MASTER THESIS
FAIRNESS IN ROAD PRICING POLICIES

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Summary

This research explores how people in the Netherlands perceive the fairness and acceptability of road pricing. As cities worldwide continue to face challenges such as traffic congestion, air pollution, rising infrastructure costs, and limited public transit funding, road pricing could offer a potentially effective response. By charging drivers based on how much they drive or how polluting their vehicles are, road pricing systems may influence travel behavior, reduce congestion, and provide new streams of revenue for transport investments. However, despite these possible benefits, the broader success of such systems may depend less on their technical design and more on public acceptance, something closely tied to how fair the policy is perceived to be.

To investigate these dynamics, a multi-method approach was followed. A literature review was conducted to identify how fairness and acceptance have been approached in the context of road pricing in other cities, including Stockholm, London, and Singapore. These cases suggest that how policies are designed, particularly in terms of revenue use and exemptions, can have a meaningful impact on whether people support them. Interviews with Dutch academics and policymakers provided additional context, revealing specific concerns, expectations, and trade-offs relevant to the Netherlands. Finally, a survey among 107 Dutch residents was carried out to explore public views on fairness, preferred revenue uses, and acceptance of various pricing schemes. This combination of methods allowed the research to integrate theoretical understanding, expert views, and public sentiment.

The concept of fairness emerged as a complex and multi-layered theme throughout the research. Fairness in road pricing can take on various forms. Procedural fairness refers to how transparent and participatory the policymaking process is, while distributive fairness concerns the distribution of costs and benefits among different people and groups. Concepts of equity are central to this debate. Horizontal equity emphasizes that similar users should be treated equally, such as by charging the same fee to all who use the same road, while vertical equity focuses on minimizing burdens for low-income individuals or those with fewer alternatives to car travel. Geographical equity brings another dimension, recognizing that people living in rural areas may be affected differently than those in urban centers. Balancing these sometimes competing dimensions could help policymakers design road pricing systems that are perceived as more just.

Different types of road pricing schemes appear to be received in different ways. Distance-based and emission-based schemes are often perceived as fairer, possibly because they reflect the principle of "paying for what you use" or "paying for how much you pollute." These approaches could help people feel that the costs imposed by the system are proportional and justified. On the other hand, congestion charges and toll roads may be viewed more negatively, perhaps because they can feel more punitive or unevenly distributed in their impact. Some people might see them as disproportionately affecting commuters or lower-income individuals who cannot avoid peak-hour travel.

Socio-demographic characteristics could shape these perceptions in meaningful ways. Urban residents, who often have access to more extensive public transport networks, may be more likely to support reinvestment of road pricing revenues into those systems. In contrast, rural residents and frequent car users could prefer that funds be used to maintain roads or reduce vehicle-related taxes, as these forms of reinvestment may better align with their mobility needs. Income, age, and car ownership also play a role in how people judge the fairness and acceptability of different pricing schemes and revenue uses.

Revenue use, in particular, appears to be a crucial factor in shaping public support. When people believe that the money collected through road pricing will be spent in ways that visibly benefit them

or their communities, they may be more open to the idea. Reinvesting in public transport, improving road infrastructure, or reducing existing taxes could each help build acceptance, depending on the audience. At the same time, ensuring transparency in how funds are used may be just as important as the actual investment choices. If people do not know or trust how revenues are being handled, even a well-designed reinvestment plan may fall flat. Clear, honest communication about how revenue will be used could build trust and make the policy feel more legitimate.

Communication, in general, may have a major impact on how road pricing is received. Misconceptions are common—for instance, some people may view road pricing simply as an added tax rather than a tool to address congestion or pollution. By clearly explaining what the policy aims to achieve and how it works, public authorities could help reduce resistance and foster support. Gradual implementation may also be useful. Rather than launching a large-scale policy all at once, pilot programs or phased rollouts in specific areas could allow people time to adjust and evaluate the outcomes. This gradual approach might also help mitigate initial resistance and provide evidence of the system's benefits.

Public engagement could further enhance acceptance. Providing opportunities for feedback and involvement may help people feel heard and increase their willingness to support the policy. When members of the public are invited to participate in discussions or provide input, the process may be perceived as more democratic and fair. This sense of inclusion could be particularly important in addressing procedural fairness concerns.

Quantitative analysis of the survey results supports many of these themes. A strong positive correlation was found between perceived fairness and policy acceptance, suggesting that people who view a system as fair are significantly more likely to support it. Similarly, support tended to rise when respondents understood how the policy worked and trusted that the revenue would be used responsibly. Non-car owners and urban residents were generally more supportive of road pricing, likely since they would either not pay as much or would directly benefit from reinvestment in public transit.

Taken together, these findings suggest that road pricing policies could gain broader public support if they are designed with fairness and transparency in mind. Equity considerations may need to be carefully balanced, with special attention to how revenue is used and how clearly that use is communicated. Investments in public transport, road infrastructure, or tax reductions could all be legitimate and publicly supported options—if matched to the needs and values of different groups. Gradual rollout and participatory decision-making could also help reduce resistance and foster trust.

It is worth noting that, while the survey provides valuable insights, some degree of sample bias is present. Certain socio-demographic groups were over- or underrepresented in the sample. Students made up a large portion of respondents (36.4%, compared to 8.1% nationally), which likely contributed to the lower average age, lower income, and lower car ownership observed in the data. Additionally, urban residents, males, and people who primarily cycle or use public transport were overrepresented, while rural residents, older adults, and frequent car users were underrepresented. These patterns are likely related to the survey's distribution, which occurred mainly within TU Delft, particularly among Civil Engineering students who may already have some familiarity with transport policy. As such, while the findings point to important tendencies, they should be interpreted with caution, as they may not fully reflect the views of the wider Dutch population.

