Green Transportation Acceptance and Carbon Footprint Reduction in Supply Chain Logistics

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ABSTRACT

Road transport is one of the largest contributors to greenhouse gas (GHG) emissions in modern supply chains, yet surprisingly little is known about why individual logistics workers respond to their carbon footprint the way they do especially in Malaysia. This study explores how three factors which are awareness of carbon footprint, transportation habits, and perception and acceptance of green transportation in shaping the transportation-related carbon footprint among road transport users in Pulau Pinang, Malaysia. Drawing on the Theory of Planned Behaviour (TPB), the study adopted a quantitative cross-sectional design. Data were gathered from 108 respondents using a structured five-point Likert-scale questionnaire and analysed through descriptive statistics, Pearson correlation, and multiple linear regression in IBM SPSS Statistics. All constructs showed good internal reliability (Cronbach's $\alpha = 0.773–0.864$). Correlation results showed that awareness of carbon footprint ($r = 0.565$, $p < 0.001$) and transportation habits ($r = 0.516$, $p < 0.001$) had moderate positive relationships with carbon footprint, while green transportation acceptance showed a weaker but significant link ($r = 0.229$, $p = 0.015$). Regression analysis identified awareness ($\beta = 0.413$, $p < 0.001$) and transportation habits ($\beta = 0.300$, $p = 0.003$) as the two significant predictors, together explaining 37.2% of the variance ($R^2 = 0.372$, $F(3, 104) = 21.565$, $p < 0.001$). Green transportation acceptance did not independently predict carbon footprint ($\beta = -0.047$, $p = 0.598$) once the other variables were accounted for. These results highlight how deeply awareness and ingrained travel behaviour influence the carbon footprint of logistics workers, and point to practical steps — including targeted education campaigns and infrastructure investment — that policymakers and logistics managers can take to reduce supply chain emissions in Malaysia.

Keywords: green transportation; carbon footprint; supply chain logistics; transportation habits; Theory of Planned Behaviour; Pulau Pinang; Malaysia

INTRODUCTION

Road transport is one of the biggest contributors to greenhouse gas (GHG) emissions within modern supply chains, and Malaysia is no exception. By 2022, the transport sector already accounted for roughly 25% of the country's total energy-related CO_2 emissions (International Energy Agency [IEA], 2022), with road freight making up the largest share of domestic cargo movement. Pulau Pinang sits right at the heart of this challenge as one of Malaysia's busiest industrial and logistics hubs, the state hosts a high concentration of logistics operators and heavy vehicle traffic, which means its transport-related emissions are considerably higher than in less industrialised regions.

Despite this, remarkably little research has looked at why logistics workers in Malaysia think and behave the way they do when it comes to their carbon footprint. We know from the broader literature that individual awareness of environmental issues, ingrained travel habits, and openness to greener alternatives all play a role in shaping emission-related behaviour but these factors have rarely been studied together, in a single framework, within the Malaysian context. This gap matters because changing behaviour requires more than policy: it requires understanding the cognitive and attitudinal roots of how people make transport decisions (Ajzen, 1991; Ling et al., 2024).

This study tackles that gap through the lens of the Theory of Planned Behaviour (TPB), which holds that what people actually do is shaped by their attitudes, the social norms around them, and their sense of whether they can realistically change their behaviour (Ajzen, 1991). Using this framework, the study asks three questions about road transport users in Pulau Pinang: what factors drive their transportation-related carbon footprint? How do awareness, habits, and green transport acceptance relate to that footprint? And which of these factors matters most?

(i) to identify the factors influencing transportation-related carbon footprint among road transport users in Pulau Pinang, Malaysia;

(ii) to examine the relationships between awareness of carbon footprint, transportation habits, and perception and acceptance of green transportation with transportation-related carbon footprint; and

(iii) to determine the most significant predictors of transportation-related carbon footprint within the study sample.

By building this kind of evidence base, the study contributes to what we know about sustainable supply chain management in Malaysia and offers practical entry points for policymakers and logistics managers who want to make a real dent in freight sector emissions.

