A Work Project, presented as part of the requirements for the Award of a Master's degree in Management from the Nova School of Business and Economics.

# RESEARCH INTO THE ROLE OF POLICY AND CONSUMER ATTITUDES IN GERMANY'S EV MARKET

*"How do policy developments alongside consumer attitudes shape purchase intent for electric vehicles (EVs) in the German market?"*

MORITZ TEMPLIN - 61994

Work project carried out under the supervision of:

Prof. Benoit Decreton

17/12/2024

Abstract

This study examines how policy developments and consumer attitudes shape purchase intent for electric vehicles in the German market. Using a quantitative approach, the results show that a supportive policy environment and positive policy perceptions enhance EV purchase intent. Additionally, consumer attitudes, such as perceptions of environmental benefits, costs, and safety, moderate these effects, amplifying the impact of favourable policies. However, barriers like upfront costs and range concerns persist. The findings elaborate the need for consistent, consumer-focused policies to drive EV adoption, contributing to Germany's transition toward sustainable transportation.

Keywords: Electric Vehicles – Purchase Intent – Policy – Consumer Attitudes

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209).

# Table of Contents

# List of Figures



# List of Tables



## List of Abbreviations

| | |
|---|---|
| EV | Electric Vehicle |
| ICE | Internal Combustion Engine |
| TPB | Theory of Planned Behaviour |
| GHG | Greenhouse Gas |

# 1. Introduction

Climate change is a vastly studied phenomenon that dates back to the mid-20th century with the work of Charles David Keeling, who was one of the first to draw the link between fossil fuels and rising CO2 levels (Harris 2010). Today, climate change poses one of the most pressing issues of the 21st century. In its sixth assessment report, the Intergovernmental Panel on Climate Change (IPCC) (2023) highlights how it diminishes the livelihood of the planet's nature and how it could have catastrophic implications for the future of this planet and future generations. Humanity is running the risk of increased flooding, extreme weather conditions and natural disasters. Moreover, general health is a concern and food and water supplies could become scarce as droughts are expected to become commonplace (IPCC 2023). The report also highlights that climate change is driven by many factors, with one of the main ones being greenhouse gas (GHG) emissions. The most emitted GHG is carbon dioxide, which results from burning fossil fuels, making transportation one of the main drivers of climate change. According to the International Energy Agency (IEA) (2023), personal vehicles and vans account for 10% of energy-related global emissions.

International policies for a greener future are being implemented on different scales to combat these trends. The most prominent arrangement is the "Paris Agreement", which was signed by 196 parties in Paris in 2015. Its goal is not to exceed the threshold of a 1.5°C rise in global average temperature compared to pre-industrial levels. However, said goals are not on track, as most nations' presented plans will not suffice. (UN Climate Change 2023; UN Climate Change 2024). Moreover, the annual UN "COP" summits keep nations accountable and encourage the adoption of ambitious sustainability goals. The 2021 edition, for instance (COP26), saw a driving role in the discussion on phasing out internal combustion engine (ICE) vehicles (United Nations 2021). A further example is the "European Green Deal", which encompasses the goal

of Europe being climate-neutral by 2050. With the importance of the transport sector in focus, the EU aims to be the first continent in the world to have net-zero emissions (EU Commission 2022). Overall, there are various agreements aimed at improving air quality or reducing greenhouse emissions, fostering the commitment of various governments to stay proactive.

As a response to the growing challenges governments, around the world and Europe are tackling the issue of transportation by implementing measures, such as consumer incentives, promoting the phasing out of ICE vehicles, or more specifically, the adoption of electric vehicles (EVs) (Plötz et al. 2019; Statharas et al. 2019). The global automotive industry, therefore, finds itself within a pivotal moment in time. The industry is undergoing a rapid transformation driven by advancements of EV technology as a response to the increasing concerns about climate change and agreements to combat it. Scholars such as Geels (2012) identify the overall early onset shift toward more carbon-friendly technologies, of which EVs and the resulting transition away from ICE vehicles is a part.

For over a century, since the emergence of automotive vehicles as a primary means of transportation, the industry standard was the ICE. Yet, increasing environmental concerns and global sustainability targets have pushed EVs to the forefront as the most promising alternative. Data from the International Energy Agency (IEA 2024) supports this shift and suggests EVs sold in 2023 emit only half the CO2 of their ICE counterparts, and under the "Net Zero Emissions" scenario, EVs are expected to prevent 200 metric tons of greenhouse gas emissions in 2024 alone. However, the transition to EVs is difficult and comes with challenges. Adoption is influenced by a range of interconnected factors, including government policies, consumer perceptions, and technological features (Ivanova and Moreira 2024).

While governments worldwide have introduced incentives such as subsidies, tax reductions, and stricter emissions targets to accelerate EV adoption, the success of these measures depends heavily on consumers. Despite environmental benefits, barriers such as high upfront costs, limited charging infrastructure, and concerns about driving range persist, discouraging widespread adoption (Ivanova and Moreira 2023; Carley et al. 2019). Furthermore, consumer attitudes play a pivotal role: perceptions of different factors such as reliability, affordability, and social perceptions of driving an EV considerably shape purchase decisions (Ivanova and Moreira 2023). Accentuating the complicated transition to EVs is research by Van Mossel et al. (2018) highlights the challenges incumbent firms face in overcoming "technological inertia".

Germany, as a leader in the global automotive industry, occupies a unique position in this transition. Renowned for its engineering expertise and home to iconic manufacturers such as Volkswagen, BMW, and Mercedes-Benz, Germany has long set the standard in automotive innovation. However, the emergence of international competitors like Tesla and BYD, combined with advancements in EV technology, has intensified the pressure on German automakers to adapt (Dijk et al. 2013; Bakker et al. 2014). Recent policy shifts, such as changes to subsidy programs and evolving trade dynamics, have further complicated the nation's EV trajectory (Grostern 2024). These developments raise critical questions about the interplay between policy, consumer attitudes, their willingness to purchase and the ultimate success of EV adoption in Germany.

This thesis seeks to explore the question: *"How do policy developments, alongside consumer attitudes, shape purchase intent for electric vehicles (EVs) in the German market?"* This research aims to provide insights into the challenges and opportunities within this critical sector by understanding the factors driving or inhibiting EV adoption or purchase intent. This will be

done by first delving into the existing literature on the hinted factors of policies, consumers and purchase intent. Secondly, a conceptual framework is assembled based on existing literature on dynamics between said factors, outlining the hypotheses to be analysed. Subsequently, different analyses are conducted to address the outlined hypotheses and to make inferences on the leading question.

## 2. Literature Review

Given the ongoing transformation of the automotive industry, hence the transition to electrification and EVs, this literature review seeks to compile and assess research on the factors influencing the dispersion of EVs, or more specifically, what warrants consumers‘ purchase intent. This review delves into the interplay between policy changes and how consumers perceive EVs in Germany, exploring how these elements influence buying intentions. This focus is important, considering that Germany is Europe’s largest automotive market and operates within a framework influenced by national and EU policies. By referencing existing research, this chapter highlights gaps in our understanding, especially regarding how policy shifts impact consumer behaviour and trends in EV adoption. These observations are crucial for grasping how both government policies and consumer perspectives affect the uptake of EVs, paving the way for further exploration into the EV markets in Germany and across Europe.

### 2.1. Policy Developments Impacting EV Purchase Intent

Policies at both the global and regional levels have emerged as key drivers in accelerating the adoption of EVs. As discussed earlier, climate agreements such as the Paris Accord and the European Green Deal have set ambitious targets to reduce emissions, committing governments to prioritise the transition to climate-friendly and ultimately climate-neutral technologies. EVs have been identified as a critical solution, as transport remains one of the main contributors to

global GHG emissions. Within the transport sector, personal vehicles are the simplest to address in the discussion about climate neutrality compared to aviation and shipping (Hawkins et al. 2012; Bakker et al. 2014)

The European Green Deal is one of the most comprehensive frameworks for achieving a climate-neutral Europe by 2050. A major focus of the deal is the phasing out of new internal combustion engine (ICE) vehicles by 2035 (EU Commission 2022). To support this transition, automakers must meet emissions benchmarks, such as a 15% emission reduction by 2025. Substantial fines are imposed for non-compliance, creating strong incentives for innovation and adaptation (Dahl 2024).

To further facilitate the transition to electric mobility, the EU has also encouraged member states to adopt a variety of financial incentives for consumers. These include subsidies, tax breaks, and exemptions from tolls, as confirmed by the ACEA's 2024 Tax Benefits and Incentives report (ACEA 2024). The EU has also prioritised infrastructure development through initiatives such as the Connecting Europe Facility (CEF), which supports investment in EV charging networks across the continent (EU Commission 2024a). For instance, €1 billion was allocated in early 2024 to expand alternative fuel infrastructure, signalling the EU's commitment to addressing range anxiety and promoting adoption (EU Commission 2024b). Literature on EV adoption highlights the importance of political commitment in shaping the dispersion of EV technology (Ivanova and Moreira 2023).

Germany has played a leading role in implementing such policies, given its position as Europe's largest automotive market and its reputation as a global leader in vehicle engineering. The introduction of the Umweltbonus in 2016 marked a significant step, providing a total of €10

billion in subsidies throughout its lifespan to reduce the cost burden of EV ownership (Bundesregierung 2023). Additionally, Germany offers tax exemptions for battery electric vehicles (BEVs) registered by the end of 2025, granting a 10-year ownership tax exemption (ACEA 2024). These measures have made EVs more accessible to consumers, boosting early adoption rates.

However, recent changes in German policy have introduced new challenges. The abrupt removal of the Umweltbonus in December 2023, driven by national budget constraints, highlights the dynamic and uncertain nature of EV-related policies. This sudden policy shift caused controversy, with automakers and consumers expressing concerns about its impact on adoption trends. As a result BEV registrations fell by 28.6% in the first three quarters of 2024 compared to the same period in 2023, as reported by the German Federal Motor Transport Authority (KBA 2024). The example shows how sudden cessation of measures and uncertainty can undermine consumer confidence.

The relationship between governmental policies and consumer behaviour is a consistent theme in the literature. Financial incentives such as subsidies, tax breaks, and exemptions are critical in overcoming barriers to adoption, particularly the high upfront costs associated with EVs (Ivanova et al., 2023; Lévay et al., 2017). Countries that have implemented stable and comprehensive measures, such as Norway, have experienced high adoption rates, as shown in the findings of Figenbaum (2016). Due to policies like tax exemptions, subsidies, and free tolls, Norway's success illustrates the importance of consistency in creating a supportive environment for EV adoption.

In contrast, Germany's case highlights the risks associated with policy inconsistency. While the country has made significant strides in infrastructure development, challenges persist, particularly in rural regions, as range anxiety remains a major barrier concerning EVs (Brase, 2018). The literature confirms that while financial incentives are critical, they must be supported by parallel investments in infrastructure, as inadequate infrastructure can hinder adoption regardless of financial support. The EU's efforts through the CEF reflect the importance of addressing this challenge, yet the pace of infrastructure expansion remains uneven across member states, including Germany (Platini 2019).

The existing literature demonstrates that policies from financial incentives, regulatory mandates, or infrastructural investments are central to fostering EV adoption. However, these policies' dynamic and uncertain nature raises critical questions about their long-term impact on consumer confidence and adoption trends, particularly in key markets such as Germany.

### 2.2. Understanding Consumer Purchase Intent for EVs

The decision to purchase an electric vehicle (EV) is shaped by a complex interplay of factors, including financial considerations, environmental awareness, and external influences. To better understand these dynamics, Ajzen's (1991) Theory of Planned Behavior (TPB) is a foundational framework for analysing the key drivers behind consumer intentions. The TPB identifies three determinants of behaviour: attitudes, subjective norms, and perceived behavioural control.

In the context of EV adoption, attitudes refer to a consumer's evaluation of the benefits and drawbacks of electric vehicles. These attitudes encompass perceptions of range, reliability, costs (upfront and operational), and environmental benefits. Studies by Carley et al. (2019) and

Rezvani et al. (2015) confirm that positive attitudes, such as viewing EVs as cost-efficient or environmentally friendly, significantly predict purchase intent. Conversely, negative attitudes, such as concerns about limited range or high initial costs, often act as barriers to adoption (Ivanova and Moreira 2023).

The second determinant, subjective norms, highlights the influence of societal expectations and peer pressures on consumer decision-making. For EVs, ownership is increasingly viewed as a signal of environmental consciousness and social responsibility. Carley et al. (2019) emphasise the role of environmental signalling, where consumers adopt EVs to align with societal norms and portray themselves as environmentally conscious individuals. As sustainability becomes a central value, subjective norms gain increasing importance in shaping purchase behaviour.

