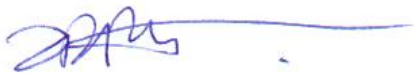**Federal State Higher Education Institution**

Saint Petersburg State University

The Institute "Graduate School of Management"

Master's in Management Program

The Transition to Cleaner Fuel Technologies in India: Assessing middle to high income consumer' attitudes and willingness to pay

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ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПУСКНОЙ
КВАЛИФИКАЦИОННОЙ РАБОТЫ

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Abstract

Master Student's Name	Abhijay Tyagi
Academic Advisor's Name	Joan Freixanet
Master Thesis Title	The Transition to Cleaner Fuel Technologies in India: Assessing middle to high income consumer' attitudes and willingness to pay
Description of the goal, tasks and main results the research	India stands as a prominent player in global vehicle purchases, with future projections indicating a continued rise in demand driven by increasing income levels. However, this surge in vehicle ownership also amplifies pollution levels, posing significant health concerns. Against this backdrop, the imperative for a sustainable transportation sector, as underscored by the United Nations Sustainable Development Goals (UNSDGs), becomes paramount. India's shift towards cleaner fuel vehicular technologies, exemplified by the current Bharat stage VI (BS6) emission standards and alternative fuel technologies, holds significant promise in mitigating vehicular emissions. This study employs a conceptual framework that integrates elements from the Theory of Planned Behaviour (TBP) and the Technology Adoption Model (TAM) to delve into consumers' awareness, adoption patterns, and preferences concerning cleaner fuel vehicles. By analysing various socio-economic, societal, environmental and behavioural factors, the research aims to offer a comprehensive understanding of consumer perceptions regarding cleaner fuel technologies in the Indian context, including their willingness to pay a premium for such vehicles. The research can be a useful evidence to inform automotive policy and market actors in India.
Keywords	Automotive, BS6, Cleaner Fuel, Electric Vehicles, Sustainability, Environment

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Chapter 1. Introduction

The rapid pace of urban development in India has led to a significant surge in motor vehicle numbers. In select cities, this increase has even doubled over the past decade (Alam, M. S., & Khan, A. 2020). The rapid urbanization, coupled with the proliferation of motor vehicles, has exerted profound effects on both human health and the environment in recent years. Motor vehicles serve as a notable source of urban air pollution, increasingly contributing to anthropogenic carbon dioxide and other greenhouse gas emissions. Notably, the transport sector stands out as a major contributor, accounting for 90% of total emissions. The ramifications of air pollution on human health are severe, encompassing symptoms such as nausea, respiratory difficulties, skin irritations, and potentially serious conditions like birth defects, immunosuppression, and cancer. These circumstances underscore the burgeoning problem of air pollution in the Indian context. (Alam, M. S., & Khan, A. 2020).

The transition to cleaner fuel technologies in India represents a pivotal juncture in the nation's trajectory towards sustainable development and environmental stewardship. Against the backdrop of escalating environmental concerns and mounting pressures to curb vehicular emissions, the shift from Bharat Stage (BS) IV to Bharat Stage VI (BS VI) emission norms emerges as a cornerstone initiative aimed at fostering eco-friendly mobility solutions. This study serves to contextualize and frame the research focus on assessing the attitudes and willingness to pay (WTP) of middle to high-income consumers in India regarding the adoption of cleaner fuel technologies, particularly within the framework of the BS emission standards.

The transition from BS IV to BS VI compliant vehicles heralds a paradigm shift in India's automotive landscape, marked by a heightened emphasis on reducing vehicular emissions and enhancing air quality. Empirical investigations, such as the study by Vats et al. (2022), delve into the nuanced dynamics of consumer behaviour, exploring the determinants of switching intention and shedding light on the factors influencing the adoption of cleaner fuel technologies. Complementing these empirical insights, technical reviews by scholars like Mirgal (2017) and Pothumsetty and Thomas IV (2020) provide invaluable perspectives on the challenges and strategies associated with the transition to BS VI norms, offering actionable guidance for industry stakeholders and policymakers alike.

The imperative to address the environmental and health impacts of vehicular emissions underscores the urgency of transitioning to cleaner fuel technologies. Scholarly inquiries, such as those conducted by Gajbhiye et al. (2023) and Singh et al. (2023), meticulously examine the evolution and mitigation of vehicular emissions under the BS emission standards, underscoring the pivotal role of stringent regulations in improving air quality and safeguarding public health.

Central to the successful implementation of cleaner fuel technologies is the understanding of consumer attitudes and behaviours, which serve as pivotal drivers of adoption. Drawing upon theoretical frameworks such as the Theory of Planned Behaviour (Ajzen, 1991) and its application in understanding green purchase behaviour (Yadav & Pathak, 2017), this research endeavours to unravel the intricate interplay of psychological determinants shaping consumer preferences and behaviours towards sustainable transportation options.

In light of these considerations, the present study seeks to holistically assess middle to high-income consumers' attitudes and WTP for cleaner fuel technologies in India. By synthesizing empirical evidence, technical insights, and theoretical frameworks, this research endeavours to offer a comprehensive understanding of the factors influencing consumer adoption of cleaner fuel technologies. Ultimately, the findings of this study aspire to inform targeted policy interventions and market strategies aimed at catalysing the transition to eco-friendly mobility in India, thereby fostering a greener, healthier, and more sustainable future for generations to come.

Concentrating on middle to high-income consumers, in the Indian context, when examining the shift toward cleaner fuel technologies provides significant insights owing to their substantial purchasing power, influence on market dynamics, and inclination to embrace innovation. Their uptake of cleaner fuel technologies not only carries substantial environmental implications but also offers policymakers valuable feedback on the efficacy of sustainability-promoting measures. Analysing this demographic facilitates refined market segmentation and targeting tactics. Nonetheless, ensuring inclusivity and fairness in sustainable development initiatives necessitates the inclusion of diverse socio-economic perspectives in future research undertakings.

1.1 Research Motivation

On examining the latest data on pollution levels worldwide, a concerning trend emerges, particularly in India. According to IqAir[1], six out of the top ten most polluted cities in the world are in India.

The transportation sector in India is undeniably a significant contributor to the country's environmental challenges (CEEW, 2021), particularly concerning greenhouse gas (GHG) emissions and air pollution. India currently stands as the world's fourth-largest emitter of GHGs, accounting for 7.08% of global emissions. Additionally, it ranks third among nations with the poorest air quality, with 13 North Indian cities featuring prominently among the world's most polluted areas (CEEW, 2021).

Within this context, transportation emerges as a prominent culprit. However, in India, this sector stands out as the fastest-growing source of carbon emissions. As policymakers in India endeavour to address these pressing environmental concerns, the adoption of electric vehicles (EVs) has emerged as a focal point.

To address the harmful vehicular emissions, the Indian government introduced emission norms for petrol-fuelled vehicles in 1992 and for diesel vehicles in 1992. Since 2000, Euro Norms have been followed in India under the name of Bharat Stage Emission standards (BS Norms) for 4-wheeled vehicles. BS3 norms were implemented in October 2010 across India (Economic times, 2023).

Upgrading the emission norms requires the manufacturing companies to upgrade their technology, which in turn increases the cost of the vehicle. Cost is one of the main reasons for the slow upgrade of emission standards. However, there are also arguments that the increase in cost is made up by savings in health costs as the pollutants causing diseases are decreased with the upgrade in emission standards. Fuels also play a crucial role in meeting these emission norms. Fuel specifications have also been aligned to its corresponding European production norms (Economic Times, 2023).

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1 https://www.iqair.com/world-most-polluted-cities
2 https://www.ceew.in/cef/quick-reads/explains/vehicular-emissions-in-india

In this backdrop, the main motivation behind conducting this study are:

1)While India has adopted European vehicular emission standards (Euro 2....6) and has made significant strides in mitigating emissions, there is a lack of critical analysis regarding the contextual factors that differentiate India and Europe. Notably, there is a dearth of studies that have scrutinized the policy mirroring approach.

2) There is a scarcity of research focusing on consumer attitudes and their willingness to pay for cleaner fuel technology vehicles. Understanding consumer behaviour in this context is crucial for shaping effective policies and

strategies.

3) Existing literature lacks comprehensive studies that explore both consumer and industry narratives regarding the challenges associated with the adoption of cleaner fuel technology vehicles. Insights into these challenges are essential for developing targeted interventions and promoting wider acceptance of cleaner fuel technology.

1.2 Research Objectives

The research is structured around three core objectives aimed at elucidating consumer attitudes and behaviours towards cleaner fuel technology vehicles:

Objective 1: Evaluate Consumer Awareness and Perception

Assess consumer awareness and comprehension of existing emission standards through surveys.

Objective 2: Analyse Adoption Patterns and Preferences

Analyse consumer Preference and behaviours regarding the adoption of cleaner technology vehicles

Objective 3: Identify Key Determinants of Consumer Attitudes

Identify key factors shaping consumers' willingness to pay for cleaner technology

1.3 Research Questions

1   How aware are consumers of the current emission standards, and what is their understanding of the transition towards cleaner vehicle technologies mandated by these standards?

2   How do consumers' perceptions regarding the performance of cleaner technology vehicles, societal attitudes towards environmental responsibility, and governmental policies supporting greener vehicles influence the adoption of cleaner technology vehicles in the automotive market?

3   Which factors drive consumers' willingness to pay for cleaner fuel technologies?

Chapter 2. Literature Review and Hypothesis Development

This chapter delves into the literature background of the thesis, focusing on the theories utilized to analyse the attitudes and willingness to pay of middle to high-income consumers towards cleaner fuel technologies in India. The Theory of Planned Behaviour (TPB) and the Technology Adoption Model (TAM) will be thoroughly examined and expanded upon in this section, as they form the cornerstone of the thesis.

2.1 The Theory of Planned Behavior

The Theory of Planned Behaviour (TPB) is a psychological framework aimed at elucidating human behaviour through the consideration of three main components: attitudes, subjective norms, and perceived behavioural control (Ajzen, I.1991). TPB builds upon the groundwork laid by the Theory of Reasoned Action (TRA), initially proposed by Ajzen and Fishbein.

In TPB, attitudes (A) denote an individual's favourable or unfavourable assessment of engaging in a specific behaviour, shaped by their beliefs about the outcomes of that behaviour and the personal significance attached to these outcomes. Subjective norms (SN) encapsulate the perceived societal pressure or influence surrounding the performance or avoidance of a behaviour, driven by beliefs regarding the expectations of influential others and the individual's inclination to adhere to these expectations.

Moreover, perceived behavioural control (PBC) encompasses an individual's perception of their capability to execute a behaviour, incorporating beliefs concerning the presence of factors that either facilitate or impede the behaviour's enactment, such as available resources, skills, and constraints.

TPB posits that behavioural intention, representing an individual's readiness to engage in a specific behaviour, is moulded by attitudes, subjective norms, and perceived behavioural control. This intention, in turn, serves as the immediate precursor to behaviour, with stronger intentions more likely to translate into actual actions. However, TPB acknowledges the potential influence of external factors, such as situational constraints, on behaviour, underscoring the dynamic interplay between individual determinants and situational contexts.

A recent study by Yadav, R., & Pathak, G. S. (2017) have advocated for expanding the TPB framework by incorporating supplementary constructs such as perceived value and willingness to pay a premium. Incorporating these additional factors has been shown to enhance the predictive power of the model in understanding consumers' green purchase intentions and behaviors. Notably, perceived value exerted a significant positive influence on consumers' intentions to purchase green products, underscoring its importance in decision-making processes related to green consumption (Yadav, R., & Pathak, G. S. 2017).

Despite these insights, several limitations exist within the current body of research. One notable limitation is the reliance on self-reported behaviour as a measure of green purchase behaviour, rather than actual observed behaviour (Yadav, R., & Pathak, G. S. 2017).