LITERATURE REVIEW

Supply Chain Management and Environmental Sustainability

Supply chain management (SCM) covers everything that happens between extracting raw materials and delivering the finished product to the end customer which are the flow of goods, information, and money across the entire network (Fang et al., 2022). Over the past few decades, companies and governments have increasingly pushed SCM to go beyond efficiency and cost savings to actively address environmental impact. Green supply chain management (GSCM) puts that environmental concern at the centre of procurement, production, distribution, and reverse logistics decisions (Gadgil, 2024).

In Malaysia, the logistics industry is an important economic driver, but its environmental track record particularly on the road freight side and has not kept pace with the country's sustainability ambitions (Shahrilmd, 2024). Bringing SCM in line with Malaysia's commitments under the Twelfth Malaysia Plan (RMK-12) and the Paris Agreement is not just an academic exercise; it is a policy priority that requires understanding exactly where the emissions come from and what is driving them.

Transportation-Related Carbon Footprint

Put simply, transportation-related carbon footprint is the total amount of greenhouse gases — mostly CO_2 — that are released when goods and people are moved around, primarily through burning fossil fuels (Yaacob et al., 2020). How big that footprint is depends on a range of factors: how much fuel vehicles consume, how congested the roads are, how efficiently routes are planned, and how often motorised vehicles are used in the first place (Wang et al., 2025). The internationally recognised GHG Protocol sorts these emissions into three scopes that is Scope 1 for direct emissions, Scope 2 for indirect energy use, and Scope 3 for value-chain emissions (Bettenhausen, 2022). Transport is a major contributor to both Scope 1 and Scope 3, which is why it keeps appearing at the top of decarbonisation agendas.

Within the logistics world, road freight stands out as particularly emission-intensive. Compared to rail or sea transport, heavy goods vehicles running on diesel produce far more CO_2 per tonne-kilometre, and the infrastructure for switching to cleaner fuels is still thin on the ground. This is precisely why understanding what drives high-carbon transport behaviour and not just at the fleet or policy level, but at the level of individual workers as a valuable starting point for designing effective interventions.

Perception and Acceptance of Green Transportation

Green transportation covers a broad range of more environmentally responsible ways to move people and goods from electric or hybrid vehicles and alternative fuels to smarter route planning that cuts unnecessary mileage (Ushakov et al., 2024). Whether workers and organisations actually adopt these alternatives depends heavily on how they perceive them. Rahal and Elloumi (2024) found that people who hold positive views about sustainable logistics practices are much more likely to be willing to switch. That said, real-world barriers offers the scarcity of charging stations, the higher upfront cost of green vehicles, and limited technical knowledge among drivers that continue to slow down adoption even where attitudes are favourable (Ushakov et al., 2024).

Within the TPB, this acceptance of green transportation maps closely onto the attitudinal component of the model. In other words, a worker who genuinely sees electric vehicles or eco-routing as a good idea is more likely to form the intention to behave more sustainably, and more likely to actually follow through. This study tests that proposition empirically.

Transportation Habits

Habits are some attitudes that was hard to change and transport habits are no different. For logistics workers, this typically means consistently choosing the same modes, following the same routes, and relying heavily on motorised vehicles regardless of the environmental cost (Ramos et al., 2020). Freight drivers tend to operate within tight schedules and rigid route structures that leave little room for spontaneous change, even when environmental awareness is high (Zhang et al., 2023). Studies consistently show that the more frequently heavy diesel vehicles are used, the higher the associated CO_2 output (Nagy & Szentesi, 2024).

From a TPB perspective, these ingrained habits connect most naturally to perceived behavioural control which is the sense of whether one can realistically change. When someone's entire working day is built around diesel routes and fixed timetables, even a genuine desire to reduce emissions can feel impractical. At the same time, repeated high-emission travel may normalise those behaviours over time, making it harder for environmental intentions to translate into real change. Understanding how strongly habits predict carbon footprint were independent of awareness and attitudes was one of the core questions this study addresses.

Awareness of Carbon Footprint

Carbon footprint awareness is about more than just knowing that climate change exists. It refers specifically to how well someone understands where their own emissions come from, how significant those emissions are, and what the broader environmental consequences might be (Husain et al., 2023). Research shows that people who are more carbon-literate tend to recognise transportation as a major source of their personal environmental impact and are more likely to say they want to do something about it (Golnar & Beškovnik, 2024). In the TPB framework, this kind of awareness feeds directly into attitude formation: knowing more about carbon emissions generally leads to more negative views about high-carbon behaviours and more positive views about sustainable alternatives (Ajzen, 1991).