The third component of the TPB, perceived behavioural control, reflects the consumer's perception of their ability to perform a behaviour influenced by both internal and external factors. In the case of EVs, this includes practical considerations such as affordability, access to subsidies, and the availability of charging infrastructure. Financial support, such as tax breaks and subsidies, has been shown to enhance perceived control by mitigating cost barriers (Axsen et al. 2020). Similarly, expanding charging infrastructure plays a crucial role in reducing range anxiety, further strengthening consumers' sense of control over their purchasing decisions (Sheldon 2022).

In summary, the TPB provides a robust framework for understanding the factors influencing purchase intent for EVs. Attitudes, subjective norms, and perceived behavioural control collectively shape consumer intentions, highlighting the importance of addressing individual perceptions and external conditions to promote EV adoption.

### 2.3. Consumer Attitudes Toward EVs

While policies significantly influence purchase intent, understanding consumer attitudes toward EVs is equally crucial. These attitudes encompass perceptions of performance, range, price, and environmental impact, all of which directly influence decision-making.

One of the most comprehensive studies on EV purchase intent is by Ivanova and Moreira (2023), who categorised key factors into economic, technical, and risk/benefit-related dimensions. Among these, price emerges as a primary concern, with high upfront costs often deterring consumers despite lower long-term operational costs (Carley et al. 2019; Bockarjova & Steg 2014). Subsidies have proven essential in mitigating this barrier by improving affordability (Ivanova and Moreira 2023). However, the removal of incentives or rising energy prices can nullify cost advantages and reduce intent.

Similarly, range anxiety remains one of the most significant barriers to adoption. Despite advances in battery technology, concerns about charging availability persist, particularly in areas with insufficient infrastructure (Brase et al., 2018). Research confirms that countries with comprehensive charging networks, such as Norway, experience higher adoption rates due to reduced range anxiety (Lieven 2015; Figenbaum 2016).

Considerations, including safety, reliability, and overall technical capabilities, also influence attitudes toward EVs. Brase et al. (2018) highlight that consumers value these attributes, with brands like Tesla gaining recognition for their safety features and advancements (Tesla, 2024). Environmental impact is another important determinant of EV attitudes. Consumers with greater environmental awareness are more motivated to adopt EVs, even if they have price or range concerns (Degirmenci and Breitner 2017). Furthermore, driving an EV often signals

social responsibility, aligning with societal norms and expectations (Song et al. 2021; Carley et al. 2019).

Overall, positive attitudes toward EVs, such as perceptions of usefulness, environmental benefits, and reliability, enhance purchase intent, while negative attitudes surrounding costs or infrastructure act as barriers (Ivanova and Moreira, 2023; Bonges and Lusk 2015). Research suggests that attitudes interact with policies, amplifying or diminishing their effects. For instance, favourable attitudes can strengthen the impact of incentives like subsidies, whereas negative attitudes may weaken their effectiveness, even when financial support is substantial.

This dynamic interplay underscores the importance of understanding how consumer attitudes interact with policy shifts to drive or hinder EV adoption, particularly in contexts like Germany, where policy consistency has been challenging in recent years.

### 2.4. Addressing Gaps in the Literature

While existing literature offers valuable insights, several gaps still need to be discovered. One notable gap concerns the dynamic nature of policy developments, particularly the long-term implications of subsidy removals or abrupt policy shifts. Research by Sheldon and Dua (2024) suggests that subsidies may have lasting positive effects, even upon removal, due to positive policy perceptions or increased awareness and familiarity with EVs. However, further investigation is needed to explore how these effects interact with consumer attitudes.

While most studies examine these factors of policy developments or policy outcomes and EV attitudes in isolation, limited research addresses how they interact. For instance, concerns about

range may reduce the effectiveness of financial incentives, while strong environmental beliefs may encourage adoption even in the absence of supportive policies. As Degirmenci and Breitner (2017) point out, in some cases, environmental concerns may outweigh other concerns, potentially meaning neglect of financial considerations when deciding on a vehicle purchase, diminishing the role of monetary incentivisation.

This research addresses these gaps by examining how consumer attitudes moderate the relationship between policy environments, policy perceptions, and purchase intent. Through a quantitative approach, it offers a nuanced understanding of these dynamics in the German EV market.

# 3. The Conceptual Framework, Variables and Hypotheses

This section presents the conceptual framework to address the research question: "How do policy developments alongside consumer attitudes shape purchase intent for electric vehicles (EVs) in the German market?" The framework outlines the key variables under investigation (policy environment, policy perceptions, EV attitudes, and purchase intent) and explores their interrelationships within the study's parameters. By systematically examining these variables, the research aims to provide nuanced insights into the dynamic interplay between governmental actions regarding policy, consumer attitudes and perceptions on policies and EVs and the resulting purchasing intentions. Furthermore, the section outlines and justifies the hypotheses in existing literature, establishing a foundation for the subsequent methodological research design and corresponding analyses.

## 3.1. The Conceptual Framework

This study draws on the TPB to address the research question about the impact of policy on

consumer purchase intent and how EV attitudes and policy perceptions shape purchase intent. As discussed, the TPB outlines the antecedents of intent to fulfil an action ultimately, including attitudes, subjective norms, and perceived behavioural control (Ajzen 1991).

This study and the conceptual framework integrate insights from the TPB to explore the relationships at hand. The independent variable is the policy environment, which influences purchase intent, and the dependent variable of the study. Policies have been found to directly affect purchase intent, as evidenced by Ivanova and Moreira (2023). Moreover, Haustein et al. (2021) explain that policy signalling can encourage purchase intent, while a lack of policies or clarity may do the opposite, as some consumers delay purchases while awaiting policy support.

Policy perceptions act as a mediator within the framework. A policy environment influences how consumers perceive policies, and these perceptions, in turn, impact purchase intent. Consumers who view policies as favourable are more likely to intend to purchase EVs, as shown by findings from Wang et al. (2021). This relationship also ties into the perceived behavioural control component of the TPB, where favourable perceptions of supportive policies enhance an individual's sense of control over their purchase decision (Ajzen 1991).

While the TPB treats attitudes as a primary antecedent of intent, this study considers EV attitudes as a moderating variable. Research by Haustein et al. (2021) highlights that aligning policies with consumer attitudes is essential to achieving purchase intent. Positive attitudes toward EVs are expected to strengthen the impact of a favourable policy environment and favourable policy perceptions, while negative attitudes could weaken these relationships. The relationships between these variables are summarised in the conceptual framework presented in Figure 1. The framework forms the foundation for the following hypotheses, and the next

sections provide a detailed introduction to the variables and hypotheses, explaining their theoretical grounding and significance.

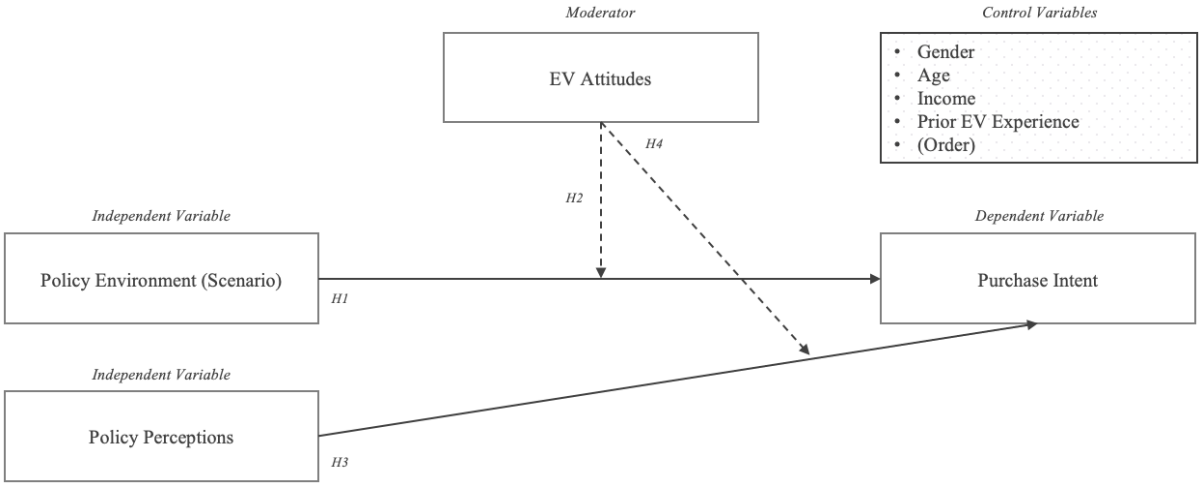
*H1: Policy Environment directly influences Purchase Intent.*

*H2: EV attitudes moderate the effect of the Policy Environment on Purchase Intent.*

*H3: Policy Perceptions directly influence Purchase Intent.*

*H4: EV attitudes moderate the effect of Policy Perceptions on Purchase Intent.*

**Figure 1** *The Conceptual Framework*




### 3.2. Discussing Variables and Hypotheses

While the conceptual framework offers a good visual representation of the basic research topic, this section elaborates on the key variables presented to provide a better understanding of their theoretical significance and role in addressing the research question. By defining and justifying the inclusion of each variable, this section establishes hypotheses to be addressed in subsequent analyses.

#### 3.2.1. Dependent Variable – Purchase Intent

Purchase intent, the dependent variable, is at the core of this study. It refers to a consumer's

readiness and willingness to buy an electric vehicle. Ajzen's TPB (1991) emphasises that behavioural intention is a direct antecedent to behaviour itself, as it reflects an individual's motivational commitment to carry out a specific action. In this study, purchase intent reflects consumers' willingness to make an EV purchase, which is vital for market growth and EV adoption.

Much of the literature focuses on EV adoption as a measurable outcome; however, purchase intent represents an earlier yet critical step in the decision-making process. Ivanova and Moreira (2023) and Carley et al. (2019) argue that understanding purchase intent is essential for identifying barriers to adoption and designing effective interventions. Studies such as those of Gecere et al. (2018) and Wang et al. (2021) further confirm that purchase intent is shaped by various interrelated factors, including financial incentives, infrastructure development, and individual attitudes.

The inclusion of purchase intent as the dependent variable provides a clear, measurable indicator of consumer behaviour within the study's scope. The hypotheses explore how purchase intent is influenced by policy-related variables and the moderating role of EV attitudes.

### 3.2.2. Independent Variable – Policy Environment

The policy environment is the independent variable, representing the external policy conditions that directly influence consumers' decision-making. For this research, the policy environment is conceptualised as a binary variable consisting of two contrasting scenarios: an unfavourable policy environment (reflecting Germany's situation as of late 2024) and a favourable policy environment (reflecting best practices in other EU nations or Germany's former developments),

aligned with information provided by the ACEA (2024) and Figenbaum (2016).

The policy environment focuses on two key components: financial incentives and charging infrastructure. Financial incentives, including subsidies and tax breaks, have been widely acknowledged as critical drivers of EV adoption. Ivanova and Moreira (2023) and Martins et al. (2023) emphasise that high upfront costs are a significant barrier for consumers, and well-designed financial incentives reduce this burden. Similarly, charging infrastructure is essential in addressing range anxiety, a key deterrent to EV adoption. Research by Qadir et al. (2024) and Higueras-Castillo et al. (2021) shows that infrastructure investments improve EV ownership's feasibility, boosting purchase intent.

In addition to these components, broader policies such as trade tariffs and long-term sustainability commitments also shape the policy environment. Recent EU trade measures imposing tariffs on Chinese EV imports highlight the role of policy in influencing market dynamics (EU Commission 2024c). However, uncertainty surrounding policies, such as the phase-out of ICE vehicles by 2035, can undermine consumer confidence (Haustein et al. 2021). Based on this understanding, this is the resulting hypothesis:

*H1: Policy Environment directly influences Purchase Intent.*

### 3.2.3. Independent Variable – Policy Perceptions

Policy perceptions are introduced as a second independent variable in this study. While the policy environment reflects the policies implemented such as financial incentives, infrastructure expansion, or trade regulations policy perceptions focus on how consumers subjectively interpret and evaluate these policies. Essentially, policy perceptions capture the degree to which consumers view policies as favourable, effective, and supportive of EV adoption.

The significance of policy perceptions lies in the variability of consumer responses to policy measures. For instance, while financial incentives or infrastructure investments may exist in a policy environment, their perceived effectiveness can vary widely among consumers. Kim et al. (2019) and Wang et al. (2021) emphasise that when policies are perceived positively such as being clear, beneficial, or reliable they encourage purchase intent. Conversely, Hu et al. (2023) explain that policy uncertainty or perceived inadequacies can erode trust in policy measures, ultimately reducing purchase intent.