The theories of TRA/TPB/RAA continue to hold significant relevance in elucidating the immediate determinants of behaviours such as physical activity and sports participation (Connor.M. 2020). These theories not only augment our understanding of various behaviours but also serve as vital tools for analysing human conduct. However, their applicability is constrained by their limited scope in capturing the diverse array of influences operating within the broader social environment. As argued by Conner and Sparks (2015), while factors like beliefs, values, perceived norms, and perceived control contribute substantially to behaviour, it is imperative to also consider individuals' behavioural history and the broader societal influences at play (Connor.M. 2020). While acknowledging the profound impact of the broader social structure on these dynamics, it is essential to recognize the TRA/TPB/RAA theories'

efficacy in delineating the psychological underpinnings of behaviour, which may serve as mediators for a multitude of other influences (Connor.M. 2020).

2.1.1 Impact of Culture, Gender, and Behaviour on Green Purchase

In India Gender seems to have a great impact on green purchase as indicated in a study done specifically to understand the impact of gender, culture and behaviour on green purchase (Sreen et al. 2018). It was found in the study that Women have a higher chance of influencing a green purchase over men. In India, the predominant societal norm is for women to take on the role of home caretakers, while men typically serve as the primary breadwinners. Female children are often socialized to assume caregiving responsibilities, including childcare and household tasks. Given their proximity to family members and the influence of societal expectations, women tend to wield considerable sway in decision-making, particularly regarding purchases for the home. Therefore, understanding how to effectively engage and influence women towards eco-friendly products holds paramount importance for both practitioners and policymakers (Sreen et al. 2018).

The findings underscore the significance of recognizing that women are particularly influenced by social dynamics and external opinions. Armed with this knowledge, practitioners and policymakers can strategically leverage opinion leaders to enhance green purchasing intentions among women (Sreen et al. 2018).

The findings another study indicate that despite India's blend of both collectivistic and individualistic values (Sinha et al., 1987), individuals tend to lean towards collectivistic beliefs when making decisions about green products. In collectivist societies like India, individuals prioritize group goals over personal objectives, striving to make choices that align with societal norms and approval. The traditional Indian family structure, historically characterized by joint family arrangements spanning multiple generations under one roof, has fostered a collectivist mindset (Sinha et al., 1987).

Although modernization, globalization, and urbanization have led to a shift towards nuclear family setups in India, collectivist values persist among the majority of households. Recognizing this, it becomes imperative for both government initiatives and marketing

strategies to reinforce collectivistic values within individualistic segments of society. By doing so, there is potential to elevate purchase intentions for green products within these demographic groups.

In the past, the Indian government has taken steps to raise awareness about environmental issues through initiatives like the Swach Bharat Mission[2]. However, there has been a lack of legislative measures to incentivize organizations to promote the procurement and manufacturing of green products. While efforts have been made to increase awareness of green products through schemes such as The Indian Eco-mark Scheme, the Energy Efficiency Labelling Scheme in India, and the National Programme for Organic Production (NPOP), the results have been underwhelming due to limited engagement from industry stakeholders.

India is still in the nascent stages of green consumerism, with a growing number of individuals expressing interest in environmentally beneficial products. To facilitate this shift, policymakers and marketers must collaborate to educate consumers about the advantages of green products and the availability of green products can further enhance consumer awareness and understanding. Hence, the government must formulate policies that incentivize organizations to expand their production of green products, thereby fostering a more sustainable market environment.

2.1.2   Electric Cars in India

The government of India has taken steps to promote electric cars by reducing the Goods and Services Tax (GST) rate for these vehicles. However, this has created a dilemma for consumers, as they grapple with the decision of whether to invest in electric cars. One of the factors contributing to this uncertainty is the nascent stage of EV charging infrastructure in the country. It is projected that it will take 5-8 more years for electric vehicles to become a popular choice in India, despite the government's efforts to incentivize their adoption by reducing the GST rate (Sasikala P.S., 2019).

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[2] https://swachhbharatmission.ddws.gov.in/

Findings (Egbue et al. 2012) indicate variations in attitudes, knowledge, and perceptions concerning electric vehicles (EVs) across gender, age, and educational groups. Additionally, research suggests that while sustainability and environmental benefits play a significant role in EV adoption, they are ranked lower than cost and performance factors. Overall, there is a moderate to high level of interest in EVs despite reservations expressed about such vehicles Generally, attitudes towards EVs were neither entirely positive nor entirely negative (Egbue et al. 2012). However, while completely negative attitudes towards EV technology were minimal, they should not be disregarded (Egbue et al. 2012).

One significant obstacle to achieving widespread adoption of electric vehicles (EVs) is the uncertainty surrounding EV battery technology and the sustainability of the fuel source. Some of this uncertainty may stem from a lack of familiarity with EV technology, but it may also arise from scepticism among certain individuals who are unconvinced that EVs offer a superior option compared to currently available conventional vehicles (CVs). The fact that some question the sustainability and environmental performance of EVs in comparison to internal combustion engine (ICE) vehicles suggests that individuals with strong environmental awareness or values may not view purchasing an EV as environmentally beneficial (Egbue et al. 2012).

Current incentives, such as tax credits to subsidize the cost of EVs and fuel taxes, may have limited impact on EV market penetration if consumers lack confidence in EV technology. Therefore, it is imperative to implement measures aimed at increasing the market share of EVs. Some of these measures, already under exploration, include educational initiatives, greater investments in EV technology and infrastructure, battery swap programs, robust warranties on EV batteries, and potentially enhanced tax credits to offset the cost of EVs (Egbue et al. 2012).

High oil prices worldwide, harmful emissions, less traditional fuel, and more environmental worries have made people like eco-friendly cars more. Electric cars are becoming more popular because of this. Rich countries are leading this change, but poorer countries are also starting to join in. In India, there are more young people and families with some extra money, so more cars are being bought. By 2030, India might be a big leader in cars that people share. Big car companies from all over the world are coming to India to sell electric cars because they see a big market here. (Mahamuni, A., & Subramanian, S. 2021)

2.2 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is a theoretical framework used to understand and predict users' acceptance and adoption of new technologies. Developed by Fred Davis in the 1980s, TAM is widely employed in various fields, including information systems, marketing, and consumer behaviour.

The TAM (Technology Acceptance Model) has garnered substantial attention and recognition within the realm of technology acceptance research since its inception over a quarter-century ago. Originating from the psychological theories of TRA (Theory of Reasoned Action) and TPB (Theory of Planned Behaviour), TAM has emerged as a cornerstone model for comprehending the factors influencing human behaviour towards the acceptance or rejection of technology (Marangunić & Granić, 2015). Its robustness is evidenced by a plethora of studies showcasing its broad applicability across various technological domains.

Key components of the Technology Acceptance Model (TAM):

Perceived Usefulness: Perceived usefulness refers to the degree to which a person believes that using a particular technology will enhance their performance or productivity in achieving specific goals. It assesses the individual's perception of the technology's utility and benefits.

Perceived Ease of Use: Perceived ease of use refers to the degree to which a person believes that using a particular technology will be free of effort. It evaluates the individual's perception of how easy or difficult it is to use the technology.

Behavioural Intention: Behavioural intention represents an individual's readiness and willingness to adopt a technology. It is influenced by perceived usefulness and perceived ease of use. According to TAM, individuals with positive attitudes towards a technology's usefulness and ease of use are more likely to intend to use the technology.

Actual Use: Actual use refers to the extent to which individuals engage in behaviours associated with using the technology in real-world settings. It is influenced by behavioural intention and external factors such as access to the technology and social norms.

The Technology Acceptance Model suggests that users' perceptions of a technology's usefulness and ease of use directly influence their behavioural intention to adopt and use the technology. Furthermore, behavioural intention mediates the relationship between perceived usefulness and actual use, as well as between perceived ease of use and actual use. In essence, TAM posits that individuals are more likely to adopt and use a technology if they perceive it to be useful and easy to use.

Despite the progress made in uncovering new determinants impacting TAM's core constructs, there remain several unexplored avenues that could enhance the model's predictive validity (Marangunić & Granić, 2015).

2.2.1 Evolution of emission standards in India: Case of Bharat Stage Norms

To combat the harmful vehicular emissions the Indian government Introduced emission norms for petrol vehicles in 1992 and for diesel vehicles in 1992. Since 2000, Euro Norms have been followed in India under the name of Bharat Stage Emission standards (BS Norms) for 4 wheeled vehicles. BS3 norms were implemented in October 2010 across India (Economic times, 2023).

Upgrading the emission norms requires the manufacturing companies to upgrade their technology, which in turn increases the cost of the vehicle. Cost is one of the main reasons for the slow upgrade of emission standards. However, there are also arguments that the increase in cost is made up by savings in health costs as the pollutants causing diseases are decreased with the upgrade in emission standards. Fuels also play a crucial role in meeting these emission norms. Fuel specifications have also been aligned to its corresponding European production norms (Economic times, 2023).

Bharat Stage Emission Standards, parallel to European Emission standards adopted by Government of India in the year 2000 for HDVs and 4-wheeled LDVs. However, for 2- and 3-wheeled vehicles, India's emission regulations apply. The regulated pollutants for vehicular emissions are HC, CO, NOx and PM.

BS6 is the 6th iteration of the Emission norms, BS1 was launched in 2000, BS2 and BS3 were launched in 2005 and 2010 respectively, BS4 was launched and implemented in 2017, after a long gap of 7 years. BS6 is a substantial leap in comparison to BS4 in terms of reducing pollution. This is also because BS5 emission norms were skipped to move to a better emission norm.

The main differences between BS4 and BS6 are as follows (Acko, 2023):
- Under the BS6 norms the permissible limit of pollution has been drastically reduced. While the norm for NOx from diesel vehicles in BS4 is at 250mg/km, it is reduced to 80mg/km in BS6 emission norms. The HC+NOx has been reduced from 300mg/km in the BS4 to 170mg/km, while the PM level has been decreased from 25mg/km to 4.5mg/km.
- The BS6 emission norm is not only for motor vehicles but also for the fuel being dispensed. Sulphur and nitrogen oxide play an important role in petrol and diesel. Compared to the BS4, the BS6 fuel has less sulphur and NOx. While the content of sulphur in BS4 fuel is 50ppm, it is five times lower in the BS6 fuel, which is at 10 ppm. As for the nitrogen oxide, the permitted level has been reduced by 70% and 25% for diesel and petrol engines, respectively.
- Real Driving Emission (RDE) has been introduced in the BS6 norms to make sure the emission from the motor vehicle is measured on a real-time basis. This was not part of the BS4 norms.
- Another addition to the BS6 norms is the Onboard Diagnostic (OD) which is not mandated in the BS4 norms.
- A BS6 vehicle using BS4 fuel will not adhere to the required emission norms due to higher levels. Hence, a BS6 vehicle has to use only BS6 fuel to achieve the desired emission levels.

The sulphur content plays a critical role in emissions. India has already reduced the sulphur content in diesel engines from 10,000 ppm in 1999 to 50 ppm in 2017 by BS-IV emission norms. The estimated average on-road sulphur content in diesel engines is 16–50 ppm in 2019. The BS-VI emission norms proposed new standards for gasoline and diesel fuel quality to support the advanced aftertreatment technologies in BS-VI vehicles. The sulphur levels in BS-VI are limited to 10 ppm, where the sulphur levels were 50 ppm at BS-IV emission norms. This reduction in sulphur fuel content will aid in effective functioning of the aftertreatment

technologies. In addition to the reduction in sulphur fuel content, BS-VI also requires some additional fuel quality characteristics for taking into account engine's thermal efficiency and exhaust emissions. The availability of ultra-low sulphur fuel, which is necessary for BS-VI diesel engines, is a matter of great concern. The ultra-low sulphur fuel was available in different phases over different regions of the country. Delhi and NCR have started receiving the 10 ppm sulphur fuel content since April 2018 and many cities in India started receiving the same since January 2019. By October 2019, the entire NCR Delhi switched to BS-VI fuel. By the end of 2019, almost all refinery stations in India started producing the 10 ppm sulphur fuel. With the BS-VI sulphur fuel standards, the advanced aftertreatment technologies are expected to reduce the vehicular emissions by ~90% (Gajbhiye et al. 2023) The transition to BS6 emission standards in India represents a significant milestone for the automotive industry and the environment. Researching its transition is crucial to understanding its implications on multiple fronts, including environmental impact, technological advancements, market dynamics, industry challenges and opportunities and policy and regulatory implications. By gaining insights into these aspects, researchers can contribute to a more sustainable and efficient automotive industry while addressing the urgent need to combat air pollution and promote cleaner mobility solutions.

