in a year. Ritase Calculation of UNNES Campus Shuttle Transport

Table 1. Campus Transport Shuttle Ritase Calculation

	Many passengers				Average ritase in 1 day
	7-8 AM	12-1 PM	3-4 PM	Shuttle Transport Capacity	
Monday	5	26	20	15	17
Wednesday	13	23	21		19
Friday	9	22	28		20
Average ritase in 1 week					19
Average ritase in 1 year					965

Source: Primary data (2023).

Table 2. Calculation of Shuttle Transport Capability Campus observation data

Day	Average ritase in 1 day	Passengers transported in 1 day
Monday	17	255
Wednesday	19	285
Friday	20	278
Average	19	278

Source: Primary data (2023).

Table 3. Campus Transport Shuttle's ability to carry passengers for 1 working week

Day	Average 1 day ritase	Passengers transported in 1 day	Motorbike equivalent	Equivalent to a 4-passenger car
Monday	17	255	128	64
Tuesday	19	278	140	70
Wednesday	19	285	143	71

Day	Average 1 day ritase	Passengers transported in 1 day	Motorbike equivalent	Equivalent to a 4-passenger car
Thursday	19	278	140	70
Friday	20	295	148	74
Average	19	278	140	70
Total in 1 working week		1.392	698	348

Source: Primary data (2023).

Comparison of Fuel Rates between Motorbike, Conventional Car and Electric Vehicle (Campus Transport Shuttle)

Table 4. Fuel cost calculation (Pertamax) motorbike

Travelling distance (km)	Fuel cost (Rp)
100	35.000
1	350
3,4	1.190
64,6	22.610

Source: Primary data (2023).

Table 5. Conventional Car Fuel Cost

Travelling distance (km)	Fuel cost (Rp)
13	14.000
100	107.692
1	1.077
3,4	3.662

Source: Primary data (2023).

Table 6. Fuel cost for 140 motorbikes if doing 19 ritase in a day

Day	Average ritase in 1 day	Passengers transported in 1 day
Monday	17	255
Wednesday	19	285
Friday	20	278
Average	19	278

Source: Primary data (2023).

Table 7. Fuel Costs for 70 Cars If Doing 19 Ritase in a Day

Number of motors	Number of ritase	Daily Cost (Rp)
70	19	4.869.846

Source: Primary data (2023).

Table 8. Greenhouse Gas Quantity of Motor Vehicles

CF	0.08277	Emissions in 1 day	Emissions in 1 year
Distance 3.4 km	196,52	3.733,95	194.165,29
Emission GHG	Kg CO2 ek	Kg CO2 ek	Kg CO2 ek

Source: Primary data (2023).

CONCLUSIONS

The academic community and shuttle manager perceptions, considering that the shuttle has become realization of the green economy and UNNES conservation. Environmental experts and educators have stated that UNNES implements green economy and conservation both through program policies and learning, but certainly, many improvements are still needed so that the concepts of green economy and conservation are implemented maximally and sustainably.

The campus transport shuttle is able to accommodate more passengers than conventional motorbikes and cars. The efficiency on Monday was classified as medium, while on Wednesday and Friday it was classified as high. The regression results obtained an interrelation coefficient of 0.759 means that the shuttle has a high relevance in realizing the UNNES green economy and conservation programme. The shuttle is very effective in supporting the green economy and conservation programme at UNNES.

The researcher's recommendations to the campus transport shuttle management are:

1. Improving campus transport shuttle services
 - a. Increase ritase frequency, especially during peak hours.
 - b. Increase the number of campus transport shuttle fleets.
2. Improving campus transport shuttle services
 - a. Periodic evaluation of the performance of the campus transport shuttle service.
 - b. Routine servicing of the existing campus transport shuttle fleet.

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