Policy perceptions are also closely linked to the perceived behavioural control component of the TPB. Ajzen (1991) explains that perceived behavioural control reflects a consumer's sense of capability to perform an action. In this study, favourable perceptions of policies such as seeing subsidies as reducing financial barriers or viewing infrastructure expansion as solving range anxiety enhance consumers' perceived ability to purchase EVs. In contrast, unfavourable perceptions, such as scepticism about policy reliability or short-term support, may undermine this sense of control and reduce purchase intent. Thus, the following hypothesis is proposed to capture the relationship between policy perceptions and purchase intent:

*H3: Policy Perceptions directly influence Purchase Intent.*

### 3.2.4. Moderating Variable – EV Attitudes

A further important building block within the model is the variable "EV attitudes", which describes the attitudes and opinions consumers have toward EVs. The impact of attitudes toward EVs has been vastly studied and has set a vastly unanimous precedent that positive attitudes toward EVs also positively impact consumers' intentions to purchase an EV (Dutta and Hwang 2021).Especially the metrics of range, costs (upfront and operating), environmental

benefits, as well as social implications and technical factors (reliability and safety) have produced streamlined results throughout different studies (Ivanova and Moreira 2023; Song et al. 2021; Rezvani et al. 2015).

As explained earlier, less research has been done about the dynamic of EV attitudes in conjunction with policies, or more specifically, how EV attitudes may impact the usefulness of policies in shaping consumers' purchase intent. This lack of literature warrants the inclusion of EV attitudes as an important moderator, denoting their impact in the form of the following hypotheses:

*H2: EV attitudes moderate the effect of Policy Environment on Purchase Intent.*

*H4: EV attitudes moderate the effect of Policy Perceptions on Purchase Intent.*

# 4. Methodology

This chapter outlines the methodology to investigate the role of policy environments or developments and consumer attitudes in shaping purchase intent for EVs in the German market by addressing the previously discussed hypotheses. The research utilises a quantitative approach combining primary data collected through a survey, and statistical tools to perform analyses and make inferences. In the following is a detailed explanation of the research design, how the survey was made, and what the main measurements are. The data collection is discussed, and the data processing before conducting the necessary analyses is outlined. Finally, an overview of the statistical tests to be applied for analyses is provided.

## 4.1. Research Design

The topic of EV purchase intent and its drivers has been largely studied with quantitative methods, this study also employs a quantitative approach and builds on existing approaches.

Both in foundational theories, such as Ajzen's (1991) TPB, as well as new applied literature, intent is handled as a quantified variable. Since the main dependent variable of this research handles intent, namely purchase intent the quantitative approach qualifies as a valid option for analyses. Furthermore, in their systematic literature review Ivanova and Moreira (2023) found that 81% of the studies they assessed on predecessors of EV purchase intent used quantitative methods, with most of them conducting primary data collection through surveys.

### 4.1.1. Survey Design

Based on prior research, the necessity to accumulate primary data for the research at hand through a survey is evident. The previously introduced conceptual framework denotes the key variables, which a survey is intended to capture in a nuanced way, to provide the necessary data to answer the research question.

To fulfil these criteria, a survey was designed in a manner to capture within-subjects responses. Meaning, respondents are subject to different treatments within the same research, in this case a survey. This fits to the nature of the two scenarios intended to be presented to the respondents and aligns with findings of Charness et al. (2012), that argue that this approach assumes adjusted behaviours across different circumstances of individuals. Further, due to the constrained population the survey is targeting, just the German market, a further advantage of within-subjects designs is the need for less participants (Greenwald et al., 1976). Nonetheless, there are drawbacks to the approach, namely demand effects or carryover effects, as well as order biases (Charness et al., 2012). The survey that was created follows a structured setup. It begins by capturing respondents' overall attitudes toward EVs. Next, respondents are randomly exposed to either one of the two scenarios explained earlier (unfavourable and favourable). Upon confirming the reading and understanding of the scenario respondents are presented with

a series of questions on how they perceive the presented policy measures. After that, the purchase intent is recorded with another series of questions respondents answer based on the policy scenario at hand. Once finishing the first scenario, respondents are presented with the remaining scenario and follow the same procedure. Finally, demographics and the control variables were covered. A more detailed overview of the key aspects of the survey is provided in Table 1 in the section (Measurements) below.

### 4.1.2. Measurements

The key variables of the research design are aimed at answering the question of how policy affects purchase intentions. While, many studies concerning EV purchase intentions or uptake and consumer perceptions have been conducted by the means of quantitative methods, different measurements have been employed by researchers. The measures utilised within this research originate from amended measures throughout different studies. Most key variables (EV attitudes, policy perceptions, and purchase intent) were collected on a 7-point Likert scale, as has been previously done by different researchers, such as Song et al. (2021) and Degirmenci and Breitner (2017).

The first key variable and moderator EV, attitudes include different items reflecting different measures research has deemed necessary when assessing people's stances on EVs, measured on a 7-point Likert scale (ranging from strongly disagree to strongly agree). Items include environmental friendliness with an item adapted from research done by Song et al. (2021). The upfront cost and, operational cost items were constructed based on research by Song et al. (2021) and Degirmenci & Breitner (2017) respectively. Range confidence, arguably one of the most critical dimensions has been accounted for by many different researchers. In the case of this study, it is measured with an item adapted from Degrimenci & Breitner (2017). Items to

reliability and safety were adapted based on literature by Rezvani et al. (2015). Finally, social perception was recorded through an item amended, inspired by research conducted by Song et al. (2021) and Wang et al. (2021).

The main independent variable policy environment is measured as a binary variable denoting one of the two scenarios presented to consumers. Detailed descriptions of the scenarios are provided in Appendix 1. Due to the nature of the variable, stemming from a "has been", or "best practices" scenario of policy measures in Germany or the EU, compared to the current political measures Germany is subject to, this binary variable can offer a means for direct comparison. Though this approach has not been employed in prior literature, research conducted by Sheldon & Dua (2024) has investigated different policy levels, or more specifically subsidy levels, and investigated implications on EV dispersion, inspiring this policy environment level approach.

Policy perceptions the other independent variable is also measured on a 7-point Likert scale, (ranging from strongly disagree to strongly agree) reflecting not only the situation of a specific policy environment, but also the respondents' views on the respective environment. It is made up of five items including consistency, promoting acceptance, ease of access, affordability, and commitment. Though the perceptions of policies around EVs have been less studied than direct implications, Wang et al. (2021) take an approach of quantifying perceptions especially on incintive policy, from which items in this study were adapted and motivated.

The variable purchase intent is a focal point of much of the EV literature, and likewise poses the dependent variable within this research. Scholars have applied different scales to measure purchase intent within the context of EVs. In the case of this study, 4 items were utilised to obtain an understanding of consumers' purchase intent under certain policy environments, including short term purchase readiness, preferences of EVs over ICE vehicles, serious

consideration of EVs, and next vehicle purchase. The items were adapted and motivated by work from Wang et al. (2017), as well as Zhang et al. (2022).

The included control variables are some of the most discussed among researchers. Firstly, as recorded by Ivanova and Moreira (2023), some of the most recurring control variables include gender age, and income. Regarding gender, Plötz et al. (2014) in a study on early adopters in Germany found that men exhibit higher purchase intentions for EVs, while more current studies find that women may in some cases exhibit higher intent (Habich-Sobiegalla et al. 2019). Regarding age, the variable was split into 3 groups, young adults (18-30), middle-aged (31-50) and older adults (51+). Kim et al. (2019) found that older individuals exert more purchase intent than their younger counterparts. Additionally, findings by Habich-Sobiegalla et al. (2019) inspire a three-group approach for this variable, as they find that people falling within a middle-aged category exert the highest purchase intent (35-49).

This study's third demographic control variable includes income, which has revealed mixed results. While Lashari et al. (2021) found that lower-income may relate to higher purchase intent, Egnér and Trosvik (2018) found the opposite. Therefore, income is divided into low annual income (ranging from 0 €40,000) and high income (including €40,001 +). Another important variable to control for, as reported by different researchers, is prior experience with EVs, which impacts purchase intent (Kim et al. 2019; Carley et al. 2019). Therefore, the variable was included to account for prior or current ownership or never owning an EV. The final control variable is Order, alluding to the order in which scenarios are presented to respondents, accounting for potential order effects inherent to the research design at hand. A summary of all variables is provided below in Table 1.

**Table 1** *Variables and Measurements*

| Variable | Item / Question | Measurement |
|---|---|---|
| | | |
| | I believe EVs are better for the environment than conventional vehicles. | 7-point Likert scale (Strongly disagree – Strongly agree) |
| | I believe EVs have reasonable upfront costs, compared to conventional vehicles. | 7-point Likert scale (Strongly disagree – Strongly agree) |
| | I believe EVs are a cost-efficient alternative in the long run, compared to conventional vehicles (gas, maintenance). | 7-point Likert scale (Strongly disagree – Strongly agree) |
| | I am confident EVs offer sufficient range to cover my driving needs. | 7-point Likert scale (Strongly disagree – Strongly agree) |
| | I believe EVs are reliable, and do not cause technical difficulties. | 7-point Likert scale (Strongly disagree – Strongly agree) |
| | I believe EVs are safe to drive compared to conventional vehicles. | 7-point Likert scale (Strongly disagree – Strongly agree) |
| | I believe the driving of an EV is perceived positively in society. | 7-point Likert scale (Strongly disagree – Strongly agree) |
| **Policy Environment** | | |
| | Respondents get shown 2 scenarios in random order, responses to PI (DV) and PP (IV2) get recorded for each:<br>- Unfavourable<br>- Favourable | Binary variable:<br><br>Denoted as 0<br>Denoted as 1 |
| **Policy Perceptions** | | |
| | I believe that the policies are clear and consistent. | 7-point Likert scale (Strongly disagree – Strongly agree) |
| | The policies effectively promote the acceptance of EVs. | 7-point Likert scale (Strongly disagree – Strongly agree) |
| | The policies make it easier for consumers to switch to EVs. | 7-point Likert scale (Strongly disagree – Strongly agree) |
| | The policies make EVs more financially accessible. | 7-point Likert scale (Strongly disagree – Strongly agree) |
| | I believe the government will remain committed to a transition to EVs. | 7-point Likert scale (Strongly disagree – Strongly agree) |
| **Purchase Intent** | | |
| | How likely is it that you would purchase an EV within the next 12 months? | 7-point Likert scale (Not likely at all – Extremely likely) |
| | If I were to purchase a vehicle, I would prefer an EV over a conventional vehicle. | 7-point Likert scale (Not likely at all – Extremely likely) |
| | I would seriously consider purchasing an EV in the future. | 7-point Likert scale (Not likely at all – Extremely likely) |
| | My next vehicle purchase will be an EV. | 7-point Likert scale (Not likely at all – Extremely likely) |
| **Control Variables** | | |
| | Gender | 0 Female<br>1 Male |
| | Age | 0 Young Adult (18 – 30)<br>I Middle – Aged (31 – 50)<br>II Older Adult (51+) |
| | Income | 0 Low Income (0 - €40,000)<br>1 High Income (€40,001+) |
| | Prior EV Experience | 0 Never Owned<br>1 Ownership (prior/current) |
| | Order | 0 Unfavourable Scenario First<br>1 Favourable Scenario First |

### 4.1.3. Sampling

The survey was distributed through different channels, using snowball sampling predominantly to gather the data. Eligible was every person residing in Germany and speaking German.

Participants had to be 18 or older aligning with the legal driving age excluding the provisional "accompanied driving" rule (BF17) for 17-year-olds (BMDV, 2024). The primary approach was selecting peers to fill out the survey and to have it distributed further to people falling into the eligible category but assuring that no age group or other demographic emerges as dominant within the population of responses. Secondly forums with other researchers were used where people looking for respondents and exchanged survey responses. Finally, forums where the topic of vehicles and mobility are a focal discussion point were used to gather additional responses, however yielding the least responses. The approach of snowball sampling is more commonly utilised in qualitative research and is less common in quantitative research, due to its less probabilistic nature. However, in any case it raises concerns about potential selection biases and diminished validity (Parker et al., 2019).

While overall, 141 responses were collected through these distribution approaches, the data likely has some limitations due to the nature of chosen survey distributions. These concerns are later acknowledged in the limitations section. To assure, the highest robustness possible given these limitations the data must be processed before delving into any analyses.

### 4.2. Preparing the Data

After concluding the distribution of the survey and rounding up the final responses, a total of 141 respondents had participated. To begin with the analyses, datasets were assessed and cleaned or prepared appropriately. Upon first inspection, it was clear that of the 141 recorded responses 13 responses were incomplete, where respondents likely bailed around halfway through the survey. The incomplete responses were removed promptly.

Upon further inspection, some responses were completed within a time frame that does not

allow for a complete and cohesive response. To cap off the response time, the total response time of 4 minutes (240 seconds) was chosen, as this can be deemed a realistic minimum time required to read through and understand every element of the survey. When filtering for the responses that took under 240 seconds, a further 5 responses fell short. Leaving the set at a strong 123 respondents.

### 4.2.1. Composite Variables

As a next step, the assessment and potential removal of outliers is essential preceding meaningful analyses. However, before removing outliers, the presence of the correct variables must be assured. While the survey was made up of different items measuring the variables "EV attitudes", "policy perceptions", and "purchase intent", it does not make sense to filter outliers from each item. Rather the items should be composited to represent the variables portrayed in Figure 1. While this makes sense especially for policy perceptions and purchase intent, EV attitudes will also be composited, while maintaining the relevance of individual items for later analyses, to be able to assess the variable on a broad and more granular scale.