Regulations continue to get tighter throughout the world, with major regions such as China and India adopting some of the strictest measures. These developments are happening in conjunction with increased focus on reducing GHG emissions and achieving all of this under real-world driving conditions. This talk will give an overview of some of these regulatory trends and also the accompanying technology developments on the engine side as well as the after-treatment systems.

The Environmental Impact

Numerous studies have extensively investigated the environmental impact of transitioning from BS4 to BS6 emission standards. Recent research conducted by Vats et al. (2022) has shed light on the significant disparities between these two standards, particularly in terms of PM (particulate matter), sulphur, and nitrogen oxide (NO_x) emissions. The study by Vats et al. (2022) reveals that the key distinction between BS4 and BS6 emission standards lies in the concentration of PM, sulphur, and NO_x traces. BS4 fuel is found to contain sulphur traces that are five times higher than those present in BS6 fuel. When the BS4 standards were implemented

in April 2017, the sulphur content in BS4 fuel stood at 50 parts per million (ppm). However, the introduction of BS6 standards led to a further reduction in the sulphur content of gasoline and diesel fuels to as low as 10 ppm (Sathiamoorthy & Bandivadekar, 2020).

The transition from BS4 to BS6 emission standards is projected to result in substantial reductions in PM and NO_x emissions. Naik et al. (2017) reported that PM emissions are expected to decrease by approximately 66%, while NO_x emissions are anticipated to decrease by 88%. In summary, recent studies have shown that the shift from BS4 to BS6 emission standards brings about notable improvements in terms of reduced sulphur, PM, and NO_x emissions. The sulphur content in BS6 fuel is significantly lower compared to that in BS4 fuel, and the implementation of BS6 standards is expected to lead to significant reductions in PM and NO_x emissions, contributing to a more environmentally friendly transportation sector (Joshi, A., & Johnson, T).

Technological Impact

The implementation of BS6 emissions standards has spurred significant technological advancements within the automotive industry. Meeting the emission limits outlined in BS6 necessitates the integration of ample engine electronics. Consequently, this has created growth opportunities for both domestic and multinational automotive electronic suppliers. Additionally, vendors and engineering solution providers specializing in eco testing, fuel system testing, and emission testing are expected to experience substantial benefits (Mirgal, N., 2017). Because of the transition to BS6 standards, we can anticipate the emergence of more fuel-efficient vehicles with significantly reduced emissions soon. Downsizing and down speeding strategies will result in smaller yet more powerful engines. However, the increased after treatment requirements for diesel vehicles will lead to higher costs. This may incentivize original equipment manufacturers (OEMs) to explore alternative fuels and hybrid technologies (Mirgal, N., 2017).

According to Pothumsetty and Thomas (2020), it has been observed that modern engines require fuel with very low sulphur content to ensure optimal performance. The transition from BS4 to BS6 emission norms can play a crucial role in reducing air pollution caused by automobiles. This transition is expected to have a significant positive impact on the air quality of densely populated cities, as vehicle exhaust emissions are a major contributor to urban air

pollution. The study also highlighted the strategies employed by foreign car manufacturers to adapt to the shift from BS4 to BS6. Furthermore, researchers could explore the sales strategies implemented by leading car manufacturers to sell their existing BS4-compliant vehicles in inventory. This line of investigation would provide valuable insights into the industry's response to the transition.

The literature review comprehensively examines both the Theory of Planned Behaviour (TPB) and the Technology Acceptance Model (TAM), elucidating their core components: attitudes, subjective norms, and perceived behavioural control for TPB, and Perceived Usefulness and Perceived Ease of Use for TAM. These components collectively shape behavioural intentions and subsequent actions.

The review delves into the intricate interplay of culture, gender, and consumer behaviour in the context of green purchases in India, emphasizing the pivotal role of women and the prevalence of collectivist values. It also scrutinizes the promotion of electric cars in the country, spotlighting governmental initiatives, consumer sentiments, and obstacles such as infrastructural limitations and advancements in battery technology.

In addition, it highlights the imperative for policy interventions aimed at incentivizing the production of environmentally friendly goods and the widespread adoption of electric vehicles, thus fostering sustainability within the market.

2.3 Theoretical Framework

In our study, we have expanded upon both, the Theory of Planned Behaviour (TPB) and the Technology Acceptance Model (TAM) by integrating additional factors, creating a more comprehensive theoretical framework. The models have been adapted and expanded to suit the Indian context . Within the TPB framework, we've incorporated Governmental incentives and policies related to cleaner fuel vehicle purchases, alongside considerations of the technological performance of cleaner fuel vehicles. These additions aim to deepen our understanding of the factors influencing consumer attitudes and behaviours regarding the adoption of cleaner technology vehicles.

Within the TAM framework, we've integrated variables such as personal and household income, educational background, societal attitudes, and governmental policies. This expanded model seeks to elucidate the multifaceted nature of consumer decision-making processes in adopting cleaner fuel technologies.

Our utilization of the TPB will facilitate a thorough exploration of adoption patterns and preferences for cleaner technology vehicles among respondents. Simultaneously, the TAM will allow us to assess consumer willingness to pay for cleaner fuel technology vehicles, considering various socio-economic and environmental factors.

By using these enhanced theoretical models alongside an examination of consumer awareness regarding clean technology vehicles, our study aims to comprehensively evaluate the attitudes and willingness to pay for cleaner fuel technology vehicles among middle to high-income consumers in India. Ultimately, this integrated approach will provide valuable insights to inform strategies for promoting the adoption of cleaner fuel technologies and advancing sustainable transportation practices in the country.
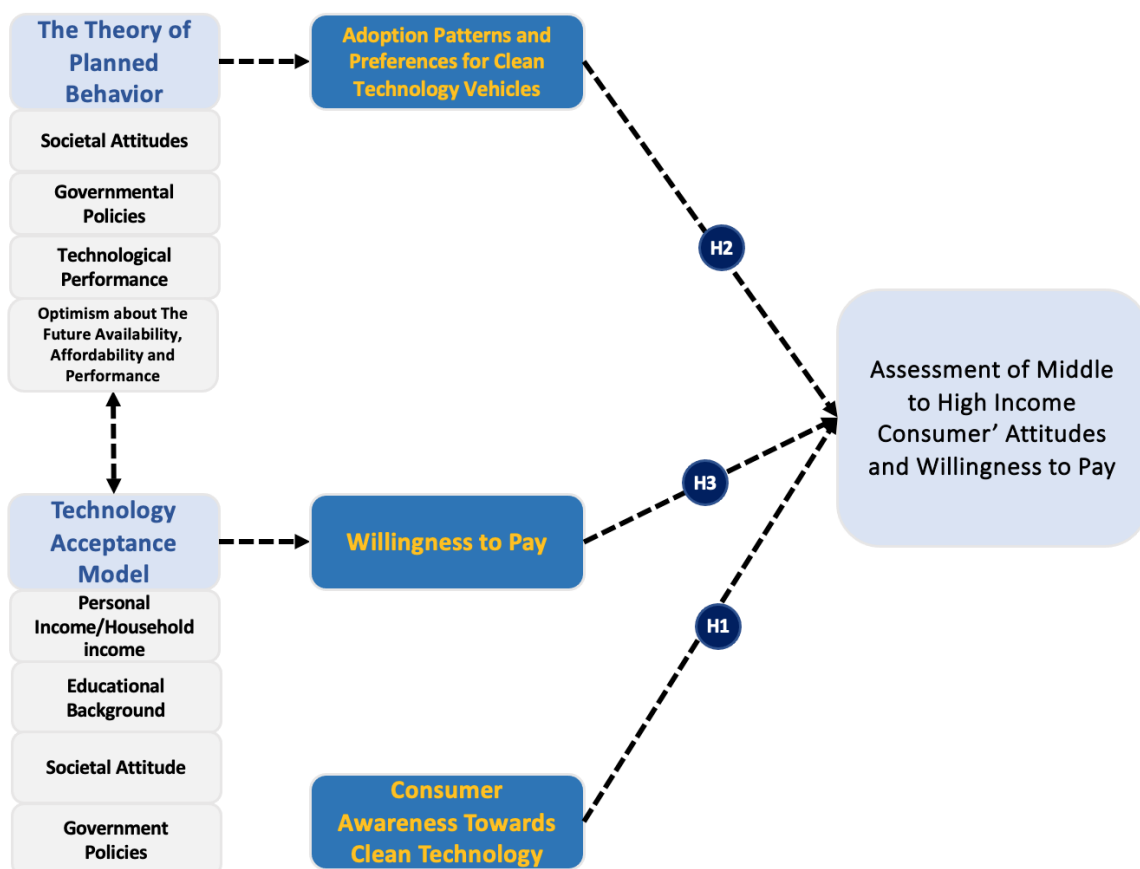
Figure 1 Theoretical Framework

2.4 Hypothesis

Building upon the foundation laid by existing literature and the theoretical framework delineated in *Figure 1*, the study seeks to address the following hypotheses:

1. **Hypothesis (H1):** Consumers exhibit a high level (60%) of awareness of the current emission standards in India (BS6) and demonstrate a comprehensive understanding of the transition towards cleaner vehicle technologies mandated by these standards.
2. **Hypothesis (H2):** Consumers' perceptions about the technology performance, societal attitudes and Government policies towards greener vehicles significantly influence adoption of cleaner technology Vehicles.
3. **Hypothesis (H3):** Consumers' willingness to pay (WTP) for cleaner technology fuel vehicles are influenced by multiple factors

    *   H3.A: Environmental consciousness influences consumer's wtp for cleaner fuel technology vehicles

    *   H3.B: Consumers' individual and household income influences their consumer's wtp for cleaner fuel technology vehicles

    *   H3.C: Socio-Demographic factors influences consumer's wtp for cleaner fuel technology vehicles

Chapter 3. Methodology

The research methodology employed in this study encompasses the utilization of an online survey questionnaire to test hypotheses about consumer attitudes and willingness to pay for cleaner fuel technologies. The survey targeted middle to high-income consumers within the Indian automotive market, recognizing that while this demographic represents a smaller portion of the overall Indian population, they play a crucial role in shaping preferences and trends within the automotive industry. Conducting the survey in English, despite its limitations in capturing insights from a broader demographic, was a strategic decision considering the

relatively higher English proficiency among middle to high-income consumers in India. This approach allowed us to gain valuable insights into the preferences, attitudes, and behaviors of this target segment, which are vital for understanding and catering to the needs of car companies operating in India.Over a span of 10 days, a total of 102 responses were gathered, employing the snowball sampling (Bryamn, 2016) method to ensure a diverse pool of survey participants. The questionnaire was designed to capture comprehensive information on respondents' demographics and social factors, allowing for a nuanced analysis of consumer preferences and behaviours. The survey sample is reflective of the diverse demographics characteristic of the Indian automotive market, encompassing consumers from various socio-economic backgrounds, age groups, and geographic locations, particularly focusing on regions within North India. This inclusive approach ensures a robust and representative dataset, facilitating a comprehensive understanding of consumer perspectives on cleaner fuel technologies across different segments of the population.

3.1 Survey Questionnaire

For this research, data collection was facilitated through a survey questionnaire distributed using the snowball sampling method. Linear snowball sampling (Bryman, 2016) is a process where a sample population is gathered one individual at a time through referrals. Initially, one person is selected and added to the sample. This person then refers another individual, who is subsequently added to the sample. The process continues with each new participant referring the next individual until the desired sample size is reached. The questionnaire comprised 32 questions designed to delve into various themes pivotal for comprehending consumer perceptions and awareness regarding cleaner fuel technologies and norms. These questions were categorized into distinct sections: Current Vehicle Ownership, Assessment of government incentives and policies, Identification of concerns and barriers related to transitioning, Evaluation of peer recommendations and social factors, Assessment of vehicle performance perception, Exploration of willingness to pay, and Examination of future expectations and trends. To ensure the questionnaire's robustness, it was vetted by 3 employees of leading Indian car manufacturing companies.