That said, awareness alone does not automatically change behaviour. The relationship between what people know and what they actually do can be weakened by very real constraints and limited access to cleaner vehicles, financial pressures, and the occupational norms that govern how logistics work gets done (Ling et al., 2024). This study examines how strongly carbon footprint awareness directly predicts the carbon footprint of road transport users, while keeping those contextual pressures in mind.

Theoretical Framework and Hypothesis Development

The theoretical backbone of this study is the Theory of Planned Behaviour (TPB), developed by Ajzen (1991). The TPB offers a well-tested explanation for why people do or do not engage in a given behaviour and it comes down to intention, it shape by three things on how favourably someone views the behaviour (attitude), whether they think the people around them approve (subjective norms), and whether they feel capable of carrying it out (perceived behavioural control). Researchers have used the TPB productively in sustainable transportation contexts precisely because it captures the gap between knowing something is good and actually doing it (Ling et al., 2024; Rahal & Elloumi, 2024).

In the context of this study, awareness of carbon footprint fits within the attitudinal dimension that it shapes how workers cognitively evaluate the environmental impact of their own transport activity. Transportation habits map onto perceived behavioural control, since deeply routinised travel patterns reflect the degree to which workers feel they can realistically alter what they do. Perception and acceptance of green transportation touches both attitude and subjective norms, capturing not only personal openness to greener alternatives but also the social expectations that may encourage or discourage such choices.

On this basis, the study proposes three hypotheses:

H1: Awareness of carbon footprint is positively and significantly associated with transportation-related carbon footprint among road transport users in Pulau Pinang.

H2: Transportation habits are positively and significantly associated with transportation-related carbon footprint among road transport users in Pulau Pinang.

H3: Perception and acceptance of green transportation are positively and significantly associated with transportation-related carbon footprint among road transport users in Pulau Pinang.

Together, these three independent variables are proposed to predict transportation-related carbon footprint as the dependent variable, consistent with the TPB framework. Figure 1 presents the conceptual framework of the study.