To be able to composite variables, the items must be reviewed for internal consistency. To do that "Cronbach's Alpha" is an appropriate test to be applied. Alphas higher than 0.7 indicate internal consistency and will allow for variable composition. Table 2 shows the Cronbach's Alpha for the two variables under each of the given scenarios.

**Table 2** *Cronbach's Alphas – Internal Consistencies*

| Scenario | **α** Policy Perception Items | **α** Purchase Intent Items | **α** EV attitudes (Reliability & Safety) | **α** EV attitudes (General) |
|---|---|---|---|---|
| Unfavourable | 0.87 | 0.91 | 0.78 | 0.84 |
| Favourable 2 | 0.89 | 0.91 | | |

As can be seen in the table, the Cronbach's Alphas of the variables policy perceptions and purchase intent for each scenario allow for aggregation, which was conducted accordingly through the row-wise mean approach. Moreover, table 1 includes the Cronbach's alpha of the two items alluding to EV attitudes on reliability and safety respectively. In their research Rezvani et al. (2015) addressed reliability and safety as a single dimension, which can be supported by the high Alpha of 0.78. Consequently, the two items were aggregated. Overall EV Attitudes also showed internal consistency resulting in an Alpha of 0.84, allowing for a composited EV Attitude variable alluding to consumers' general views on EVs.

### 4.2.2. Addressing Outliers

Having created composite variables, they must be investigated for outliers, to assure no extreme observations could potentially distort any pending analyses, thus increasing robustness. Outliers in key variables, including Purchase Intent (PI), Purchase Intent under Favourable Conditions (PI2), Policy Perceptions (PP), and Policy Perceptions under Favourable Conditions (PP2) were identified and removed to enhance data robustness and ensure valid analyses. The interquartile range (IQR) method was used to detect outliers, with values below the range of typical data (1.5 times the IQR below the lower quartile) or above the range of typical data (1.5 times the IQR above the upper quartile) flagged for removal. This approach ensures that extreme values do not unjustly influence statistical models. Identified outliers were removed for each variable and stored in a separate dataset for transparency.

Upon manually reviewing the removed outliers, it is clearly observable that they likely correspond to respondents not properly reading or understanding the survey. Policy Perceptions extremely low in the favourable scenario inherently do not make sense and could suggest

lacklustre understanding or reading. The cleaned dataset of 116 observations better reflects respondents' central tendencies and provides a robust foundation for analyses. The different items representing EV attitudes were not subject to outlier checks, as a controversial topic such as EVs can yield extreme responses in each direction. Both positive and negative attitudes are to be expected.

Finally, an integrity check was employed assessing linear responses resulting in a final single removed respondent, and a further suspect case, where responses seem linear, but upon close inspection all signs point to an extreme EV enthusiast, resulting in the preservation of said observation. Overall, the cleaning and preparation process of the data resulted in a reduction from 141 total responses to 115 utilisable observations. Upon concluding the removals of unjust observations, the data had to be pivoted into a long version, to suit the research design. The current wide version does not allow for the necessary analyses, as key variables (purchase intent & policy perceptions) are split into multiple columns. To mitigate any issues with the long version, stemming from treating each row as an independent observation, clustering for the response ID was employed. Appendix 1 provides a concise overview of the data preparation process and aids in better understanding the dataset later used for analyses.

### 4.3. Statistical Testing

Following the preparation of the dataset, a series of statistical tests will proceed, to draw concrete inferential analyses and results to discuss theoretical and practical implications later. Firstly, a brief overview of descriptive statistics is provided, to provide a foundational understanding of the dataset. It will highlight demographics and other control variables, as well as the key variables purchase intent, policy perceptions, and EV attitudes. Moreover, paired t-tests are used to formally conduct comparisons of the two scenarios, allowing preliminary insights.

After establishing an overview of the data, the hypotheses depicted in the conceptual framework are tested. The objective is to evaluate relationships between policy environments, policy perceptions, EV attitudes and purchase intent. The testing will follow a two-step approach using various regression models, first assessing EV attitudes, then assessing individual EV attitude metrics, to gain a more granular understanding of potential moderating effects. To attain well interpretable results, and due to the utilisation of interaction terms, the variables policy perceptions, general EV Attitudes, as well as the individual EV attitudes are centered.

The first step includes a set of models that examines the effect of the independent variable policy environment on the dependent variable purchase intent, with EV attitudes (measured using the composite general EV attitudes variable) as a moderator. Further, in the first step, the alternative independent variable policy perceptions is assessed, again testing its effect on purchase intent while accounting for the moderating role of EV attitudes. These models will help assess whether and how the policy environment and consumer perceptions of policies influence purchase intent for EVs, moderated by general attitudes toward EVs.

In the next step, granular models are investigated, where each individual item of EV attitudes (e.g., environmental friendliness, range confidence, social perception) is tested as a moderator through separate interaction terms. This analysis identifies which dimensions of EV attitudes most significantly impact purchase intent and how they interact with the two independent variables: policy environment and policy perceptions. These models enable a detailed comparison of the effects of both independent variables on purchase intent.

Finally, robustness checks are conducted, where order effects are accounted for. This implies

repeating the main models, however based on narrowed down datasets, once using data, of just those who were presented with the unfavourable scenario first and once, only using the data of those who were presented with the favourable scenario first.

All analyses are conducted in RStudio, and regression models utilise the "lm_robust" function provided in R which allows clustering. This is necessary for the main models, due to within-subject nature of the data. To fulfil the main analyses, the dataset needs to be transformed from its current wide format to a long format. The function mitigates any standard error issues stemming from the related responses, due to respondents answering once under the favourable and once under the unfavourable scenario. Moreover, to ensure the validity of the regression models, several assumption checks were conducted. Linearity was assessed using a residuals vs. fitted values plot. Homoskedasticity was tested using the Breusch-Pagan test. Normality of residuals was evaluated through a Q-Q plot and the Shapiro-Wilk test, ensuring residuals follow a normal distribution. Lastly, multicollinearity was checked using the Variance Inflation Factor (VIF) (Thériault 2020).

## 5. Analyses and Results

This section presents the findings of the study, beginning with an overview of the dataset through descriptive statistics. It outlines the demographics, key variables, and initial trends observed within the data. Following this, the results of the main regression analyses are discussed, including checks for robustness, to shed light on the hypotheses presented.

### 5.1. Descriptive Statistics

With the prepared dataset ready, it is important to get an initial understanding of the data and the respondents at hand. It is also important to investigate the different variables and gain

preliminary ideas of what trends responses might indicate. This section provides an overview of the dataset comprised of the retained observations, collected via the survey.

### 5.1.1. Demographics and Control Variables

The final dataset consists of 115 recorded observations. The demographics and in the case of this study the control variables include Gender (female or male), Age (Young Adults including 18–30-year-olds, Middle-Aged including 31–50-year-olds, and Older Adults including those aged 51 and older), Income (Low Income including people from no income up to €40,000, and High Income including people making €40,001 or more), and Prior EV Experience (Either those who never owned an EV, or those who have or had an EV). These control variables will be included in subsequent analyses to account for their potential impact on purchase intent. A detailed overview of demographics is provided in Table 3.

**Table 3** *Demographics / Control Variables Overview*

| Variable | Category | Frequency | Percentage |
|---|---|---|---|
| Gender | Female | 62 | 53.91% |
| | Male | 53 | 46.09% |
| Age | Young Adults | 48 | 41.74% |
| | Middle-Aged | 36 | 31.30% |
| | Older Adults | 31 | 26.96% |
| Income | Low Income | 49 | 42.61% |
| | High Income | 66 | 57.39% |
| Prior EV Experience | Never Owned | 85 | 73.91% |
| | (Prior) Ownership | 30 | 26.09% |

### 5.1.2. Key Variables

The study investigates the relationship between policy environments, policy perceptions, and purchase intent, with EV attitudes serving as a moderator. Table 4 provides descriptive statistics for said key variables, including purchase intent under both unfavourable and favourable policy environments, policy perceptions, and attitudes toward electric vehicles. This overview provides a clear understanding of respondents' perceptions and intentions, offering a solid

foundation for subsequent analyses. The table includes means and standard deviations for these variables across both policy scenarios, while initial insights into the relation of policy environments, consumer perceptions and intentions are further supported by a correlation matrix in Appendix 2.

**Table 4** *Summary Statistics – Key Variables*

| **Key Variables** | **Mean** | **Standard Deviation** | **Min** | **Max** |
|---|---|---|---|---|
| Purchase Intent *Unfavourable Policy Environment* | 2.66 | 1.47 | 1 | 7 |
| Purchase Intent *Favourable Pol. Environment* | 4.00 | 1.74 | 1 | 7 |
| Policy Perceptions *Unfavourable Pol. Environment* | 2.58 | 0.825 | 1 | 4.8 |
| Policy Perceptions *Favourable Pol. Environment* | 4.92 | 1.14 | 2 | 6.8 |
| **EV Attitudes (Moderators)** | | | | |
| Environmentally Friendly | 4.58 | 1.70 | 1 | 7 |
| Upfront Costs | 3.38 | 1.48 | 1 | 7 |
| Operating Costs | 4.33 | 1.68 | 1 | 7 |
| Range Confidence | 3.99 | 1.88 | 1 | 7 |
| Social Perception | 4.85 | 1.24 | 1 | 7 |
| Reliability & Safety | 4.19 | 1.49 | 1 | 7 |
| **EV Attitudes General** | 4.22 | 1.15 | 1 | 6.71 |

Purchase intent (PI) under the unfavourable scenario is low (mean = 2.66, SD = 1.47), while intent under the favourable scenario (PI2) is higher (mean = 4.00, SD = 1.74). Similarly, policy perceptions (PP) are more positive under the favourable scenario (mean = 4.92, SD = 1.14) than under the unfavourable one (mean = 2.58, SD = 0.825). This can also be highlighted by paired T-tests, as the means of Purchase intent throughout the two scenarios significantly differ with a mean difference of 1.34. Likewise, the means of policy perceptions significantly differ with a mean difference of 2.34. This preliminarily suggests that participants are more willing to consider EVs in supportive policy environments. A detailed overview is provided in Appendix 2.

Participants generally have positive attitudes toward EVs. The environmentally friendly (mean = 4.58, SD = 1.70) and social perception (mean = 4.85, SD = 1.24) dimensions score highest,

while attitudes about upfront costs (mean = 3.38, SD = 1.48) expectedly remain the largest concern. These findings highlight differences between scenarios, with more favourable policies leading to higher purchase intent and better perceptions. Supportive policy environments and positive EV attitudes may play a crucial role in influencing consumer behaviour.

## 5.2. Hypothesis Testing

This section seeks to address the conceptual framework and test the proposed hypotheses, by conducting quantitative tests, both on a broad, and more granular scale. To validate findings and account for potential limitations, it revisits the models with an adjustment for order effects. This analysis will support later inferences regarding the research question, providing insights into the dynamics between policy environments, purchase intent, and consumer attitudes toward EVs and EV related policies.

### 5.2.1. The Impact of Consumers' General EV Attitudes

The first set of models assesses the direct effect of policy environment on purchase intent (Hypothesis 1) and the moderating role of general EV attitudes (Hypothesis 2), as well as the direct effect of policy perceptions on purchase intent (Hypothesis 3) and the moderating role of general EV attitudes (Hypothesis 4). This broad approach gives an understanding of how the consumer's stance on EVs affects the effectiveness of different sets of policies (and their perceptions of them) on their purchase intent. Results are displayed in Table X at the bottom of this section.