Name	Company	Position

Ayush Kuwala	Ather	Senior Lead Development Manager
Vikas Lathwal	Maruti Suzuki India Ltd.	Senior Brand Manager
Dhruv Verma	KTM India	Area Sales Manager

The Survey Questionnaire:

1. Age
2. Gender
3. What is your educational background?
4. What is your current employment status?
5. What is your work industry?
6. Are you Married?
7. How many dependents do you have? (In your family)
8. Personal Income Per Annum (In INR)
9. Household income Per Annum (In INR)
10. How many cars do you own?
11. What type of car/s do you currently own?
12. How frequently do you use your car/s?
13. Are you satisfied with the emissions performance of your current vehicle?
14. Are you aware of any government policies or incentives promoting the adoption of cleaner vehicle technologies?
15. Which policies are you aware of?
16. Have you considered any government subsidies or tax benefits when contemplating purchasing a vehicle?
17. Do you think government policies influence consumer decisions regarding vehicle purchases?
18. Are you aware of the Bharat Stage 6 (BS6) norms in vehicular emissions?
19. Is your vehicle BS6 compliant?
20. What is your primary concern about transitioning to a BS6-compliant vehicle?
21. Do you anticipate any challenges in finding BS6-compliant vehicles in the market?

22. Are there any specific barriers preventing you from considering a cleaner technology vehicle?
23. Are you willing to pay more for a cleaner technology vehicle?
24. If yes (in the above question), how much more will you be willing to pay for a cleaner technology vehicle?
25. Would you be more likely to consider purchasing a BS6-compliant vehicle if recommended by friends or family?
26. How much importance do you place on the environmental choices of yourself and your family members while making your vehicle purchase decisions?
27. Do you think societal attitudes towards environmental responsibility impact consumer choices regarding vehicle purchases?
28. How important is vehicle performance to you when choosing a new vehicle?
29. Do you believe BS6-compliant vehicles offer comparable performance to older, non-compliant models?
30. Do you anticipate a significant increase in the adoption of cleaner technology vehicles in the coming years?
31. What do you think will be the most significant factors driving consumer preferences towards cleaner vehicle technologies in the future?
32. Are you optimistic about the future availability, affordability and performance of cleaner technology vehicles?

Chapter 4. Results

4.1 Survey Descriptive

The survey comprised a comprehensive set of 32 questions designed to elicit insights into various aspects of consumer attitudes and behaviours towards cleaner fuel technologies. A total of 102 responses were collected, providing a rich dataset for analysis. The questionnaire was structured into distinct categories of inquiry, covering topics such as Current Vehicle Ownership, Assessment of government incentives and policies, Identification of concerns and

barriers towards transitioning, Influence of peer recommendations and social factors, Perception of vehicle performance, Willingness to pay, and Future expectations and trends.

In terms of demographic representation, the survey sample exhibited notable characteristics. Approximately 48% of respondents fell within the 24-35 age bracket *(See figure 2)* , indicative of a relatively mature and working-class sample. Gender distribution was fairly balanced, with 54.9% of respondents identifying as male and 45.1% as female *(See figure 3)*, closely mirroring the official sex ratio of the total Indian population. Education levels among respondents were notably high, with 51% holding a master's degree and 9.8% having completed a PHD, *(See Figure 4)* underscoring the highly educated nature of the sample.
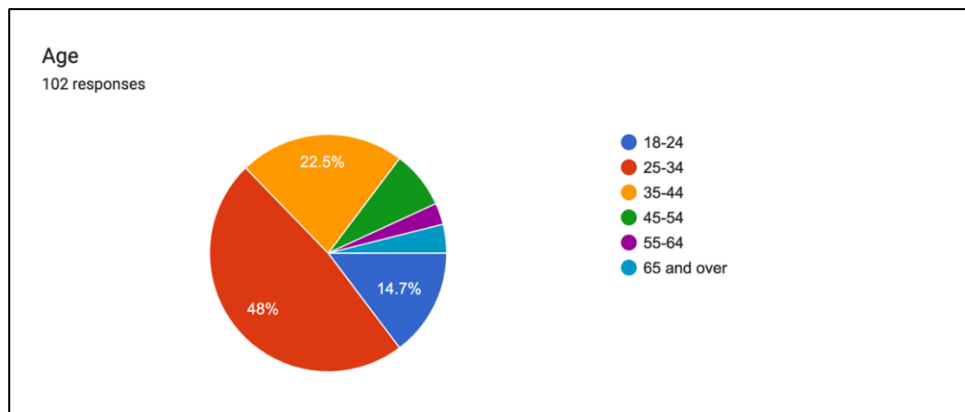
Figure 2 Age Profile of Respondents
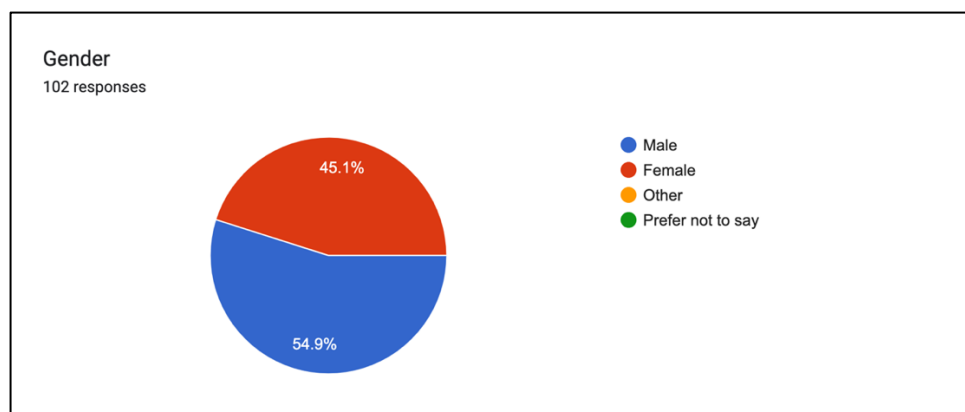
Figure 3 Age of Respondents
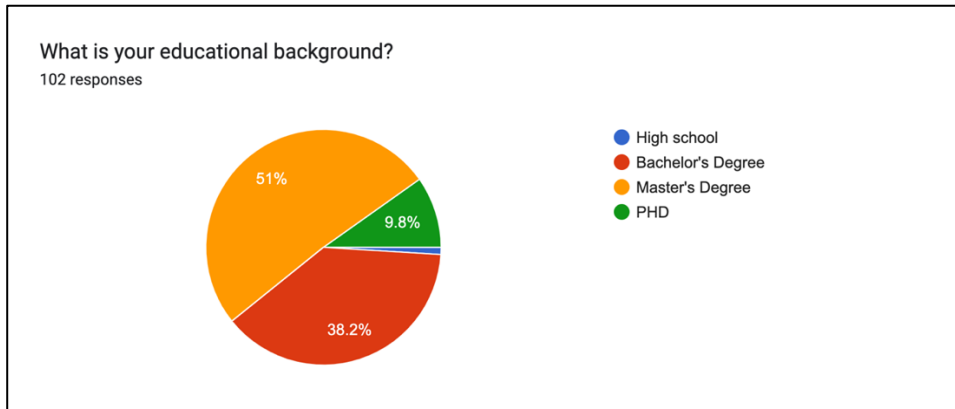
Figure 4 Educational Background of consumers

Financially, the sample group skewed towards higher income brackets, with 45.1% of respondents reporting annual earnings between 12-25 lacs Rupees (1.2 Million Rupees-2.5 Million Rupees) *(See Figure 9),* indicative of a predominantly affluent cohort. A significant majority of respondents, comprising 89%, reported ownership of at least one car, highlighting the prevalence of car ownership within the surveyed population. These survey descriptives collectively provide valuable insights into the demographic composition and characteristics of the sample, laying the groundwork for a nuanced analysis of consumer attitudes and behaviours towards cleaner fuel technologies.
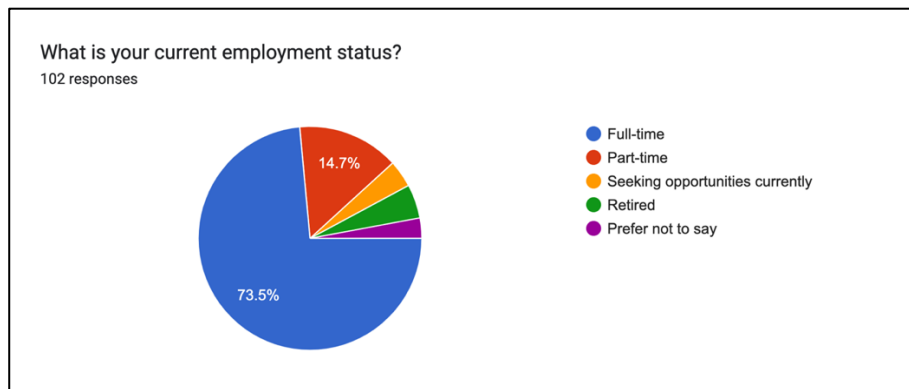
Figure 5 Employment Status of Respondents
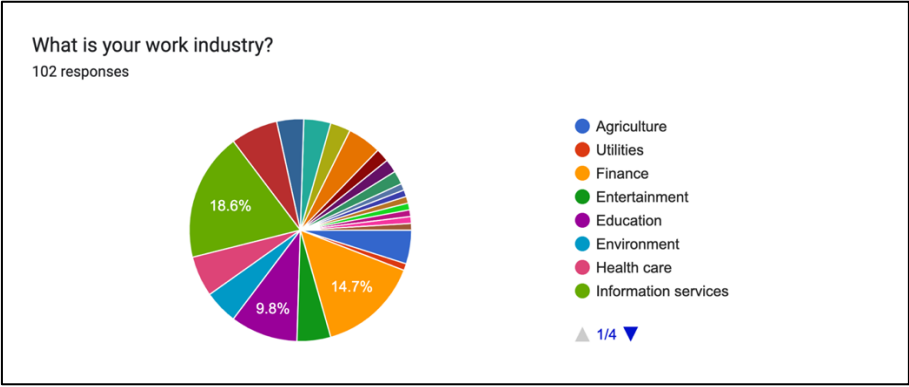
Figure 6 Work Industry of Respondents
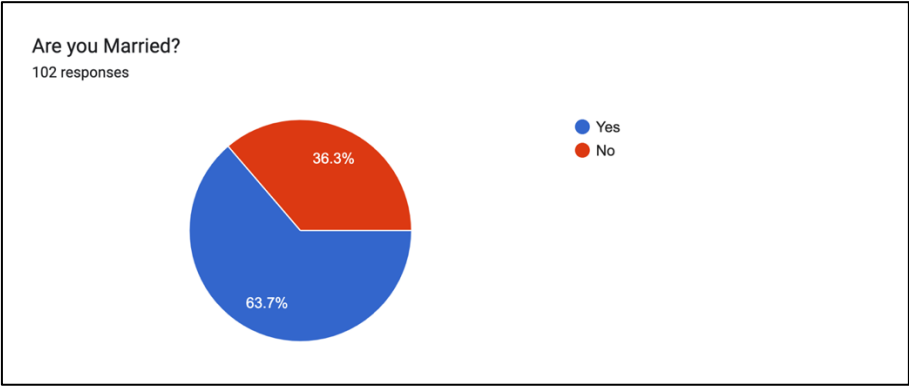
Figure 7 Marital Status of Respondents
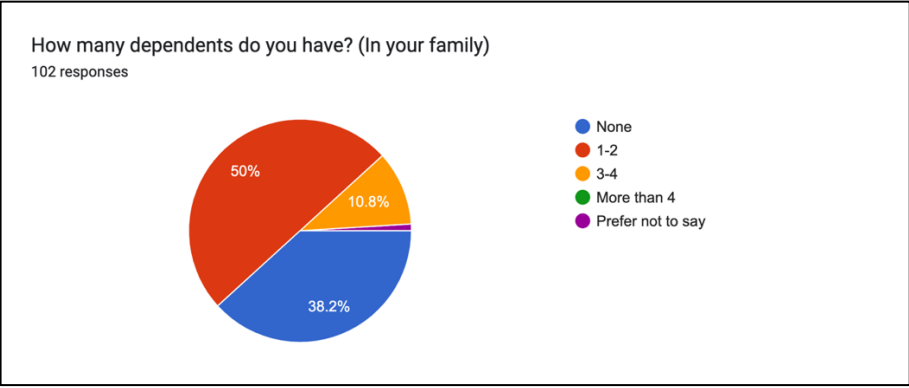
Figure 8 Dependents in the Family
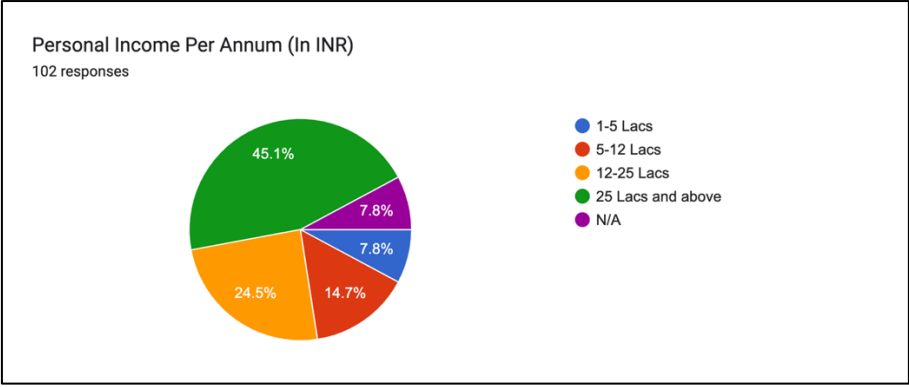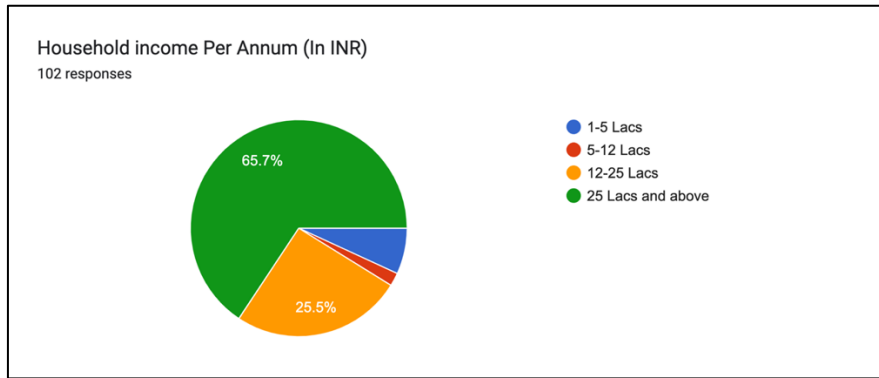