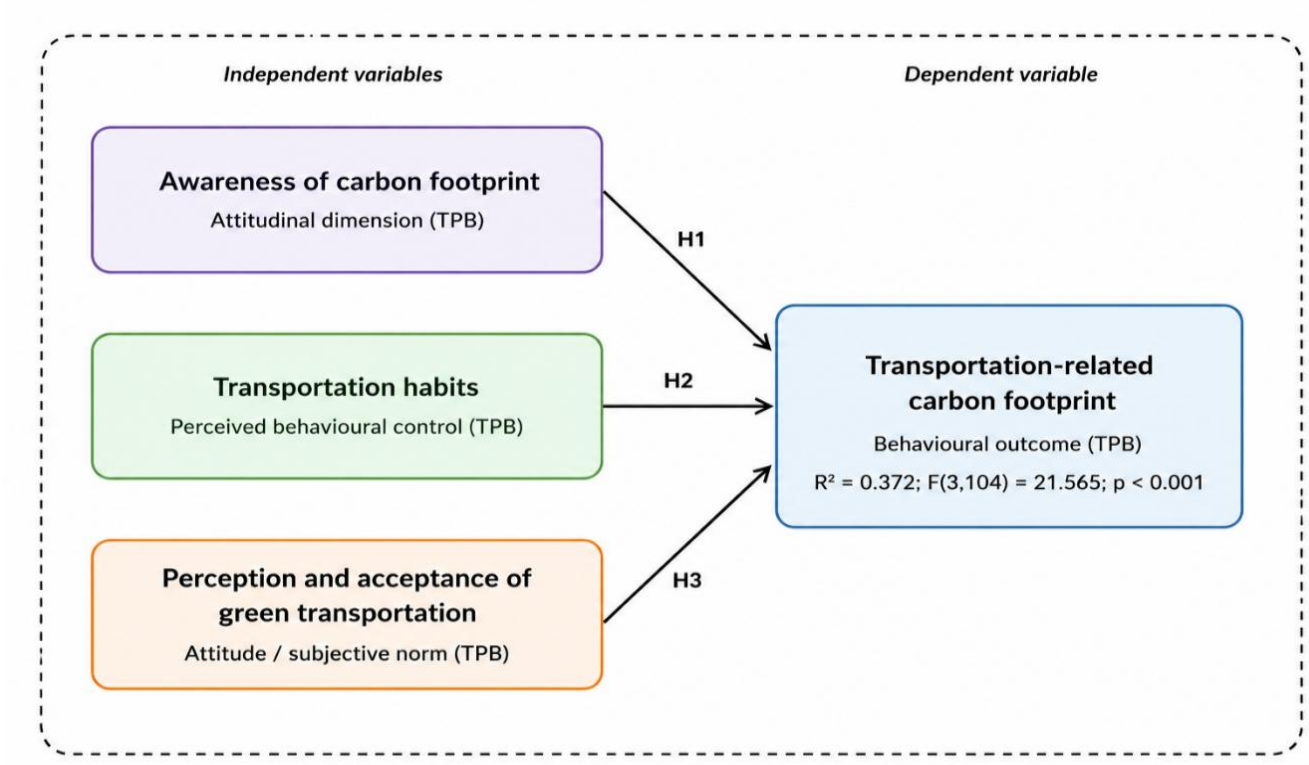

Figure 1. Conceptual framework grounded in the Theory of Planned Behaviour (Ajzen, 1991)

METHODOLOGY

Research Design

This study used a quantitative, cross-sectional design to test the relationships between the identified variables at a single point in time. This approach is well suited to studies that aim to measure how variables relate to each other across a sample and to test theoretically derived hypotheses against real-world data (Creswell & Creswell, 2018). The analytical direction followed a deductive logic, starting from the TPB framework and working toward empirical testing.

Population and Sampling

The study focused on road transport users working in logistics and freight operations in Pulau Pinang that includes professional freight drivers, logistics supervisors, and supply chain staff whose daily work centres on road-based cargo movement. Because a complete, formal sampling frame for this population does not exist, a convenience sampling approach was used to recruit participants from accessible logistics facilities. The final sample of 108 respondents was considered adequate for multiple regression: as a rule of thumb, at least 10 observations per predictor variable are needed for stable estimates (Hair et al., 2019), and the sample also meets the statistical power requirements for detecting medium effect sizes at the standard $\alpha = 0.05$ level.

Instrumentation

Data collection relied on a structured, self-administered questionnaire with two main sections. The first section gathered basic sociodemographic information (gender, age, education, and job role). The second measured the four study constructs using a five-point Likert scale, where 1 = strongly disagree and 5 = strongly agree. Items were adapted from established scales in the literature and adjusted to reflect the Malaysian logistics context. Table 1 summarises the reliability of each construct. All four Cronbach's alpha values comfortably exceeded the widely used 0.70 threshold (Hair et al., 2019), confirming that the items within each construct were measuring the same underlying concept reliably.

Table 1. Construct Reliability Summary

Construct	No. of Items	Cronbach's α
Awareness of Carbon Footprint	6	0.864
Transportation Habits	6	0.841
Perception and Acceptance of Green Transportation	6	0.773
Transportation-Related Carbon Footprint	6	0.852

Data Collection Procedure

Questionnaires were distributed through two channels: in person at logistics facilities and via an online link to reach respondents who could not be approached directly. Taking part was entirely voluntary, and all participants were assured that their responses would remain confidential and anonymous. Before analysis, every completed questionnaire was checked for missing or inconsistent responses, and no notable gaps in the data were found.

Data Analysis

All data were analysed using IBM SPSS Statistics Version 26. The analysis proceeded in four steps. First, descriptive statistics were used to build a profile of the sample and describe how respondents scored on each construct. Second, Cronbach's alpha reliability analysis confirmed the internal consistency of the measurement scales. Third, Pearson product-moment correlation examined the bivariate relationship between each

independent variable and the dependent variable. Fourth, multiple linear regression tested the simultaneous predictive effects of all three independent variables on the dependent variable. Before interpreting the regression results, the standard assumptions were checked: residual plots were inspected for normality and homoscedasticity, and variance inflation factors (VIF) were calculated to rule out problematic multicollinearity.