#### 5.2.1.1. Hypothesis 1 & 2: Impact of Policy Environment and General EV Attitudes

The first model that was employed covers Hypotheses 1 and 2 and was conducted to evaluate the effect of policy environment on purchase intent, moderated by general EV attitudes. Control

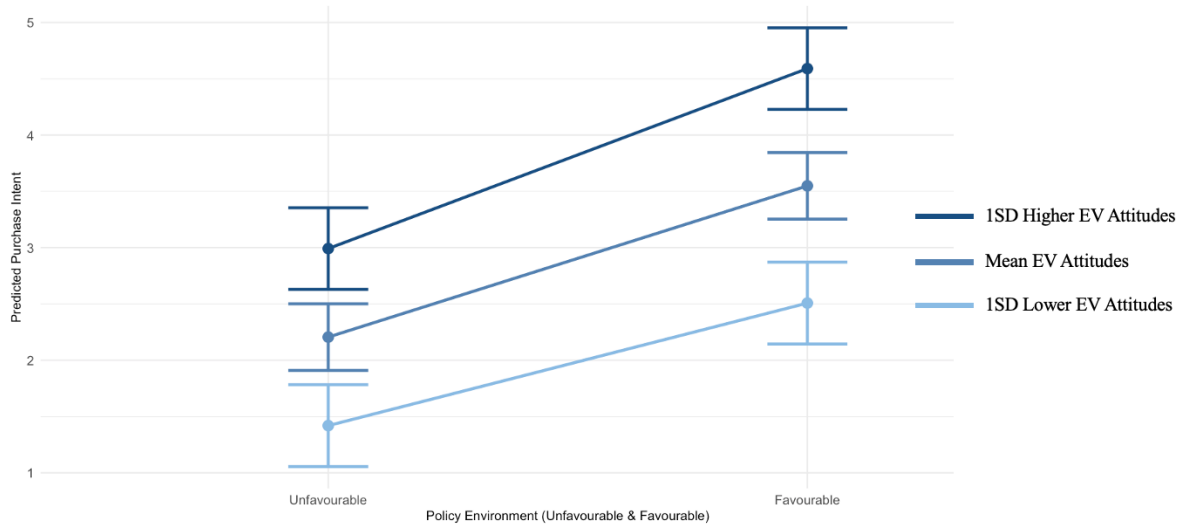
variables included gender, age, income, prior EV ownership, and scenario order. All assumptions were met, as backed up in Appendix 3. The model adopts the following structure:

$$(1)\ PI = \beta_0 + \beta_1 PolicyEnvironment + \beta_2 EVAttitudes + \beta_3(PolicyEnvironment \times EVAttitudes) + \beta_4 Gender + \beta_5 Age + \beta_6 Income + \beta_7 PriorExperience + \beta_8 ScenarioOrder + \epsilon$$

The intercept ($\beta = 1.47$; $p < 0.001$) indicates the baseline purchase intent for individuals exposed to the unfavourable policy environment, with mean-centered EV attitudes, and at reference levels for the control variables (female, young adults, low income, and no prior EV ownership). Results show a substantial and significant effect of policy environment on purchase intent. Being subject to a favourable policy environment increases purchase intent by 1.34 units ($\beta = 1.34$; $p < 0.001$), relative to an unfavourable one. General EV attitudes also significantly predict purchase intent ($\beta = 0.68$; $p < 0.001$), suggesting that for each one standard deviation increase in EV attitudes, purchase intent increases by 0.68 units.

A significant interaction between policy environment and EV attitudes ($\beta = 0.22$; $p < 0.05$) further reveals that the positive effect of a favourable policy environment is amplified for individuals with higher EV attitudes. For instance, an individual with EV attitudes one standard deviation above the mean would experience an additional 0.22-unit increase in purchase intent when exposed to a favourable policy environment, beyond the independent effects of the policy scenario and their attitudes. This is further exemplified in Figure 2, which visualises the moderating effect. In a favourable policy environment, purchase intent is highest for those with positive EV attitudes, shown by the line „1SD Higher“, while an unfavourable environment exhibits lower purchase intent, particularly for individuals with negative EV attitudes („1SD Lower“ line). Yet, in case of an unfavourable policy environment, the lower purchase intent is somewhat dampened by positive attitudes toward EVs, as shown by the „1SD Higher“ line.

**Figure 2** *Interaction Plot: Policy Environment & EV Attitudes*




Control variables showed several noteworthy effects. Middle-aged ($\beta = 0.90$; $p < 0.001$) and older adults ($\beta = 0.82$; $p < 0.01$) reported significantly higher purchase intent compared to young adults. Prior EV ownership ($\beta = 0.84$; $p < 0.01$) also positively impacted purchase intent. Conversely, individuals with high income reported slightly lower purchase intent compared to those in the low-income group ($\beta = -0.44$; $p < 0.05$). Gender was not significant, while scenario order significantly influenced purchase intent ($\beta = 0.51$; $p < 0.01$), indicating that respondents who encountered the favourable policy environment first exhibited slightly higher purchase intent overall.

The model explains a considerable proportion of variance in purchase intent ($R^2 = 0.62$), supporting both Hypotheses 1 and 2. These findings emphasise that policy environments directly influence purchase intent and that EV attitudes moderate this relationship, amplifying the impact of a favourable policy environment for individuals with positive EV attitudes.

5.2.1.2. Hypothesis 3 & 4: Impact of Policy Perceptions and General EV Attitudes

To assess Hypotheses 3 & 4, a second regression model was estimated, to assess the relationship between policy perceptions and purchase intent, with EV attitudes as a moderator. Control variables were consistent with the prior model, and all assumptions were met, as can be seen in Appendix 3. The model adopts the following structure:

(2) $$PI = \beta_0 + \beta_1 PolicyPerceptions + \beta_2 EVAttitudes + \beta_3 (PolicyEnvironment \times EVAttitudes) + \beta_4 Gender + \beta_5 Age + \beta_6 Income + \beta_7 PriorExperience + \beta_8 ScenarioOrder + \epsilon$$

The intercept ($\beta = 2.24$, $p < 0.001$) in model represents the baseline purchase intent for individuals with average (centered) policy perceptions and EV attitudes, and at the reference levels for control variables. Policy perceptions were found to have a strong and significant positive effect on purchase intent ($\beta = 0.49$, $p < 0.001$). This indicates that for every one standard deviation increase in policy perceptions, purchase intent rises by 0.49 units. General EV attitudes also significantly affect purchase intent ($\beta = 0.66$, $p < 0.001$), meaning a one standard deviation increase in EV attitudes corresponds to a 0.66-unit purchase intent increase.

Unlike the first model, the interaction term between policy perceptions and EV attitudes was not significant ($\beta = -0.016$, $p = 0.41$). This suggests that the effect of policy perceptions on purchase intent does not vary significantly based on an individual's EV attitudes. Thus, policy perceptions seem to exhibit a consistent influence across respondents, regardless of their baseline attitudes toward EVs.

Control variables showed patterns largely aligned with the first model. Middle-aged and older adults again reported significantly higher purchase intent compared to young adults. Prior EV ownership positively impacted purchase intent, while high income showed a non-significant estimate. Gender was also not significant, while scenario order significantly influenced

purchase intent, reinforcing the effect of encountering the favourable scenario first, and therefore concerns with order effects.

The model explains a similar amount of variance in purchase intent ($R^2 = 0.63$). These findings support Hypothesis 3, as policy perceptions directly influence purchase intent, but do not support Hypothesis 4, as EV attitudes do not moderate the relationship between policy perceptions and purchase intent. This suggests that policy perceptions influence purchase intent consistently but is not enhanced or impaired by an individual's EV attitudes, contrary to the dynamic observed in the previous model.

**Table 5** *Results Model General EV Attitudes as Moderator*

| | Model (1) Addressing H 1&2 | Model (2) Addressing H 3&4 |
|---|---|---|
| Estimates | Policy Environment | Policy Perceptions |
| Intercept | 1.47*** | 2.24*** |
| | (0.26) | (0.28) |
| Policy Environment (Favourable) | 1.34*** | |
| | (0.12) | |
| Policy Perceptions | | 0.49*** |
| | | (0.05) |
| General EV Attitudes | 0.68*** | 0.66*** |
| | (0.08) | (0.08) |
| Gender (Male) | -0.03 | -0.04 |
| | (0.18) | (0.18) |
| Age (Middle-Aged) | 0.90*** | 0.94*** |
| | (0.23) | (0.24) |
| Age (Older Adults) | 0.82** | 0.89*** |
| | (0.23) | (0.22) |
| Income (High Income) | -0.44* | -0.31 |
| | (0.21) | (0.20) |
| Prior Experience (Ownership) | 0.84** | 0.67* |
| | (0.24) | (0.25) |
| Scenario Order (Favourable First) | 0.51** | 0.41* |
| | (0.17) | (0.17) |
| Policy Environment x General EV Attitudes | 0.22* | |
| | (0.11) | |
| Policy Perceptions x General EV Attitudes | | -0.02 |
| | | (0.04) |
| $R^2$ | 0.617 | 0.632 |
| Adjusted $R^2$ | 0.601 | 0.617 |
| F-Statistic | 89.89 | 76.58 |
| | (DF = 9; 114) | (DF = 9; 114) |

*Note: *** p < 0.001; ** p < 0.01; * p < 0.05; • p < 0.1*

### 5.2.2. The Impact of Individual EV Attitudes

Building on the broader analysis concerning consumers' overall stance or attitudes on EVs, the subsequent models take a more granular approach, delving into attitudes on different dimensions, environmental friendliness, upfront costs, operating costs, range, reliability & safety, as well as social perception. Different regression models are estimated, to give an understanding of the different dimensions of EV attitudes, while firstly focusing on the independent variable Policy Environment to cover Hypotheses 1 & 2, and secondly focusing on the independent variable Policy Perceptions for Hypotheses 3 & 4. Upon analysing, no concerns were raised regarding assumption checks.

#### 5.2.2.1. Hypothesis 1 & 2: The Impact of Policy Environment and Individual EV Attitudes

While the favourable policy environment significantly boosts purchase intent in general, its effect is amplified by certain attitudes particularly. For instance, the interaction between the favourable policy environment and the belief that EVs are cost-efficient is marginally significant and positive ($\beta = 0.15$; $p < 0.1$). This indicates that for consumers who view EVs as cost-efficient (operating costs), supportive policies further enhance their intent to purchase an EV. A similar trend is observed for reliability and safety, with a significant interaction term ($\beta = 0.25$; $p < 0.01$). These findings suggest that favourable policies are amplified by positive attitudes toward said EV features, further contributing to purchase intentions.

In contrast, some attitudes such as range confidence and social perceptions do not significantly interact with the policy environment. This lack of significant interaction suggests that while favourable policies broadly encourage EV purchase intent, their additional impact is not further induced by these attitudes.

**Table 6** *Results of Models - Policy Environment x Individual EV Attitudes*

| Model Using EV Attitude: | Intercept | β EV Attitude | β Interaction Term | $R^2$ |
|---|---|---|---|---|
| Environmental Friendliness | 1.65*** | 0.42*** | 0.12 • | 0.568 |
| | (0.31) | (0.06) | (0.07) | |
| Upfront Costs | 1.31*** | 0.33** | 0.02 | 0.439 |
| | (0.35) | (0.09) | (0.09) | |
| Operating Costs | 1.59*** | 0.36*** | 0.15 • | 0.530 |
| | (0.32) | (0.07) | (0.08) | |
| Range Confidence | 1.15*** | 0.33*** | -0.02 | 0.489 |
| | (0.31) | (0.06) | (0.06) | |
| Reliability & Safety | 1.46*** | 0.39*** | 0.25** | 0.546 |
| | (0.30) | (0.07) | (0.08) | |
| Social Perception | 1.44*** | 0.29** | 0.14 | 0.437 |
| | (0.36) | (0.10) | (0.10) | |

*Note: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; • $p < 0.1$*

5.2.2.2. Hypothesis 3 & 4: The Impact of Policy Perceptions and Individual EV Attitudes

Policy perceptions also show strong positive effects on purchase intent overall, but their interactions with specific EV attitudes are more limited. A significant interaction is estimated between policy perceptions and range confidence ($\beta = -0.05$; $p < 0.05$), suggesting a small diminishing effect. Consumers who already feel confident in an EV's range rely less on their policy perceptions to shape purchase intent. This points to a dynamic where confidence in the range of EVs reduces the dependence on what a consumer thinks of policies.

Other attitudes, such as environmental friendliness and cost-related beliefs, exhibit significant main effects, but lack proving any interaction effects. For instance, the belief that EVs are environmentally friendly significantly increases purchase intent ($\beta = 0.43$; $p < 0.001$), but in interaction with policy perceptions, does not show moderating effects. Similarly, cost-related attitudes, including operating costs and upfront costs, directly drive purchase intent, with minimal interaction with policy perceptions. These findings suggest that while positive policy perceptions are critical, their interplay with specific consumer attitudes is less important.

**Table 7** *Results of Models - Policy Perceptions x Individual EV Attitudes*

| Model Using EV Attitude: | Intercept | β EV Attitude | β Interaction Term | $R^2$ |
|---|---|---|---|---|
| Environmental Friendliness | 2.41*** | 0.43*** | -0.01 | 0.621 |
| | (0.30) | (0.05) | (0.03) | |
| Upfront Costs | 2.13*** | 0.24** | -0.04 | 0.505 |
| | (0.35) | (0.08) | (0.03) | |
| Operating Costs | 2.34*** | 0.36*** | -0.01 | 0.576 |
| | (0.32) | (0.06) | (0.03) | |
| Range Confidence | 1.99*** | 0.27*** | -0.05* | 0.556 |
| | (0.32) | (0.06) | (0.02) | |
| Reliability & Safety | 2.23*** | 0.42*** | -0.01 | 0.579 |
| | (0.30) | (0.06) | (0.03) | |
| Social Perception | 2.21*** | 0.25* | 0.01 | 0.500 |
| | (0.36) | (0.09) | (0.04) | |

*Note: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; • $p < 0.1$*

### 5.3. Accounting for order Effects

The study employed a within-groups design, where participants were presented with two policy scenarios, one unfavourable and one favourable, and provided responses for each. This design offers a good premise for assessing the German EV market and its political landscape. However, within-groups designs can introduce carryover biases, as highlighted by Charness et al. (2012). To mitigate this, the order of the scenarios was randomized using Qualtrics' randomisation function. While this approach reduces the risk of systematic bias (e.g., always presenting the unfavourable scenario first), it does not entirely eliminate potential order effects, which may still require further analysis, as also found in prior analyses, where order vastly posited a significant effect on purchase intent.