Figure 9 Personal Income of Respondents

Figure 10 Household Income of Respondents

The survey revealed insights into respondents' usage patterns and satisfaction levels regarding their vehicles. A significant majority, comprising 82.8 percent of the respondents, indicated frequent utilization of their car/s, underscoring the integral role of automobiles in their daily lives *(See Figure 11)*. Additionally, an overwhelming majority, accounting for 88.3 percent of respondents, expressed satisfaction with the emissions performance of their car/s *(See Figure 12)*, suggesting a positive perception of environmental impact and aligning with efforts towards cleaner fuel technologies. These findings offer valuable indications of consumer behaviour and attitudes towards vehicle usage and emission standards, informing potential strategies for promoting eco-friendly mobility solutions.
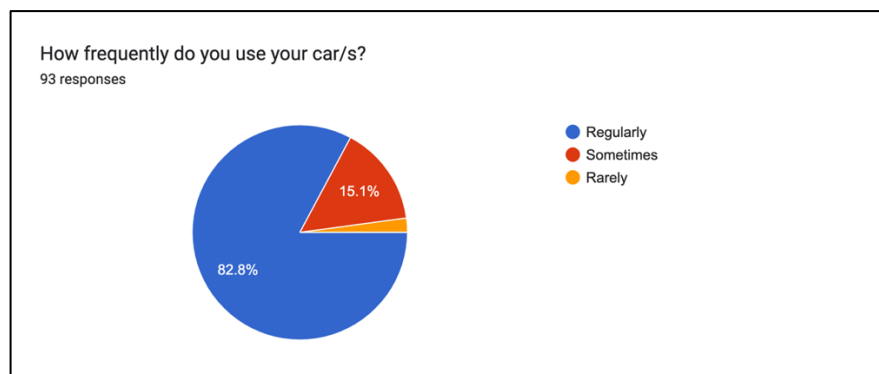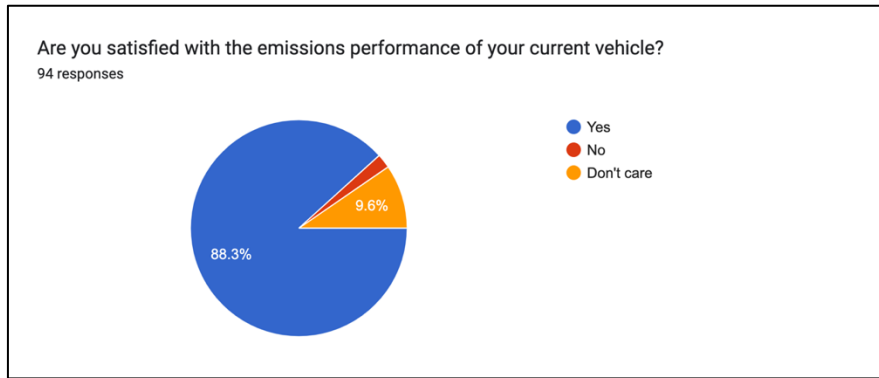

Figure 11 Car Usage

Figure 12 Current Vehicle Emissions Satisfaction

Further analysis of the survey data revealed noteworthy insights into respondents' awareness and perceptions of governmental policies and incentives related to cleaner vehicle technologies. A considerable majority, comprising 68.6 percent of respondents, demonstrated awareness of governmental initiatives aimed at promoting the adoption of cleaner vehicle technologies *(See Figure 13)*, highlighting a growing recognition of environmental sustainability efforts within the automotive sector. However, when queried about the consideration of government subsidies or tax benefits during vehicle purchase deliberations, a striking 80% of respondents indicated that they had not factored such incentives into their decision-making process *(See Figure 15)*. Despite this, a substantial 91.2 percent of respondents acknowledged the influential role of government policies in shaping consumer decisions regarding vehicle purchases *(See Figure 16)*, underscoring the perceived significance of regulatory frameworks and incentives in influencing market dynamics and consumer behaviour. These findings shed light on the complex interplay between governmental interventions, consumer awareness, and purchasing decisions in the context of cleaner vehicle technologies, informing potential strategies for enhancing policy effectiveness and consumer engagement in sustainable transportation initiatives.
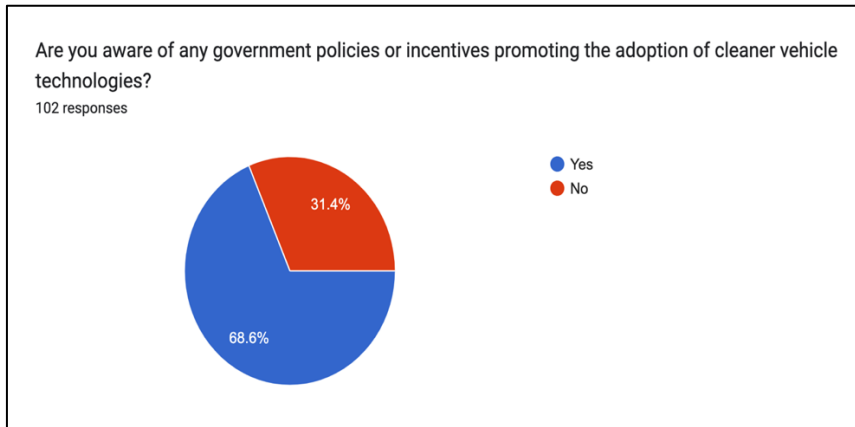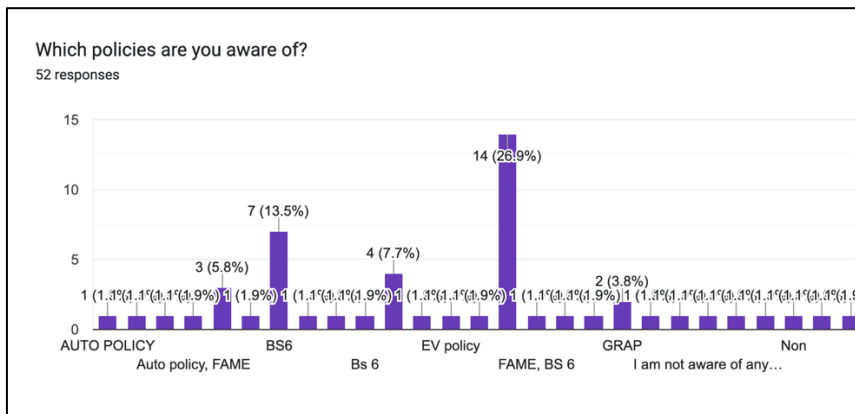
Figure 13 Government Policies Awareness

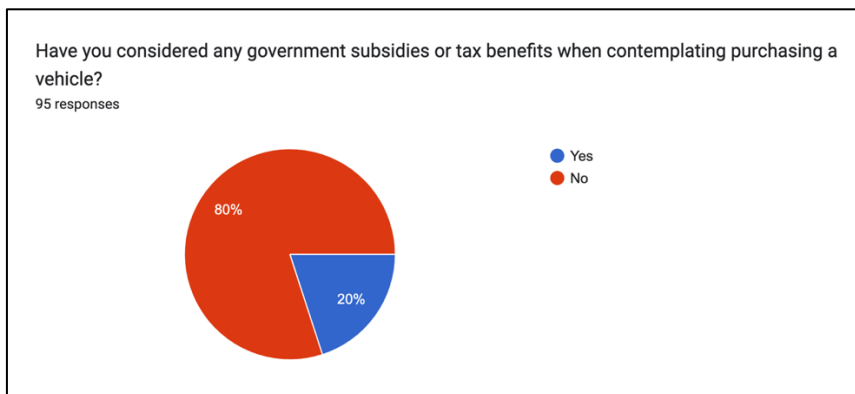*Figure 14 Government Policies Awareness (2)*

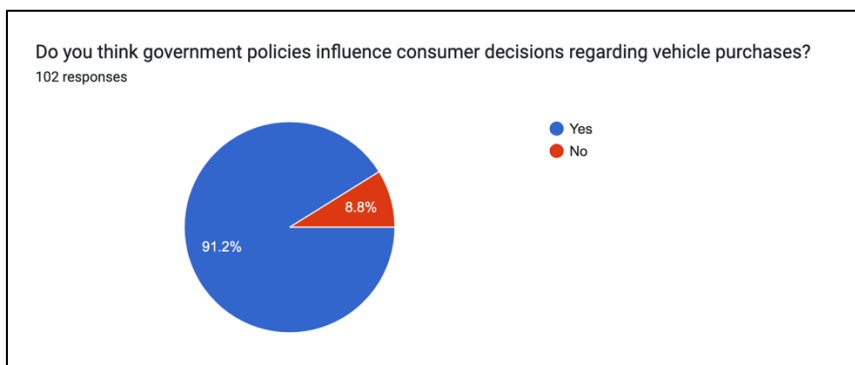*Figure 15 Government Subsidies Consideration*

Figure 16 Government Policies Influence Regarding Vehicle Purchase

Insights garnered from the survey regarding awareness and perceptions of Bharat Stage VI (BS6) emission standards in India shed light on key trends and considerations among respondents. An overwhelming majority, comprising 82.4 percent of respondents, demonstrated awareness of the BS6 norms *(See Figure 17)*, indicating a widespread understanding of the regulatory framework governing vehicle emissions. Impressively, 76.5 percent of respondents reported already owning a BS6 compliant vehicle *(See Figure 18)*, suggesting a significant uptake of cleaner fuel technologies within the surveyed population.