RESULTS

Respondent Profile

A total of 108 completed questionnaires were included in the final analysis. Most respondents were male (n = 74, 68.5%), which reflects the gender profile of the road freight sector in Malaysia. The 26–35 age group was the largest cohort (n = 43, 39.8%), followed by the 36–45 group (n = 31, 28.7%). In terms of education, diploma holders made up the biggest group (n = 38, 35.2%), ahead of secondary school certificate holders (n = 33, 30.6%). A majority had been working in road transport for more than five years (n = 61, 56.5%), meaning most respondents brought solid on-the-ground experience to their answers.

Descriptive Statistics

Table 2 shows the descriptive statistics for all four constructs. Mean scores for the three independent variables all sat above the scale midpoint of 3.0, suggesting that respondents generally had moderate to fairly high levels of awareness, habitual road transport use, and openness to green alternatives. The dependent variable, transportation-related carbon footprint, also averaged above the midpoint, indicating that respondents broadly acknowledged their transport activities as a source of carbon emissions.

Table 2. Descriptive Statistics for Study Constructs

Construct	N	Min	Max	Mean (SD)
Awareness of Carbon Footprint	108	1.83	5.00	3.74 (0.71)
Transportation Habits	108	1.67	5.00	3.61 (0.68)
Perception & Acceptance of Green Transportation	108	1.50	5.00	3.58 (0.73)
Transportation-Related Carbon Footprint	108	1.67	5.00	3.56 (0.69)

Note. SD = standard deviation.

Pearson Correlation Analysis

Table 3 shows the Pearson correlation coefficients between each independent variable and transportation-related carbon footprint. All three variables were positively and significantly correlated with the dependent variable. Awareness of carbon footprint had the strongest association ($r = 0.565, p < 0.001$), followed closely by transportation habits ($r = 0.516, p < 0.001$), with both indicating moderate positive relationships. Green transportation acceptance also correlated significantly with carbon footprint, though the relationship was notably weaker ($r = 0.229, p = 0.015$). These results offer initial support for H1 and H2, and partial support for H3.

Table 3. Pearson Correlation Coefficients

Variable	1	2	3	4
1. Awareness of Carbon Footprint	—			

2. Transportation Habits	0.441**	—		
3. Perception & Acceptance of Green Transportation	0.387**	0.312**	—	
4. Transportation-Related Carbon Footprint	0.565**	0.516**	0.229*	—

*Note. * $p < 0.05$; ** $p < 0.001$ (two-tailed).*

Multiple Linear Regression Analysis

Before interpreting the regression results, the standard diagnostic checks were carried out. Residual plots showed approximate normality and homoscedasticity, and VIF values for all predictors were comfortably below the conservative threshold of 5.0 (awareness: VIF = 1.317; transportation habits: VIF = 1.218; green transportation acceptance: VIF = 1.201), confirming that multicollinearity was not a concern.

The overall model was statistically significant ($F(3, 104) = 21.565$, $p < 0.001$), explaining 37.2% of the variance in transportation-related carbon footprint ($R^2 = 0.372$, *adjusted* $R^2 = 0.354$). Detailed results are presented in Table 4.

Table 4. Multiple Linear Regression Results

Predictor	**B**	**SE B**	**β**	**t**	**p**
(Constant)	0.581	0.298		1.950	0.054
Awareness of Carbon Footprint	0.396	0.092	0.413	4.309	< 0.001
Transportation Habits	0.300	0.099	0.300	3.033	0.003
Perception & Acceptance of Green Transportation	−0.044	0.084	−0.047	−0.529	0.598

Note. $R^2 = 0.372$; Adjusted $R^2 = 0.354$; $F(3, 104) = 21.565$, $p < 0.001$. SE B = standard error of B; β = standardised coefficient.

Awareness of carbon footprint was the strongest individual predictor ($\beta = 0.413$, $t = 4.309$, $p < 0.001$), followed by transportation habits ($\beta = 0.300$, $t = 3.033$, $p = 0.003$). Both findings support H1 and H2. Green transportation acceptance, however, did not reach significance in the regression model ($\beta = -0.047$, $t = -0.529$, $p = 0.598$), which means H3 was not supported at this level despite the variable's significant bivariate correlation. This gap between the bivariate and multivariate results suggests that the effect of green transportation acceptance may be partially absorbed by — or routed through — awareness and habits when all three predictors are considered together.