To assess whether the earlier findings regarding the moderating effect of EV attitudes on the relationships between policy environment and purchase intent, and policy perceptions and purchase intent are robust to potential order effects, the main models, assessing the moderation effect of general EV attitudes were retested using subsets of the data. Specifically, separate analyses were conducted for participants who first viewed the unfavourable policy scenario and

those who first viewed the favourable policy scenario.

For the subset of participants who viewed the unfavourable policy scenario first, the interaction between policy environment and EV attitudes remained significant ($\beta = 0.43$; $p < 0.05$), suggesting that individuals' EV attitudes continued to moderate the relationship between policy environment and purchase intent, as previously observed. Similarly, EV attitudes in this subset did not moderate the relationship between Policy Perceptions and Purchase Intent, consistent with earlier findings ($\beta = 0.05$, $p > 0.1$). For the subset of participants who were exposed to the favourable policy environment first, the results for policy environment and EV attitudes showed a diminished but also non-significant interaction ($\beta = 0.03$; $p > 0.1$), indicating that the earlier findings may be somewhat tarnished, yet they remain directionally aligned. Likewise, the interaction between policy perceptions and EV attitudes ($\beta = -0.06$; $p > 0.1$) did not present significance, aligning with earlier findings.

These analyses suggest that earlier mentioned results from the full dataset are generally robust to order effects, particularly in the case of the policy environment model, yet some concerns in the strength of the interaction depending on the order in which scenarios were presented persist, warranting further research. Nevertheless, the overall direction of results supports the moderating role of EV attitudes in the relationship between policy environment and Purchase Intent. The absence of a significant interaction between policy perceptions and EV attitudes remains consistent across different subsets of the data. This reinforces the reliability of the earlier findings and suggests limited influence of order effects on the key results.

# 6. Discussion

The automotive industry has undergone meaningful change in recent years, shifting the sector away from the long-established ICE vehicle toward the greener alternative, the EV. While EV technology is rapidly advancing, EVs often are still more expensive than their ICE counterparts. Additionally, consumers remain concerned about their technical capabilities, especially their driving range. In Germany, for years, to counteract concerns, there was a series of incentives in place compelling consumers to adopt EVs. However, upon the removal of the well-established "Umweltbons", the German automotive market saw a decline in EV sales. To assess why and which policies are important to German consumers and how their views on EVs impact the importance of those policies, this study employed analyses, investigating exactly that dynamic. While detailed results can be found in the previous chapter, this section discusses the main findings made, the theoretical and practical implications, and limitations to the employed research design and future directions for research.

## 6.1. Main Findings

To assess the dynamics of policy environments and EV purchase intentions in the presence of diverse consumer attitudes toward EVs, some hypotheses were formed to be assessed by means of regression analyses. The first hypothesis (*H1: Policy Environment directly influences Purchase Intent.*) can be confirmed, as policy environment is proven to have a direct significant impact on purchase intent, highlighting the importance of the presence of favourable policies to drive consumers‘ purchase intent. The third hypothesis (*H3: Policy Perceptions directly influence Purchase Intent.*) can also be confirmed, as the understanding of policies also plays a vital role in forming purchase intent. This confirms that consumers, when they perceive policies as favourable, can generally facilitate the adoption of EVs.

When adding the effect of consumer's attitudes to the equation however, findings are mixed. While the second hypothesis (*H2: EV attitudes moderate the effect of Policy Environment on Purchase Intent.*) proves to hold, the same cannot be said for hypothesis 4 (*H4: EV attitudes moderate the effect of Policy Perceptions on Purchase Intent.*). The results reveal that consumers who have positive perceptions toward EVs and are subject to a favourable set of policies exhibit increased purchase intent. In contrast, positive attitudes toward EVs, while being subject to an unfavourable set of policies, can dampen the adverse effect caused by a lack of policy support. These results are not replicated when assessing policy perceptions. Thus, consumers with favourable attitudes toward EVs do not exhibit any significantly higher intent to purchase when they deem supportive policies as favourable. Overall, the analyses somewhat support the narrative of a moderating effect of EV attitudes when it comes to EV purchase intent, offering new premises for future research.

Moreover, the more granular approach focusing on individual EV attitudes reveals that positive attitudes toward the reliability and safety of EVs can enhance the effect of favourable policies on purchase intent. When assessing the interaction terms with policy perceptions, a finding is that the effect of favourable policies diminishes those who are already confident in range, potentially because those consumers do not require range anxiety mitigating policies.

Other findings replicated across the analysed regression models include the diminished purchase intent of higher-income individuals compared to lower-income individuals. This may be due to the correlation of income and age, which suggests that higher-income, thus likely older individuals are more averse to EVs. This makes sense, especially in Germany, where people are conservative toward EVs, especially from foreign brands (European Investment Bank (EIB) 2022).

Further replicable findings are that prior ownership of an EV is highly important for driving EV purchase intent. This aligns with the findings of Carley et al. (2019), who argue the importance of EV experience in EV adoption. The results show that consumers who have at least previously owned an EV are estimated to exert significantly higher purchase intent than those who have not. This consideration is especially important for deriving the implications of this study.

### 6.2. Implications

Conducting different regression analyses yields a series of findings and results. While those results provide insights into the dynamics of the different variables, what those results imply on a theoretical and practical scale remains to be discussed. In theory, the study provides new researchable directions to complement the application of TPB in the realm of EVs. In practice, the study points in the direction of finding consolidated and coordinated political and industrial actions, leveraging the dynamic of incentive policies and consumers' views of EVs.

#### 6.2.1. Theoretical Implications

This study contributes to the existing field of literature on EV adoption by investigating the direct interplay of policy environments, policy perceptions and consumer attitudes in shaping purchase intent. Most prior research focuses exclusively on the direct effects of EV attitudes or political measures on purchase intent by utilising the TPB, as done by Haustein et al. (2021). The model in this study is based on the TPB; however, contrary to prior literature vastly focusing on the direct antecedents to intent, this study offers an interactive perspective of those antecedents. Brase (2018) discusses the utilisation of TPB in EV adoption literature but criticises its depth in capturing the actual notions of pre-intent. With this study, the understanding is expanded by viewing the interaction of the factors introduced by Ajzen (1991),

especially attitudes and perceived behavioural control. In terms of this study, those factors correspond to EV attitudes and policy environments/perceptions, showing that there may be interaction effects, when assessing purchase intent.

Additionally, this study provides a detailed overview and case study into one of the leading EV markets. While prior research has been done on the implications of German consumers on the EV and automotive industry, such as the work done by Pötz et al. (2014), this study offers a modern perspective looking at the new unique dynamics capturing the cessation of the Umweltbonus, the implementation of trade tariffs, staggering market saturation and questions about the commitment to climate goals (European Commission 2024c; Bundesregierung 2023). Though the market is maturing, in light of new challenges and developments, German consumers are still somewhat conservative when it comes to EVs (EIB 2023).

A further important contribution to theory is the distinction of policy perceptions, rather than assessing the impact of policies directly, existing literature on this approach is limited with the work of Wang et al. (2021), largely addressing the perceptions on monetary incentives in isolation. This study focuses on the way consumers perceive policies, or policy mixes as a whole. Though results show limited relevance, the notion offers grounds for future research.

### 6.2.2. Practical Implications

Based on the finalised analyses and the main findings, implications can be drawn for both policymakers and automakers. For instance, automakers' marketing campaigns should directly target consumers’ attitudes toward EVs, which can enhance purchase intent outcomes, as the literature supports (Dutta and Hwang 2021).

Furthermore, it can be beneficial for people to experience EVs firsthand, as ownership or prior ownership has pronounced effects on consumers and their purchase intent. This is supported not only by existing literature, such as the work of Carley et al. (2019) but also by the findings of this study. Given that prior experience imperatively impacts consumers, automakers and EV dealerships should prioritise giving potential customers the possibility to drive or rent an EV and consequently experience it, enhancing their prior experience.

Overall, policymakers' and automakers' actions should align. The study's evidence suggests that favourable policies, in conjunction with favourable attitudes toward EVs, may further bolster purchase intent and, therefore, the dispersion of EVs. The alignment of industry and politics seems to play a vital role in safeguarding the phasing out of EVs, or at least the push to reach climate goals.

### 6.3. Limitations

Though the study reveals insights into the dynamics of policies, EV attitudes, and consumer purchase intent, the research design has some limitations, warranting careful consideration when drawing inferences or generalising based on the results.

Firstly, this study's within-subjects design has introduced order effects or carryover biases, which significantly influence results. Although randomisation was applied to mitigate these effects, and robustness checks were conducted to assess their impact, these biases remain a methodological limitation. Consumers who were exposed to one scenario first (for instance, the unfavourable one) seem to have inflated or deflated their subsequent responses, warranting caution when interpreting these findings.

Secondly, the employed sampling method is not optimal. While the approach of snowball sampling offered convenient and efficient data collection, the sample cannot assure random selection of participants and is therefore likely not generalisable due to potential selection bias. Stratified random sampling and quota sampling are more appropriate and offer possibilities in future research. Thirdly, the data includes strictly self-reported estimates of personal purchase intent. While this is a valid indication of purchase intent in the scope of this study, it likely is inflated compared to an individual's actual readiness to purchase. Wang et al. (2017) point out the disparities between reported intent and actual intent.

Finally, a limited scope of the German market offers narrowed-down applicability to broader theory or practice. While the German automotive industry plays an important role in the global context, its cultural, economic, and political dynamics tend not to translate to broader international contexts.

### 6.4. Future Research

Due to the limitations discussed, namely the within-subjects design, future research could focus on assessing the dynamics of policy environments or policy perceptions and purchase intent, with the moderating role of EV attitudes, using between-subjects designs. This would offer more robust results due to the neglect of carryover biases. To expand on that, a more specific approach to specific policies could be an interesting complementary approach in the context of EV attitudes.

Moreover, specific additional measures, such as willingness to pay, can be employed. Additionally, experimental designs, with decision-making within realistic frames, could provide purchase intent measures closer to actual purchase intent than reported purchase intent.

Future research can also expand the scope of the research, going beyond the German market and potentially comparing two or more important automotive markets.

Finally, a focus on policy perceptions can be a meaningful direction for future research. Literature is limited, with accounts of Wang et al. (2021) discussing policy clarity and other aspects in terms of monetary incentives. However, since people have different subjective views on policies due to demographical or socio-economic factors, further research could offer valuable insights.

## 7. Conclusion

This study investigated how policy environments, policy perceptions, and consumer attitudes shape purchase intent for electric vehicles in Germany. The findings confirm that supportive policies such as monetary incentivisation, or infrastructural expansion directly contribute to consumers' purchase intent. Moreover, the role of positive policy perceptions including consistency, accessibility and affordability was discussed, as it is crucial that consumers perceive policies as favourable to shape urchase intent.

Consumer attitudes on EVs such ass beliefs about the environmental friendliness, safety and reliability, as well as the social image of driving an EV were found to amplify the impact of favourable policies. Yet concerns about range may promote the contrary and remain an important issue in the field of EV adoption.

The study extends on TPB and offers new perspectives on expanding research into new directions. Though limited to the German market, research can be expanded, to gain broader understandings of the interplay of policies, consumers and intent to purchase. In summary, the

research demonstrates that clear policies, positive perceptions, and supportive attitudes are essential for accelerating EV adoption and achieving climate goals.

# 8. References


Ajzen, Icek. 1991. “The Theory of Planned Behavior.” *Organizational Behavior and Human Decision Processes* 50 (2): 179–211. https://doi.org/10.1016/0749-5978(91)90020-t.

Axsen, Jonn, Patrick Plötz, and Michael Wolinetz. 2020. “Crafting Strong, Integrated Policy Mixes for Deep CO2 Mitigation in Road Transport.” *Nature Climate Change* 10 (9): 809–18. https://doi.org/10.1038/s41558-020-0877-y.

Bakker, Sjoerd, Kees Maat, and Bert Van Wee. 2014. “Stakeholders Interests, Expectations, and Strategies Regarding the Development and Implementation of Electric Vehicles: The Case of the Netherlands.” *Transportation Research Part a Policy and Practice* 66 (May): 52–64. https://doi.org/10.1016/j.tra.2014.04.018.