When queried about concerns regarding the transition to BS6 compliant vehicles, intriguing patterns emerged. While 44.6 percent of respondents expressed no concerns about transitioning, a notable proportion, accounting for 35.6 percent, identified cost as the primary concern, underscoring the economic considerations associated with upgrading to cleaner fuel technologies. Additionally, 16.8 percent of respondents cited performance as a major concern *(See Figure 19)*, highlighting the importance of ensuring that BS6 compliant vehicles meet consumers' performance expectations.

Despite these concerns, the survey revealed positive sentiments regarding the availability and performance of BS6 compliant vehicles. An impressive 81.4 percent of respondents reported no challenges in finding BS6 compliant vehicles in the market *(See Figure 20)*, indicating the widespread availability of such models. Furthermore, a majority, comprising 65.7 percent of respondents, perceived BS6 compliant vehicles as offering comparable performance to older non-compliant models *(See Figure 21)*, suggesting confidence in the technological advancements underlying cleaner fuel technologies.

Interestingly, social influence emerged as a significant factor influencing consumer preferences towards BS6 compliant vehicles. A substantial 76.5 percent of respondents indicated being more likely to consider purchasing a BS6 compliant vehicle if recommended by friends or family *(See Figure 22)*, highlighting the influential role of peer recommendations in shaping consumer behaviour.

These survey findings offer valuable insights into consumer awareness, perceptions, and preferences regarding BS6 emission standards, providing nuanced perspectives on the challenges and opportunities associated with the transition to cleaner fuel technologies in India.
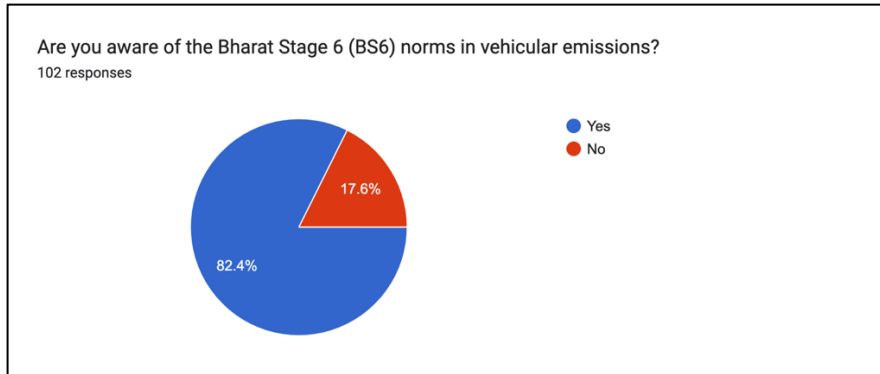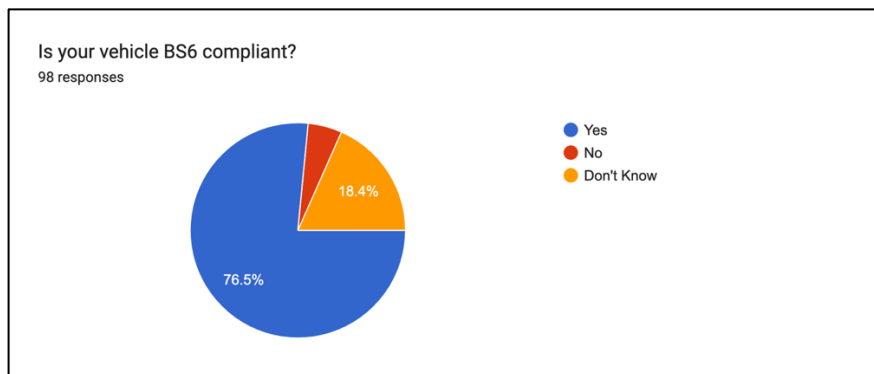

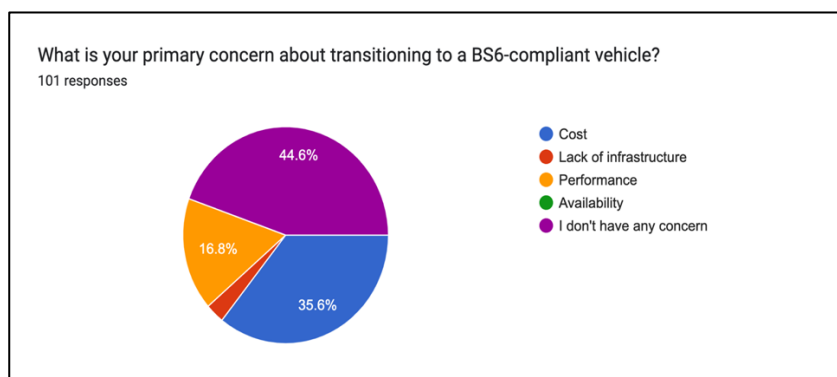*Figure 17 BS6 Awareness*

Figure 18 BS6 Vehicle Compliance

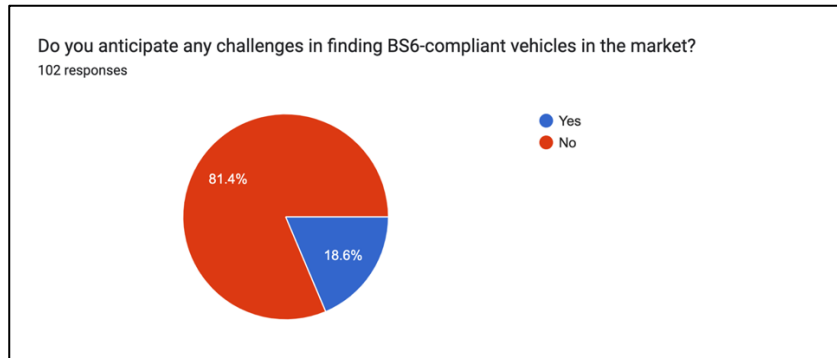*Figure 19 Primary Concern About Transitioning to BS6 Vehicle*

Figure 20 BS6 Anticipation Challenges
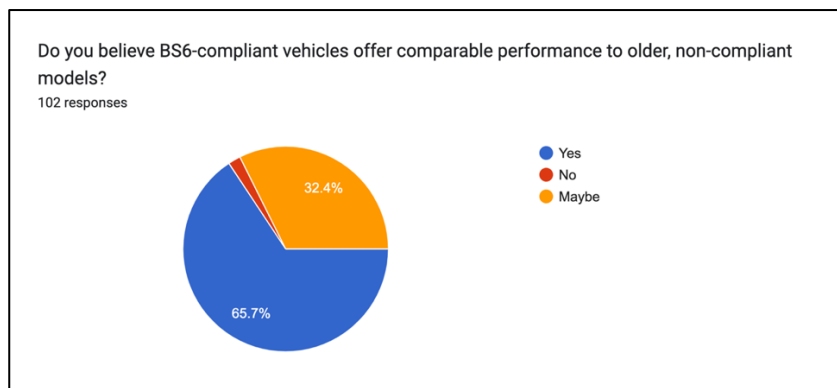
Figure 21 BS6 Vehicles Performance
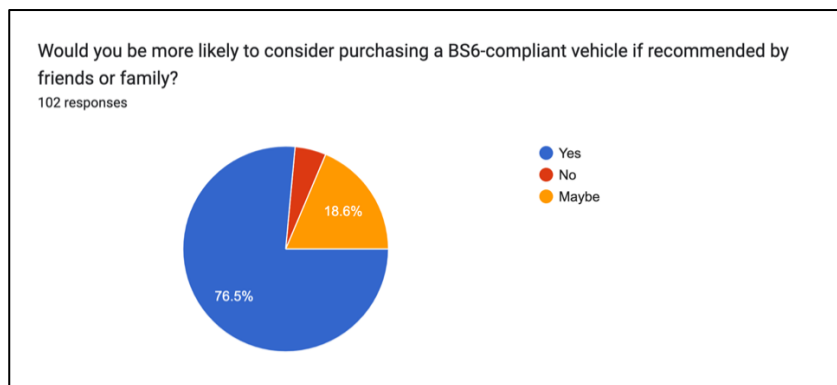
Figure 22 BS6 Recommendation by friends or family

Insights from the survey show that most people think the main reason they don't consider buying a cleaner technology vehicle is because it costs too much, according to 87.3% of respondents *(See Figure 23)*. However, about half of the respondents, 51%, are willing to pay extra for a cleaner technology vehicle, even though it costs more upfront *(See Figure 24)*.

When we looked closer at the group of people who are willing to pay extra, we found that 58.2% of them are ready to pay 10% more for a cleaner technology vehicle. Another 34.2% are

willing to pay even more, up to 20% extra *(See Figure 25)*. These findings suggest that while cost is a big concern, many people are still willing to invest a bit more in cleaner technology if it means helping the environment.
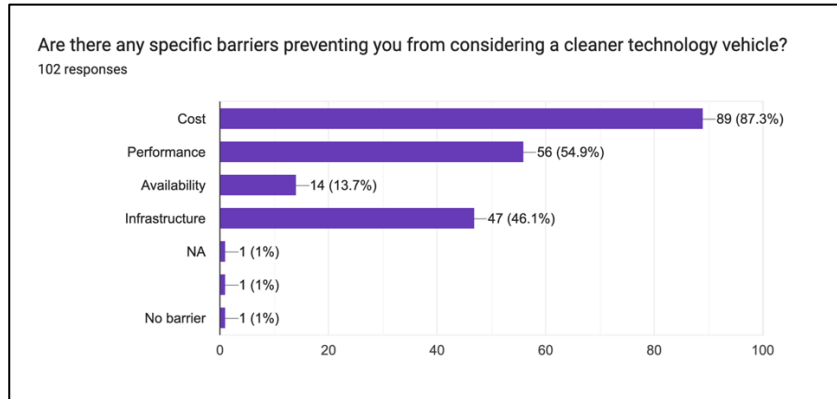
Figure 23 Cleaner Technology Vehicle Adoption Barriers
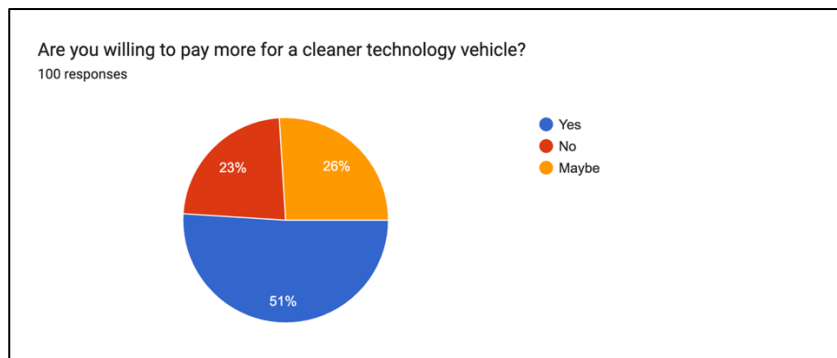
Figure 24 WTP for Cleaner Technology Vehicle
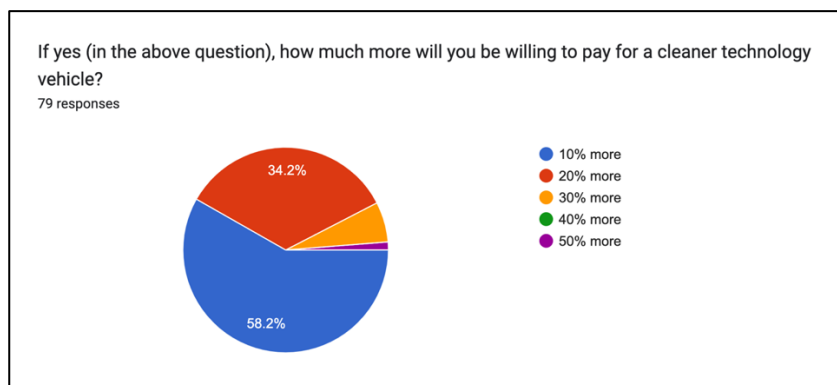
Figure 25 WTP for Cleaner Technology Vehicle (2)