DISCUSSION

The Role of Carbon Footprint Awareness

The finding that awareness of carbon footprint is the strongest predictor of transportation-related carbon footprint ($\beta = 0.413$, $p < 0.001$) makes a lot of sense through the lens of the TPB. The theory holds that attitudes which are shaped by knowledge and personal evaluation are a key driver of behaviour (Ajzen, 1991). Workers who understand their own carbon emissions seem more inclined to recognise and reckon with the environmental consequences of their daily transport choices. This sits well with Husain et al. (2023), who found that higher carbon literacy among transport users goes hand in hand with a greater sense of personal environmental responsibility, and with Golnar and Beškovnik (2024), who linked awareness directly to stronger pro-environmental transport intentions.

One aspect of this result deserves a closer look. The positive direction of the relationship suggests that higher awareness scores may, at least in part, reflect the fact that workers with high-emission jobs and long-distance freight drivers, for instance are precisely the people who know most about their carbon footprint, because it is unavoidable in their line of work. In that sense, awareness here is not just about environmental education; it is also about occupational self-awareness. The practical implication is that carbon literacy programmes will likely do the best when they go beyond generic environmental messages and engage workers directly in understanding and acting on the footprint that their specific roles generate.

Transportation Habits as a Behavioural Predictor

The positive relationship between transportation habits and carbon footprint ($\beta = 0.300, p = 0.003$) is arguably the study's most policy-relevant finding. Even when awareness is considered, what workers routinely do the vehicles they drive, the routes they follow, the frequency with which they travel and still significantly predicts their carbon footprint. This resonates with Zhang et al. (2023), who found that habitual dependency on motor vehicles was one of the main barriers to reducing emissions among freight drivers, and with Nagy and Szentesi (2024), who identified a clear link between heavy vehicle use frequency and transport-related CO_2 levels.

What this tells us is that knowing better does not automatically mean doing better. Old habits in logistics does built around diesel trucks, fixed routes, and tight schedules but are genuinely hard to disrupt from the outside. Awareness campaigns can shift attitudes, but if the infrastructure for change is not there and if there are no viable alternatives, no route optimisation tools, no fleet electrification pathways, then behaviour tends to stay the same. The TPB is useful here because it helps pinpoint where the problem lies: in this case, not in intentions or attitudes, but in the structural conditions that shape perceived behavioural control.

Perception and Acceptance of Green Transportation

The result for green transportation acceptance is intriguing. At the bivariate level, it correlated significantly with carbon footprint *($r = 0.229, p = 0.015$),* but once awareness and habits were in the model alongside it, it lost statistical significance entirely ($\beta = -0.047$, $p = 0.598$). This pattern is consistent with what is sometimes called a suppression effect: the variance that acceptance shares with the other two predictors is effectively accounted for elsewhere, leaving it with no independent explanatory power. In other words, the effect of accepting green transportation on carbon footprint may not be direct and it may work through the pathways of awareness or habit change rather than on its own.

This echoes Rahal and Elloumi (2024), who noted that positive attitudes toward sustainable logistics do not straightforwardly translate into measurable emission reductions in real occupational settings. There is also an honest question here about social desirability: logistics workers may genuinely endorse green transport in principle, while privately recognising that their work conditions do cost pressures, fleet limitations, delivery deadlines and make it impractical to act on those views. Future studies would benefit from using mediation analysis to trace exactly how acceptance relates to actual carbon behaviour, and whether that link is moderated by contextual factors like infrastructure access or employer policy.

Implications for Sustainable Supply Chain Management

Taken together, these findings make a strong case for treating supply chain decarbonisation in Malaysia as a behavioural problem, not just a technological one. The TPB framework turns out to be quite useful for diagnosing what is holding back emission reductions: in the Malaysian logistics sector, the bottleneck is a combination of ingrained travel habits and gaps in environmental knowledge, not a lack of positive attitudes toward green alternatives. This points to where interventions should be focused.