Bockarjova, M., and L. Steg. 2014. “Can Protection Motivation Theory Predict Pro-environmental Behavior? Explaining the Adoption of Electric Vehicles in the Netherlands.” *Global Environmental Change* 28 (August): 276–88. https://doi.org/10.1016/j.gloenvcha.2014.06.010.

Bonges, Henry A., and Anne C. Lusk. 2015. “Addressing Electric Vehicle (EV) Sales and Range Anxiety Through Parking Layout, Policy and Regulation.” *Transportation Research Part a Policy and Practice* 83 (December): 63–73. https://doi.org/10.1016/j.tra.2015.09.011.

Brase, Gary L. 2018. “What Would It Take to Get You Into an Electric Car? Consumer Perceptions and Decision Making About Electric Vehicles.” *The Journal of Psychology* 153 (2): 214–36. https://doi.org/10.1080/00223980.2018.1511515.

Bundesministerium für Digitales und Verkehr. 2024. Fahranfänger/Innen Und Begleitetes Fahren Ab 17. https://bmdv.bund.de/SharedDocs/DE/Artikel/StV/Strassenverkehr/fahranfaenger-innen-und-begleitetes-fahren-ab-17.html.

Bundesregierung. 2023. Umweltbonus Läuft Aus. Die Bundesregierung Informiert | Startseite. https://www.bundesregierung.de/breg-de/aktuelles/faq-umweltbonus-1993830.

Carley, S., Siddiki, S., and Nicholson-Crotty, S. 2019. "Evolution of Plug-in Electric Vehicle Demand: Assessing Consumer Perceptions and Intent to Purchase over Time." Transportation Research Part D: Transport and Environment 70: 94–111. https://doi.org/10.1016/j.trd.2019.04.002.

Charness, Gary, Uri Gneezy, and Michael A. Kuhn. 2011. “Experimental Methods: Between-subject and Within-subject Design.” *Journal of Economic Behavior & Organization* 81 (1): 1–8. https://doi.org/10.1016/j.jebo.2011.08.009.

Dahl, Jordyn. 2024. “5 Things to Know About Europe’s Electric Vehicle Transition.” *POLITICO*, August 22, 2024. https://www.politico.eu/article/5-things-to-know-europe-electric-vehicle-transition-green-deal/.

Degirmenci, Kenan, and Michael H. Breitner. 2017. “Consumer Purchase Intentions for Electric Vehicles: Is Green More Important Than Price and Range?” *Transportation Research Part D Transport and Environment* 51 (February): 250–60. https://doi.org/10.1016/j.trd.2017.01.001.

Dijk, Marc, Renato J. Orsato, and René Kemp. 2012. “The Emergence of an Electric Mobility Trajectory.” *Energy Policy* 52 (May): 135–45. https://doi.org/10.1016/j.enpol.2012.04.024.

Dutta, Bireswar, and Hsin-Ginn Hwang. 2021. “Consumers Purchase Intentions of Green Electric Vehicles: The Influence of Consumers Technological and Environmental Considerations.” *Sustainability* 13 (21): 12025. https://doi.org/10.3390/su132112025.

Egnér, Filippa, and Lina Trosvik. 2018. “Electric Vehicle Adoption in Sweden and the Impact of Local Policy Instruments.” *Energy Policy* 121 (July): 584–96. https://doi.org/10.1016/j.enpol.2018.06.040.

EIB. 2022. “Germans Seem Less Inclined to Buy Electric or Hybrid Cars Than Their European Neighbours - How Climate Considerations Affect Germans’ Daily Life Choices.” European Investment Bank. January 28, 2022. https://www.eib.org/en/press/all/2022-041-germans-seem-less-inclined-to-buy-electric-or-hybrid-cars-than-their-european-neighbours-how-climate-considerations-affect-germans-daily-life-choices.

European Commission. 2022. "Zero Emission Vehicles: First ‘Fit for 55‘ Deal Will End the Sale of New $CO_2$ Emitting Cars in Europe by 2035." European Commission Press Corner. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6462.

European Commission. 2024a. About the Connecting Europe Facility. *European Climate,* Infrastructure and Environment Executive Agency. https://cinea.ec.europa.eu/programmes/connecting-europe-facility/about-connecting-europe-facility_en.

European Commission. 2024b. Commission Makes €1bn Available for Recharging and Refuelling Points Under the Connecting Europe Facility (CEF). Mobility and Transport. February 29, 2024. https://transport.ec.europa.eu/news-events/news/commission-makes-eu1bn-available-recharging-and-refuelling-points-under-connecting-europe-facility-2024-02-29_en.

European Commission. 2024c. Definitive Duties on BEV Imports From China. European Commission October 29, 2024. https://ec.europa.eu/commission/presscorner/detail/en/ip_24_5589.

Figenbaum, Erik. 2016. “Perspectives on Norway’s Supercharged Electric Vehicle Policy.” *Environmental Innovation and Societal Transitions* 25 (November): 14–34. https://doi.org/10.1016/j.eist.2016.11.002.

Cecere, Grazia, Nicoletta Corrocher, and Marco Guerzoni. 2018. “Price or Performance? A Probabilistic Choice Analysis of the Intention to Buy Electric Vehicles in European Countries.” *Energy Policy* 118 (March): 19–32. https://doi.org/10.1016/j.enpol.2018.03.034.

Geels, Frank W. 2012. “A Socio-technical Analysis of Low-carbon Transitions: Introducing the Multi-level Perspective Into Transport Studies.” Journal of Transport Geography 24 (February): 471–82. https://doi.org/10.1016/j.jtrangeo.2012.01.021.

Greenwald, Anthony G. 1976. “Within-subjects Designs: To Use or Not to Use?” *Psychological Bulletin* 83 (2): 314–20. https://doi.org/10.1037/0033-2909.83.2.314.

Grostern, Joey. 2024. European Commission’s Chinese EV Tariffs Plan to Proceed Despite German Opposition. Clean Energy Wire. https://www.cleanenergywire.org/news/european-commissions-chinese-ev-tariffs-plan-proceed-despite-german-opposition.

Habich-Sobiegalla, Sabrina, Genia Kostka, and Niklas Anzinger. 2019. “Citizens’ Electric Vehicle Purchase Intentions in China: An Analysis of Micro-level and Macro-level Factors.” *Transport Policy* 79 (May): 223–33. https://doi.org/10.1016/j.tranpol.2019.05.008.

Harris, D. C. 2010. "Charles David Keeling and the Story of Atmospheric $CO_2$ Measurements." Analytical Chemistry 82 (19): 7865–70. https://doi.org/10.1021/ac1001492.

Haustein, Sonja, Anders Fjendbo Jensen, and Elisabetta Cherchi. 2020. “Battery Electric Vehicle Adoption in Denmark and Sweden: Recent Changes, Related Factors and Policy Implications.” *Energy Policy* 149 (December): 112096. https://doi.org/10.1016/j.enpol.2020.112096.

Hawkins, Troy R., Ola Moa Gausen, and Anders Hammer Strømman. 2012. “Environmental Impacts of Hybrid and Electric Vehicles—a Review.” *The International Journal of Life Cycle Assessment* 17 (8): 997–1014. https://doi.org/10.1007/s11367-012-0440-9.

Higueras-Castillo, Elena, Alberto Guillén, Luis-Javier Herrera, and Francisco Liébana-Cabanillas. 2020. “Adoption of Electric Vehicles: Which Factors Are Really Important?” *International Journal of Sustainable Transportation* 15 (10): 799–813. https://doi.org/10.1080/15568318.2020.1818330.

Hu, Xianfeng, Shanyong Wang, Rongting Zhou, Lan Gao, and Zujun Zhu. 2023. “Policy Driven or Consumer Trait Driven? Unpacking the EVs Purchase Intention of Consumers From the Policy and Consumer Trait Perspective.” *Energy Policy* 177 (March): 113559. https://doi.org/10.1016/j.enpol.2023.113559.

IEA. 2023. "Cars and Vans." International Energy Agency. https://www.iea.org/energy-system/transport/cars-and-vans.

IEA. 2024. “Global EV Outlook 2024” International Energy Agency Reports. https://www.iea.org/reports/global-ev-outlook-2024

Intergovernmental Panel on Climate Change. 2023. AR6 Synthesis Report: Climate Change 2023. Sixth Assessment Report. https://www.ipcc.ch/report/sixth-assessment-report-cycle/.

Ivanova, G., and Moreira, A. C. 2023. "Antecedents of Electric Vehicle Purchase Intention from the Consumer’s Perspective: A Systematic Literature Review." Sustainability 15 (4): 2878. https://doi.org/10.3390/su15042878.

Kim, Jae Hun, Gunwoo Lee, Ji Young Park, Jungyeol Hong, and Juneyoung Park. 2019. “Consumer Intentions to Purchase Battery Electric Vehicles in Korea.” *Energy Policy* 132 (June): 736–43. https://doi.org/10.1016/j.enpol.2019.06.028.

Kraftfahrt-Bundesamt (KBA) 2024. Neuzulassungen Von Personenkraftwagen (Pkw) Im Jahresverlauf 2024 Nach Marken Und Alternativen Antrieben  Pressemitteilungen – Kraftfahrt-Bundesamt.” https://www.kba.de/DE/Presse/Pressemitteilungen/AlternativeAntriebe/2024/pm36_2024_Antriebe_09_24_komplett.html;jsessionid=25A9CBDC4FB52DD93EC270F537BF8507.live11312.

Lashari, Zulfiqar Ali, Joonho Ko, and Junseok Jang. 2021. “Consumers’ Intention to Purchase Electric Vehicles: Influences of User Attitude and Perception.” *Sustainability* 13 (12): 6778. https://doi.org/10.3390/su13126778.

Lévay, Petra Zsuzsa, Yannis Drossinos, and Christian Thiel. 2017. “The Effect of Fiscal Incentives on Market Penetration of Electric Vehicles: A Pairwise Comparison of Total Cost of Ownership.” *Energy Policy* 105 (March): 524–33. https://doi.org/10.1016/j.enpol.2017.02.054.

Lieven, Theo. 2015. “Policy Measures to Promote Electric Mobility – a Global Perspective.” *Transportation Research Part a Policy and Practice* 82 (September): 78–93. https://doi.org/10.1016/j.tra.2015.09.008.

Martins, H., C.O. Henriques, J.R. Figueira, C.S. Silva, and A.S. Costa. 2023. “Assessing Policy Interventions to Stimulate the Transition of Electric Vehicle Technology in the European Union.” *Socio-Economic Planning Sciences* 87 (January): 101505. https://doi.org/10.1016/j.seps.2022.101505.

Parker, C., Scott, S., and Geddes, A. 2019. Snowball Sampling. SAGE. https://eprints.glos.ac.uk/6781/

Platini, I. 2024. "German Manufacturers Are Lowering EV Prices Following the Removal of the Bonus: What Consequences Will This Have?" Mobility Portal, February 19. https://mobilityportal.eu/german-manufacturers-reducing-prices-evs/.

Plötz, Patrick, Jonn Axsen, Simon A. Funke, and Till Gnann. 2019. “Designing Car Bans for Sustainable Transportation.” *Nature Sustainability* 2 (7): 534–36. https://doi.org/10.1038/s41893-019-0328-9.

Plötz, Patrick, Uta Schneider, Joachim Globisch, and Elisabeth Dütschke. 2014. “Who Will Buy Electric Vehicles? Identifying Early Adopters in Germany.” *Transportation Research Part a Policy and Practice* 67 (July): 96–109. https://doi.org/10.1016/j.tra.2014.06.006.

Qadir, Sikandar Abdul, Furkan Ahmad, Abdulla Mohsin a B Al-Wahedi, Atif Iqbal, and Amjad Ali. 2024. “Navigating the Complex Realities of Electric Vehicle Adoption: A Comprehensive Study of Government Strategies, Policies, and Incentives.” *Energy Strategy Reviews* 53 (April): 101379. https://doi.org/10.1016/j.esr.2024.101379.

Rezvani, Zeinab, Johan Jansson, and Jan Bodin. 2014. “Advances in Consumer Electric Vehicle Adoption Research: A Review and Research Agenda.” *Transportation Research Part D Transport and Environment* 34 (November): 122–36. https://doi.org/10.1016/j.trd.2014.10.010.

Sheldon, Tamara L. 2022. “Evaluating Electric Vehicle Policy Effectiveness and Equity.” *Annual Review of Resource Economics* 14 (1): 669–88. https://doi.org/10.1146/annurev-resource-111820-022834.

Sheldon, Tamara L., and Rubal Dua. 2024. “The Dynamic Role of Subsidies in Promoting Global Electric Vehicle Sales.” *Transportation Research Part a Policy and Practice* 187 (July): 104173. https://doi.org/10.1016/j.tra.2024.104173.

Song, Mee Ryoung, Wujin Chu, and Meeja Im. 2021. “The Effect of Cultural and Psychological Characteristics on the Purchase Behavior and Satisfaction of Electric Vehicles: A Comparative Study of US and China.” *International Journal of Consumer Studies* 46 (1): 345–64. https://doi.org/10.1111/ijcs.12684.