The survey also revealed that 48% of respondents place a significant emphasis on the environmental choices made by their family members when deciding which vehicle to purchase *(See Figure 26)*.
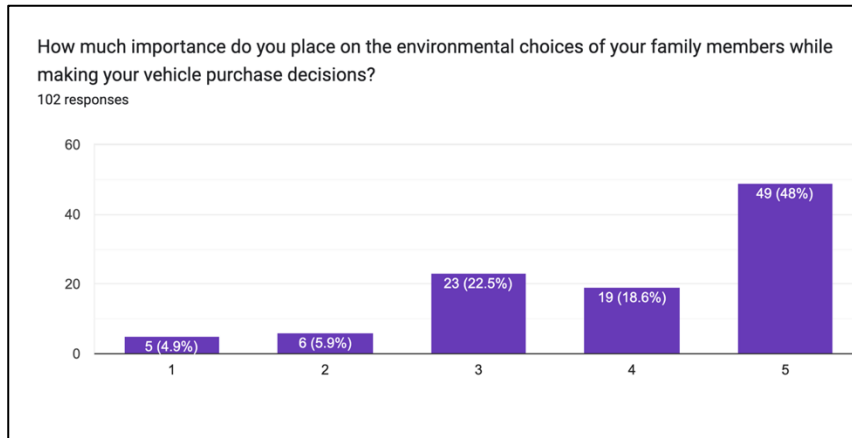
Figure 26 Environmental Choices of Family Members

76.5 percent of respondents acknowledged the influence of societal attitudes towards environmental responsibility on consumer decisions regarding vehicle purchases *(See Figure 27).*
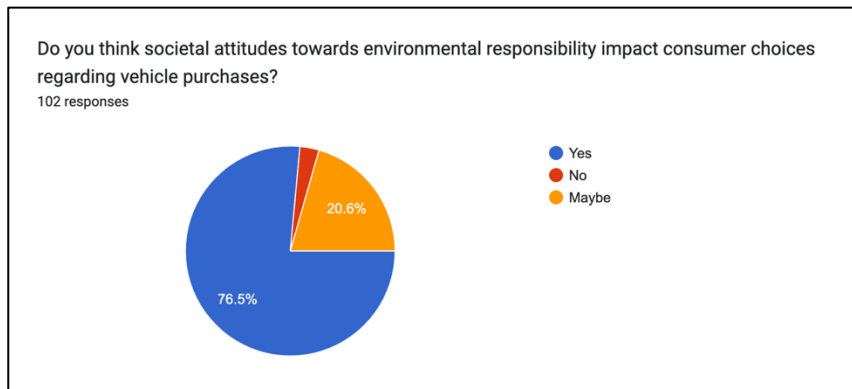
Figure 27 Societal Attitudes Towards Environment Responsibility

76.5 percent of respondents emphasized the importance of vehicle performance when selecting a new vehicle *(See Figure 28).*
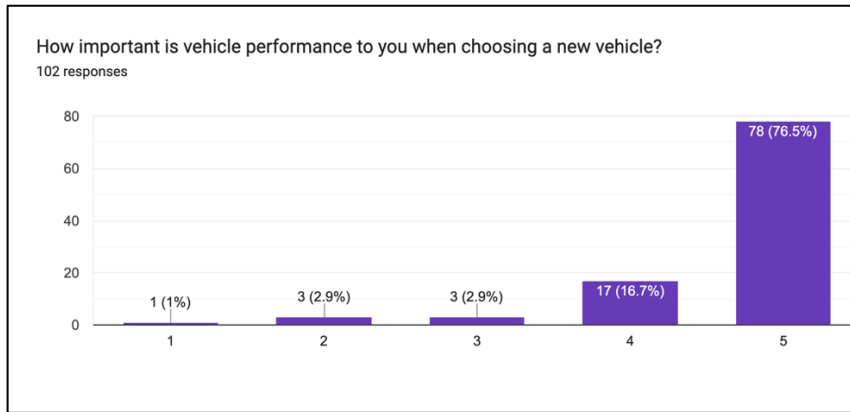
Figure 28 Importance of Vehicle Performance

survey indicate optimistic sentiments among respondents regarding the future of cleaner fuel technologies in the automotive industry. A substantial majority, comprising 78.4 percent of respondents, anticipate a significant increase in the adoption of cleaner fuel technology vehicles in the coming years *(See Figure 29)* , reflecting a positive outlook on the trajectory of eco-friendly mobility solutions. Additionally, an overwhelming 88.2 percent of respondents express optimism regarding the future availability, affordability, and performance of cleaner technology vehicles *(See Figure 30)*, underscoring confidence in the ongoing advancements and innovations within the automotive sector. These findings suggest a strong belief in the potential for cleaner fuel technologies to drive positive change and shape the future of transportation towards a more sustainable and environmentally conscious direction.
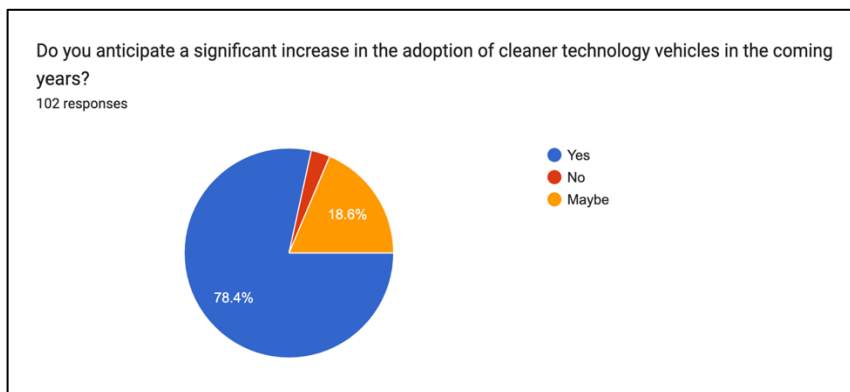
Figure 29 Cleaner Technology Vehicle Adoption Anticipation
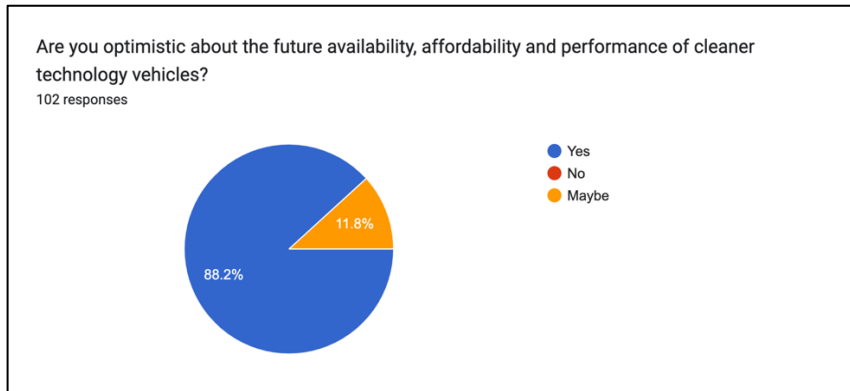
Figure 30 Optimism About Future Availability, Affordability and performance of cleaner Technology Vehicle

4.2 Results

1   **Hypothesis (H1):** Consumers exhibit a high level (more than 60%) of awareness of the current emission standards in India (BS6) and demonstrate a comprehensive understanding of the transition towards cleaner vehicle technologies mandated by these standards.

Are you aware of the Bharat Stage 6 (BS6) norms in vehicular emissions?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	18	17.6	17.6	17.6
	Yes	84	82.4	82.4	100.0
	Total	102	100.0	100.0	

Do you anticipate any challenges in finding BS6-compliant vehicles in the market?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	83	81.4	81.4	81.4
	Yes	19	18.6	18.6	100.0
	Total	102	100.0	100.0	

Is your vehicle BS6 compliant?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		4	3.9	3.9	3.9
	Don't Know	18	17.6	17.6	21.6
	No	5	4.9	4.9	26.5
	Yes	75	73.5	73.5	100.0
	Total	102	100.0	100.0	

82.4% of the respondents were aware of the BS6 emission standards.

73.5% of the respondents already own a BS6 compliant Vehicle.

81.4% of the respondents don't anticipate any challenges in finding BS6 compliant Vehicles in the market.

Hence, H1 is supported.

2. **Hypothesis (H2):** Consumers' perceptions about the technology performance, societal attitudes and Government policies towards greener vehicles significantly influence adoption of cleaner technology Vehicles.

ACT: anticipation of a significant increase in the Adoption of Cleaner Technology vehicles in the coming years.

SA: The impact of Societal Attitudes towards environmental responsibility on consumer choices regarding vehicle purchases.

GP: The influence of Governmental Policies on consumer decisions regarding vehicle purchases

FAAP: Optimism about The Future Availability, Affordability and Performance of cleaner technology vehicles.

PC: BS6 Vehicles offer Performance Comparable to older non-compliant vehicles

Correlation Matrix

	PC	FAAP	GP	SA	ACT
PC	1				
FAAP	.359**	1			
GP	.445**	.316**		1	
SA	.441**	.289**	.470**	1	
ACT	.640**	.551**	.414**	.384**	1

**. Correlation is significant at the 0.01 level (2-tailed).   Matrix 1

Interpreting the correlation matrix, we can infer that:

- Performance and Societal Attitudes: Since there is a significant positive correlation between consumers' perceptions about performance (PC) and societal attitudes (SA) towards environmental responsibility, we would expect that consumers who perceive cleaner technology vehicles as performing comparably to older non-compliant vehicles and have positive societal attitudes towards environmental responsibility are more likely to adopt cleaner technology vehicles.

- Performance and Government Policies: Similarly, there is a significant positive correlation between consumers' perceptions about performance (PC) and governmental policies (GP) regarding cleaner technology vehicles. This suggests that consumers who believe that governmental policies support the adoption of cleaner technology vehicles and perceive these vehicles as performing well are more inclined to adopt them.

- Societal Attitudes and Government Policies: While there is a positive correlation between societal attitudes (SA) and governmental policies (GP), it is not as strong as the correlations observed with performance (PC). Nonetheless, this correlation suggests that societal attitudes towards environmental responsibility and governmental policies supporting greener vehicles are related, implying that consumers who hold positive societal attitudes are likely to favor governmental policies that promote cleaner technology vehicles.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.732[a]	.536	.517	.547

a. Predictors: (Constant), SA, FAAP, PC, GP

b. Dependent Variable: ACT

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-.421	.435		-.968	.335
	Do you think government policies influence consumer decisions regarding vehicle purchases?	.217	.229	.079	.950	.345
	Are you optimistic about the future availability, affordability and performance of cleaner technology vehicles?	.846	.184	.348	4.592	<.001
	Do you believe BS6-compliant vehicles offer comparable performance to older, non-compliant models?	.387	.070	.461	5.568	<.001
	Do you think societal attitudes towards environmental responsibility impact consumer choices regarding vehicle purchases?	.042	.079	.044	.532	.596

a. Dependent Variable: Do you anticipate a significant increase in the adoption of cleaner technology vehicles in the coming years?

Based on the regression Model we can see that R-Square value is 0.536, which means that our independent variables i.e SA, FAAP, PC, GP cause 53.6% change in our dependent variable i.e ACT

based on the correlation matrix and the regression model, the hypothesis (H2) is supported. That is, consumers' perceptions about the performance of cleaner technology vehicles, societal

attitudes towards environmental responsibility, and governmental policies supporting greener vehicles significantly influence the adoption of cleaner technology vehicles.