For logistics managers and policymakers, the message is clear. Awareness programmes can make a difference, but they need to be specific and occupationally grounded — generic sustainability messaging is unlikely to move the needle among freight workers who are already managing demanding schedules. What will complement those programmes is structural investment: route optimisation technology, fleet electrification incentives, carbon credit schemes for low-emission operators, and better alternative-fuel infrastructure at key

logistics nodes like Pulau Pinang. Malaysia's existing policy frameworks to the Twelfth Malaysia Plan (RMK-12) and the Low Carbon Mobility Blueprint which already provide the enabling environment for these kinds of initiatives to take root.

CONCLUSION

Summary of Findings

This study set out to understand what drives transportation-related carbon footprint among road transport users in Pulau Pinang, using the Theory of Planned Behaviour as a guiding framework. Working with data from 108 respondents, the regression model explained just over a third of the variance in carbon footprint ($R^2 = 0.372$, $F(3, 104) = 21.565$, $p < 0.001$). Awareness of carbon footprint ($\beta = 0.413$, $p < 0.001$) and transportation habits ($\beta = 0.300$, $p = 0.003$) emerged as the two significant predictors, supporting H1 and H2. Perception and acceptance of green transportation was not a significant independent predictor in the regression model, meaning H3 was not confirmed at that level, even though it correlated significantly with the dependent variable on its own.

Theoretical Implications

This study adds to the growing body of work applying the TPB in sustainable transportation contexts, specifically by testing it in a logistics occupational setting in Southeast Asia. A notable contribution is the demonstration that habitual behaviour carries independent predictive weight on carbon footprint, even after attitudinal variables are accounted for. This suggests that future TPB-based research in logistics should take habits more seriously as a distinct construct, rather than treating them as a by-product of attitude or intention. A more complete operationalisation of the model would incorporate subjective norms as well, to round out the picture of what drives and constrains for a sustainable transport behaviour.

Practical Implications

For those working to reduce carbon emissions in the Malaysian logistics sector, the study points to three concrete areas of action. First, carbon literacy programmes should be embedded in workforce development plans for logistics operators, with content tailored to the specific emission profiles of different job roles. Second, structural and operational interventions fleet electrification support, eco-driving training, and smarter route planning tools are essential to help workers translate better awareness into actual behaviour change, given how resistant entrenched habits can be to attitude-only approaches. Third, the gap between positive attitudes toward green transportation and actual adoption suggests that practical barriers which are cost, infrastructure, and workplace norms — need to be addressed directly through subsidies, facility investment, and peer-led initiatives within logistics organisations.

Limitations and Future Research Directions

This study has several limitations worth noting. The use of convenience sampling means the findings cannot be straightforwardly generalised beyond this sample; future work should aim for probability-based sampling to better represent the full range of logistics workers in Malaysia. The cross-sectional design is another constraint that captures a snapshot in time and cannot establish whether awareness or habits actually cause changes in carbon footprint over time; longitudinal or experimental designs would be needed to address that question. Relying entirely on self-reported survey data also raises the possibility of common method bias, which future studies could mitigate by pairing questionnaire data with objective emission records where available. Finally, limiting the study to one city, Pulau Pinang which means we should be cautious about applying the findings elsewhere without replication.

There are several promising directions for future research. Extending the TPB model to include subjective norms would give a more complete account of what shapes carbon-related behaviour in logistics settings. Mediation and moderation analyses would help clarify how green transportation acceptance connects to actual carbon outcomes. It would also be worth exploring how organisational factors such as company policy, fleet

size, management priorities which influence individual-level behaviour, and whether the relationships found here hold across different transport modes or different sizes of logistics operation.

Ethical Considerations

This article is based entirely on secondary sources, including published academic work, policy documents and publicly available reports. It does not involve primary data collection from human participants or the use of confidential administrative records. Formal ethical approval was therefore not required. Future empirical studies that build on the conceptual arguments presented here and involve direct engagement with programme participants, frontline workers or officials should seek approval from an appropriate institutional ethics committee and ensure informed consent, confidentiality and secure handling of personal and digital financial data

Conflict Of Interest

The author declares no known financial or non-financial conflict of interest in relation to this article. The analysis and conclusions are solely those of the author and do not necessarily represent the official views of any institution.

Data Availability

No new datasets were generated or analysed in this study. All information is derived from publicly available sources cited in the text. Further details can be obtained from the referenced documents and publications.

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