Statharas, S., Moysoglou, Y., Siskos, P., Zazias, G., and Capros, P. 2019. "Factors Influencing Electric Vehicle Penetration in the EU by 2030: A Model-Based Policy Assessment." Energies 12 (14): 2739. https://doi.org/10.3390/en12142739.

Tesla. 2024. Tesla Vehicle Safety Report | Tesla. https://www.tesla.com/VehicleSafetyReport.

Thériault, Rémi. 2020. “Quickly Test Linear Regression Assumptions.” December 25, 2020. https://cran.r-project.org/web/packages/rempsyc/vignettes/assumptions.html.

UN Climate Change. 2024. "The Paris Agreement – What Is the Paris Agreement." UNFCCC. https://unfccc.int/process-and-meetings/the-paris-agreement.

UN Climate Change. 2023. "New Analysis of National Climate Plans: Insufficient Progress Made, COP28 Must Set Stage for Immediate Action." UN Climate Press Release. https://unfccc.int/news/new-analysis-of-national-climate-plans-insufficient-progress-made-cop28-must-set-stage-for-immediate.

United Nations. 2021. "Era Free of Fossil-Fuel Powered Vehicles Comes into Focus at COP26; Draft Outcome Is Met with Calls for More Ambition." UN News. https://news.un.org/en/story/2021/11/1105462.

Wang, Shanyong, Jun Li, and Dingtao Zhao. 2017. “The Impact of Policy Measures on Consumer Intention to Adopt Electric Vehicles: Evidence From China.” *Transportation Research Part a Policy and Practice* 105 (August): 14–26. https://doi.org/10.1016/j.tra.2017.08.013.

Wang, Xiao-Wu, Yu-Mei Cao, and Ning Zhang. 2021. “The Influences of Incentive Policy Perceptions and Consumer Social Attributes on Battery Electric Vehicle Purchase Intentions.” *Energy Policy* 151 (February): 112163. https://doi.org/10.1016/j.enpol.2021.112163.

Zhang, Wenliang, Shanyong Wang, Liang Wan, Zengtian Zhang, and Dingtao Zhao. 2021. “Information Perspective for Understanding Consumers’ Perceptions of Electric Vehicles and Adoption Intentions.” *Transportation Research Part D Transport and Environment* 102 (December): 103157. https://doi.org/10.1016/j.trd.2021.103157.

# 9. Appendices

## Appendix 1 – Methodology Additional Materials

**Table 1 (*Appendix 1)*** *Cleaned Data - Overview Table*

| Step | Initial Responses | Excluded Responses | Final Responses |
|---|---|---|---|
| Raw Dataset | 141 | - | - |
| Completeness | 141 | 13 | 128 |
| Time Spent | 128 | 5 | 123 |
| Outliers | 123 | 7 | 116 |
| Linear responses | 116 | 1 | **115** |

**Table 2 (*Appendix 1)*** *The Policy Environments*

| Policy Environment | |
|---|---|
| Unfavourable (0) | Favourable (1) |
| Subsidies Reduced: The government has recently cut subsidies and redirected funds to other areas. | Incentives: Subsidies and measures remain in place to make EVs more affordable for consumers. |
| Revised Strategy for Phasing Out Conventional Vehicles: The timeline for phasing out conventional vehicles is being reassessed. | Tariffs on Foreign Electric Vehicles: Tariffs on foreign electric vehicles remain relatively low, fostering a diverse market. |
| Expansion of Charging Infrastructure: The charging infrastructure continues to expand steadily, but some rural regions remain underserved. | Expansion of Charging Infrastructure: The charging infrastructure continues to expand steadily, with more and more regions being connected. |
| New Tariffs: Tariffs of 20–35% have been imposed on some foreign electric vehicles, particularly on Chinese models. | Strategy for Phasing Out Conventional Vehicles: The government intends to adhere to the plan of phasing out conventional vehicles by 2035. |

*Note: Policies based on ACEA (2024)*

## Appendix 2 – Descriptive Statistics

**Table 1** ***(Appendix 2)*** *Paired T-Tests: Mean Differences of Key Variables*

| | Mean Difference | t-stat | df | p-value | 95% CI |
|---|---|---|---|---|---|
| Purchase Intent | 1.34 | 11.05 | 114 | < 0.001 | {1.10;1.58} |
| Policy Perceptions | 2.34 | 16.62 | 114 | < 0.001 | {2.06;2.62} |

**Table 2** ***(Appendix 2)*** *Correlation Matrix - Key Variables and EV Attitudes*

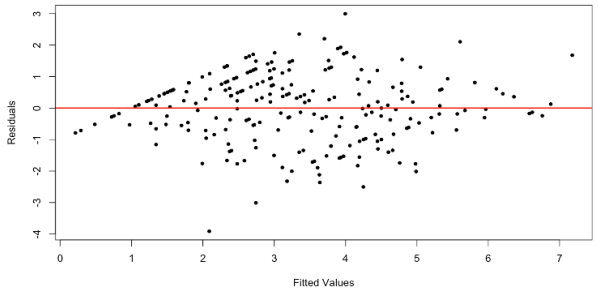
| | Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Purchase Intent Unfav. | 1 | | | | | | | | | |
| 2 | Purchase Intent Fav. | 0.68 | 1 | | | | | | | | |
| 3 | Policy Perceptions Unfav. | 0.18 | -0.08 | 1 | | | | | | | |
| 4 | Policy Perceptions Fav. | 0.31 | 0.57 | -0.16 | 1 | | | | | | |
| 5 | Environmentally Friendly | 0.57 | 0.60 | -0.04 | 0.43 | 1 | | | | | |
| 6 | Upfront Cost Reasonable | 0.35 | 0.31 | 0.15 | 0.43 | 0.40 | 1 | | | | |
| 7 | Operating Cost Efficient | 0.48 | 0.55 | -0.04 | 0.50 | 0.74 | 0.42 | 1 | | | |
| 8 | Range Confidence | 0.40 | 0.32 | 0.01 | 0.38 | 0.45 | 0.39 | 0.47 | 1 | | |
| 9 | Reliability & Safety | 0.46 | 0.60 | -0.01 | 0.47 | 0.60 | 0.36 | 0.59 | 0.45 | 1 | |
| 10 | Social Perceptions | 0.32 | 0.37 | 0.20 | 0.33 | 0.36 | 0.36 | 0.32 | 0.15 | 0.30 | 1 |

# Appendix 3 – Hypothesis Testing

## Overview 1 *(Appendix)* *Assumption Checks Main Model (1)*

**Linearity**

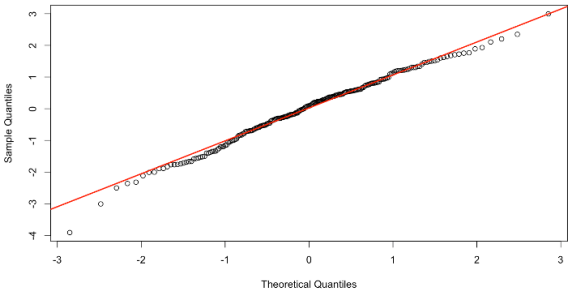
Residuals vs. Fitted Values




→ No identifiable patterns - Assumption met

**Normality**

Q-Q Plot




Shapiro-Wilk Test: W = 0.99141, p-value = 0.1955
→ P > 0.05 – Assumption met

**Multicollinearity**

| | GVIF | Df | GVIF^(1/(2*Df)) |
|---|---|---|---|
| scenario_type | 1.000000 | 1 | 1.000000 |
| ev_attitude_all_centered | 2.153441 | 1 | 1.467461 |
| gender_binary | 1.154913 | 1 | 1.074669 |
| age_group | 1.841628 | 2 | 1.164932 |
| income_group | 1.885980 | 1 | 1.373310 |
| prior_experience_group | 1.641900 | 1 | 1.281367 |
| scenario_order | 1.018411 | 1 | 1.009163 |
| scenario_type:ev_attitude_all_centered | 2.000000 | 1 | 1.414214 |

→ Assumption met

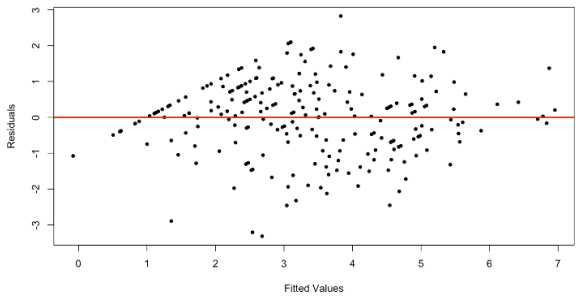
**Homoskedasticity**

Breusch-Pagan Test: BP = 13.485, df = 9, p-value = 0.1418
→ P > 0.05 – Assumption met

## Overview 2 *(Appendix)* *Assumption Checks Main Model (2)*

**Linearity**

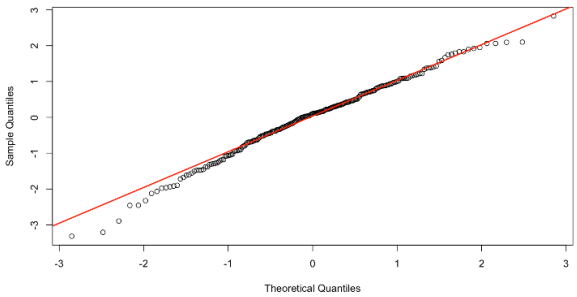
Residuals vs. Fitted Values




→ No identifiable patterns - Assumption met

**Normality**

Q-Q Plot




Shapiro-Wilk Test: W = 0.99019, p-value = 0.1222
→ P > 0.05 – Assumption met

**Multicollinearity**

| | GVIF | Df | GVIF^(1/(2*Df)) |
|---|---|---|---|
| pp_centered | 1.155867 | 1 | 1.075113 |
| ev_attitude_all_centered | 1.222970 | 1 | 1.105880 |
| gender_binary | 1.161264 | 1 | 1.077619 |
| age_group | 1.869740 | 2 | 1.169352 |
| income_group | 1.894084 | 1 | 1.376257 |
| prior_experience_group | 1.653677 | 1 | 1.285954 |
| scenario_order | 1.023368 | 1 | 1.011616 |
| pp_centered:ev_attitude_all_centered | 1.117700 | 1 | 1.057213 |

→ Assumption met

**Homoskedasticity**

Breusch-Pagan Test: BP = 15.32, df = 9, p-value = 0.08252
→ P > 0.05 – Assumption met

**Table 1** ***(Appendix 3)*** *Robustness Models: Checking for Order Effects*

| Models Replicated: | Data Sets (split based on viewing order) | | | |
|---|---|---|---|---|
| | Unfavourable First | | Favourable First | |
| | (1) Policy Environment | (2) Policy Perceptions | (1) Policy Environment | (2) Policy Perceptions |
| Intercept | 1.92*** | 2.67*** | 2.55*** | 2.99*** |
| | (0.19) | (0.19) | (0.28) | (0.30) |
| Policy Environment (Favourable) | 1.45*** | | 1.22*** | |
| | (0.16) | | (0.18) | |
| Policy Perceptions | | 0.52*** | | 0.47*** |
| | | (0.08) | | (0.07) |
| General EV Attitudes | 0.52** | 0.57*** | 0.82*** | 0.74*** |
| | (0.15) | (0.13) | (0.11) | (0.10) |
| Gender (Male) | -0.08 | -0.07 | 0.14 | 0.08 |
| | (0.40) | (0.25) | (0.26) | (0.27) |
| Age (Middle-Aged) | 1.51** | 1.43** | 0.47 | 0.64* |
| | (0.40) | (0.38) | (0.29) | (0.29) |
| Age (Older Adults) | 1.01** | 0.94** | 0.76* | 0.96** |
| | (0.33) | (0.30) | (0.32) | (0.32) |
| Income (High Income) | -0.68* | -0.57 • | -0.44 | -0.22 |
| | (0.31) | (0.28) | (0.32) | (0.33) |
| Prior Experience (Ownership) | 0.56 | 0.43 | 1.14*** | 0.85** |
| | (0.38) | (0.40) | (0.30) | (0.28) |
| Policy Environment x General EV Attitudes | 0.43* | | 0.03 | |
| | (0.18) | | (0.13) | |
| Policy Perceptions x General EV Attitudes | | 0.05 | | -0.06 |
| | | (0.06) | | (0.06) |
| $R^2$ | 0.615 | 0.622 | 0.652 | 0.681 |
| Adjusted $R^2$ | 0.589 | 0.597 | 0.623 | 0.654 |
| F-Statistic | 70.37 | 61.86 | 33.05 | 26.57 |
| | (DF = 8; 62) | (DF = 8; 62) | (DF = 8; 51) | (DF = 8; 51) |

*Note: *** p < 0.001; ** p < 0.01; * p < 0.05; • p < 0.1*