Hypothesis (H3): Consumers' willingness to pay (WTP) for cleaner technology fuel vehicles are influenced by multiple factors

- H3.A: Environmental consciousness influences consumer's wtp for cleaner fuel technology vehicles

- H3.B: Consumers' individual and household income influences their consumer's wtp for cleaner fuel technology vehicles

- H3.C: Socio-Demographic factors influences consumer's wtp for cleaner fuel technology vehicles

Are you willing to pay more for a cleaner technology vehicle?
100 responses
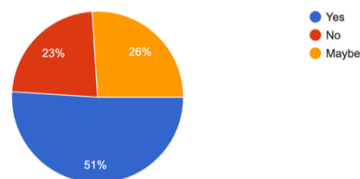
If yes (in the above question), how much more will you be willing to pay for a cleaner technology vehicle?
79 responses
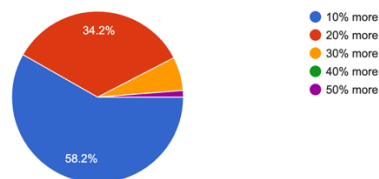
From the survey we can see that 51% of the respondents are willing to pay more for a cleaner technology vehicle.

In the follow up question it was noted that out of those who are willing to pay for cleaner technology vehicle, 58.2% are willing to pay 10% more and 34.2% are willing to pay 20% more.

PI= Personal Income

HI=household Income

EB=Educational Background

GP=Governmental Policies

SA= Societal Attitude

WTP= Willingness to Pay

Correlations

	Age	Gender	PI	HI	EB	GP	SA	WTP
Age	1							
Gender	-.083	1						
PI	-.060	.068	1					
HI	.069	-.004	.248*	1				
EB	.009	-.111	.038	.216*	1			
GP	.129	.065	.004	.035	.188	1		
SA	.215*	.090	.127	.099	.262**	.470**	1	
WTP	.071	.006	.228*	.116	.129	.216*	.406**	1

. Correlation is significant at the 0.05 level (2-tailed).

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

H3.A) WTP shows a moderate positive correlation with Societal Attitude (SA) towards environmental responsibility ($r = 0.406$, $p < 0.01$). This indicates that individuals with more positive attitude towards environmental responsibility are more willing to pay for greener vehicles.

H3.A is supported

H3.B) WTP also has a moderate positive correlation with Personal Income (PI) ($r = 0.228$, $p < 0.05$) and Household Income (HI) ($r = 0.116$, $p < 0.05$), suggesting that individuals with higher incomes are more willing to pay for greener vehicles.

H3.B is Supported

H3.C) There is no significant correlation between WTP and Gender, Educational Background (EB), or Governmental Policies (GP) at the specified significance levels.

H3.C is not supported

H3 is partially Supported- H3.A, H3.B are supported but H3.C is not Supported.

What do you think will be the most significant factors driving consumer preferences towards cleaner vehicle technologies in the future?
101 responses

Cost	89 (88.1%)
Government Initiatives/ Subsidies	69 (68.3%)
Societal Norms	19 (18.8%)
Environmental Factors	61 (60.4%)
Performance	65 (64.4%)
Availability	14 (13.9%)
Infrastructure	42 (41.6%)
	1 (1%)
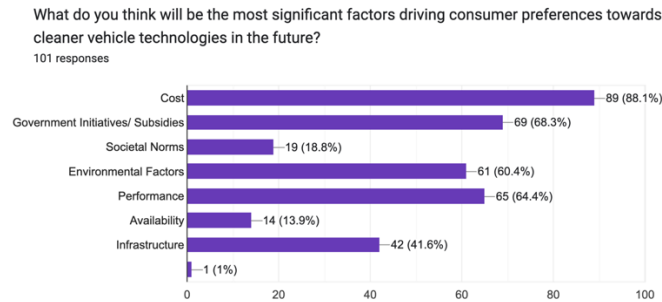
It was interesting to learn that 88.1% of the people surveyed believe that the price will be the biggest reason affecting what consumers choose when it comes to cleaner vehicle purchase in the future. This means that even though wealthier people are okay with spending more on cleaner cars, they also think that cost might stop people from buying them in the future. The survey reveals that 51% of respondents are willing to pay a premium for a vehicle with cleaner technology. Among those respondents, 58.2% are willing to pay 10% more, while 34.2% are willing to pay 20% more.

How much importance do you place on the environmental choices of your and your family members while making your vehicle purchase decisions?
102 responses

Rating	Count
1	5 (4.9%)
2	6 (5.9%)
3	23 (22.5%)
4	19 (18.6%)
5	49 (48%)
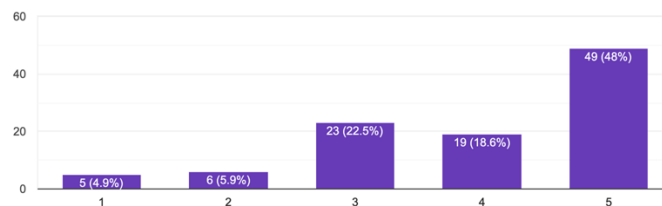
Also, when respondents were asked how much they care about their and their family's environmental choices when buying cars , 48% said they highly value these choices.

Chapter 5. Discussion and Conclusion

5.1 Discussion

The findings of this study provide valuable insights into the attitudes and willingness to pay (WTP) of middle to high-income consumers in India regarding cleaner fuel technologies, particularly in the context of electric vehicles (EVs) and the transition to Bharat Stage VI (BS6) emission standards. By integrating the Theory of Planned Behaviour (TPB) and the Technology Acceptance Model (TAM), this research aimed to comprehensively understand the factors shaping consumer behaviour towards cleaner technology vehicles in the Indian market.

Comparing the results of this study to existing literature yields several noteworthy observations. First, in line with studies such as Yadav and Pathak (2017), our findings confirm the significant influence of consumers' perceptions about technology performance, societal attitudes, and governmental policies on their adoption of cleaner technology vehicles. The strong positive correlations observed between consumers' perceptions of performance, societal attitudes towards environmental responsibility, and governmental policies supporting greener vehicles echo the findings of previous research, underscoring the importance of addressing multiple factors to promote adoption.

Second, the study corroborates the findings of Egbue et al. (2012) regarding the importance of environmental consciousness and cost considerations in influencing consumers' WTP for cleaner fuel technology vehicles. Consistent with existing literature, individuals with more positive attitudes towards environmental responsibility and higher incomes exhibit greater willingness to pay for greener vehicles. However, concerns about cost remain a significant barrier to adoption, aligning with the observations made by previous studies.

Furthermore, the regression analysis conducted in this study echoes the findings of Marangunić and Granić (2015) and Vats et al. (2022), highlighting the significant influence of consumers' perceptions about performance, societal attitudes, and governmental policies on

their adoption of cleaner technology vehicles. These results highlight the robustness of the integrated theoretical framework comprising TPB and TAM in explaining the complex interplay of individual, societal, and policy factors shaping consumer behaviour.

The findings of this study contribute to the existing literature by providing empirical evidence on consumer attitudes and behaviours towards cleaner fuel technologies in the Indian market. By integrating insights from behavioural psychology and technology acceptance research, this research offers valuable implications for policymakers, industry stakeholders, and researchers seeking to promote sustainable transportation practices in India. However, addressing the multifaceted challenges posed by cost considerations, societal attitudes, and policy constraints will require concerted efforts and collaborative initiatives across government, industry, and civil society to accelerate the transition towards cleaner fuel technologies and achieve a more sustainable future.

5.2 Conclusion

This study sheds light on the attitudes and willingness to pay of middle to high-income consumers in India regarding cleaner fuel technologies, with a specific focus on electric vehicles (EVs) and the transition to Bharat Stage VI (BS6) emission standards. By integrating the Theory of Planned Behaviour (TPB) and the Technology Acceptance Model (TAM), this research has provided valuable insights into the factors shaping consumer behaviour in the Indian market.

The findings highlight the significance of consumers' perceptions about technology performance, societal attitudes, and governmental policies in influencing their adoption of cleaner technology vehicles. Positive attitudes towards environmental responsibility and higher incomes are associated with greater willingness to pay for greener vehicles, although concerns about cost remain a significant barrier to adoption.

The study highlights the robustness of the integrated theoretical framework comprising TPB and TAM in elucidating the complex interplay of individual, societal, and policy factors shaping consumer behaviour. By addressing multiple dimensions of consumer decision-making, this research offers actionable insights for policymakers, industry stakeholders, and researchers seeking to promote sustainable transportation practices in India.

Theoretical Implications

- **Expanded Framework**: By integrating the Theory of Planned Behaviour (TPB) and the Technology Acceptance Model (TAM), this study provides a more comprehensive understanding of consumer behaviour towards cleaner fuel technologies. This expanded framework can be applied to future research in similar contexts.

- **Consumer Behaviour Insights**: The findings highlight the significant role of technology performance, societal attitudes, and governmental policies in shaping consumer attitudes and willingness to pay for cleaner vehicles. These insights add depth to the existing literature on consumer decision-making in the adoption of sustainable technologies.

- **Complex Interplay**: The study underscores the complex interplay of individual, societal, and policy factors in influencing consumer behaviour. This multi-faceted approach can inform the development of more nuanced theoretical models in future research.

- **Inclusion of Environmental Responsibility**: By demonstrating the impact of environmental responsibility and income on consumer willingness to pay, the study contributes to the growing body of research that links environmental consciousness with consumer behaviour.

Practical Implications

- **Policy Development**: The study provides actionable insights for policymakers to design and implement effective policies that promote the adoption of cleaner fuel technologies. Emphasizing the importance of governmental incentives and supportive policies can enhance consumer acceptance.

- **Marketing Strategies**: Industry stakeholders can use the findings to develop targeted marketing strategies that highlight the performance benefits of cleaner vehicles and appeal to societal attitudes towards environmental responsibility. Addressing cost concerns through financing options or subsidies can also encourage adoption.

- **Educational Campaigns**: The significance of societal attitudes suggests that public awareness and education campaigns about the benefits of cleaner fuel technologies can play a crucial role in changing consumer perceptions and behaviours.

- **Product Development**: Manufacturers can leverage the insights on consumer preferences and concerns to innovate and design cleaner vehicles that meet performance expectations while addressing cost barriers.

- **Broader Consumer Engagement**: To promote wider adoption, efforts should be made to engage diverse demographic segments, including lower-income and rural populations, ensuring that cleaner fuel technologies are accessible and appealing to a broader audience.

5.3 Limitations of the study

Despite its contributions, this study is not without limitations. First, the research sample primarily consists of middle to high-income consumers, limiting the generalizability of the findings to broader demographic segments. Future research could explore the attitudes and behaviours of lower-income groups and rural populations towards cleaner fuel technologies to provide a more comprehensive understanding of consumer preferences.

The study relies on self-reported data, which may be subject to social desirability bias and memory recall errors. Future studies could employ experimental designs or longitudinal approaches to mitigate these limitations and provide more robust insights into consumer behaviour over time.

While the integrated theoretical framework offers a comprehensive lens for understanding consumer decision-making, additional factors not captured in this study may influence adoption behaviour. Future research could explore the role of cultural, institutional, and technological factors in shaping consumer attitudes and behaviours towards cleaner fuel technologies.

The study primarily focuses on EVs and the transition to BS6 emission standards, overlooking other potential cleaner fuel technologies such as hydrogen fuel cells or biofuels. Future research could adopt a broader scope to encompass a wider range of cleaner fuel options and their implications for sustainable transportation in India.

Despite these limitations, this research contributes to the existing literature by providing empirical evidence on consumer attitudes and behaviours towards cleaner fuel technologies in India. By addressing these limitations and building upon the findings of this study, future research can further advance our understanding of consumer preferences and inform strategies for promoting sustainable transportation practices in the country.

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