While these results are rooted in the Dutch context and could be interpreted in light of the sample bias, the broader implications could be relevant for other countries as well. In particular, the findings suggest a possible disconnect between the kinds of concerns emphasized in academic or policy circles—such as technical efficiency or regional balance—and the more immediate, everyday concerns of the public, which often center on affordability, transparency, and personal impact. Bridging this gap could be critical for ensuring that road pricing systems are not only effective but also widely accepted.

Ultimately, road pricing should not be seen purely as a technical solution. Rather, it is a policy tool embedded in a broader social and political context. Perceptions of fairness are shaped by people's lived experiences, societal values, and cultural expectations. Recognizing and responding to these perceptions could be key to developing road pricing systems that are equitable, effective, and supported by the public. When designed and implemented thoughtfully, road pricing may not only help address transportation challenges but also contribute to more inclusive and sustainable mobility systems.

1. Introduction

Cities around the world face transportation challenges, including congestion, accidents, pollution, rising infrastructure costs, and limited transit funding. Some argue that road pricing is an effective policy to address these challenges. Research shows that it regulates road use by influencing travel behavior, generates revenue for infrastructure and public transport, and provides economic signals for capacity expansion (Lindsey, 2012). By reducing congestion, travel delays, and accident rates, road pricing policies aim to enhance overall transport efficiency and contribute to broader societal well-being (De Palma et al., 2006).

Beyond its potential benefits on both economic and environmental levels, the success of road pricing policies depends on how they are perceived, particularly in terms of fairness. Fairness is a concern in transportation policies, particularly in road pricing, where the distribution of costs and benefits can vary across different societal groups. Policymakers also seek more research on fairness to gain public acceptance (Van Wee & Mouter, 2021). Fairness perceptions are of various dimensions, making it a difficult term to define and evaluate within transport policies such as road pricing.

One important factor that can influence the perceptions of fairness is the allocation of revenues generated from road pricing. Different allocation strategies may change how the public perceives the fairness and acceptability of road pricing policies.
This thesis examines how the Dutch public perceives the fairness of road pricing schemes, including the role of revenue allocation strategies. The relationship between fairness perceptions and policy acceptance will be explored. This research aims to provide insights into the factors that influence perceptions of fairness and public support for road pricing policies in the Netherlands.

1.1. Problem Description and Objectives
While the concept of road pricing has been implemented with varying degrees of success in countries like Singapore, Sweden, and the United Kingdom, the adoption of road pricing schemes often faces significant public resistance. A major factor influencing public support is the perceived fairness of such policies, especially regarding how costs and benefits are distributed across different societal groups.

Public perceptions of fairness play a critical role in the acceptability of road pricing policies. These perceptions are shaped not only by who pays and who benefits, but also by how revenues from pricing schemes are used. Fairness, in this context, is a complex and multidimensional concept, encompassing both procedural aspects—such as how decisions are made—and distributive aspects—such as the actual outcomes for individuals and communities.

Within this global discourse, the Dutch case presents a particularly interesting example. Although road pricing has been debated in the Netherlands for decades, efforts to implement a nationwide scheme have repeatedly stalled. Political sensitivity, social equity concerns, and a lack of public support have all contributed to this challenge (Ardıç et al., 2015). In the Dutch context, one of the primary barriers to acceptance remains the perception of fairness. Road users assess fairness not only in terms of personal cost but also concerning broader societal impacts, including how revenue is allocated and whether the policy aligns with principles of equity.

Given this backdrop, this research investigates how the Dutch public perceives the fairness and acceptability of road pricing policies, with a particular focus on the role of revenue allocation. While fairness is often cited as a critical factor in policy acceptance, the specific dimensions and drivers of fairness perceptions in the Netherlands are not yet well understood in the academic literature.

The objective of this study is to explore public attitudes towards a potential national road pricing scheme in the Netherlands. It seeks to identify the key factors that influence these attitudes and assess how different strategies for redistributing revenue—such as investments in infrastructure, healthcare, or public transport—affect perceived fairness and overall support. In doing so, the study not only contributes to the national debate but also offers lessons that may be applicable in other countries facing similar policy challenges.

To address these objectives, the research distinguishes between several equity dimensions: opportunity equity, referring to inclusive and transparent decision-making (Levinson, 2010; Karner et al., 2020), and outcome equity, referring to the distribution of impacts across the population. Outcome equity can be further subdivided into horizontal equity (equal treatment of similar users; El-Geneidy et al., 2016), vertical equity (consideration of users' needs and capabilities; Sen et al., 2022), and geographical equity (variation in impacts by location; Parkhurst et al., 2006). These dimensions each pose unique challenges for policymakers aiming to design a fair road pricing system.

Furthermore, the evaluation of transport policies is essential to ensure they deliver intended social, environmental, and economic outcomes. However, social impact assessments—crucial for understanding how policies affect different groups—are often overlooked (Geurs et al., 2009). Such assessments can improve policy design (Browne & Ryan, 2011), account for land-use interactions (Tsamboulas & Kopsacheili, 2003), and incorporate ethical considerations (Van Wee & Roeser, 2013), even though fairness remains difficult to measure (Holl, 2006). No single evaluation method can definitively determine fairness, making it vital to explore which approaches may be most suitable for road pricing.

Ultimately, the success of any road pricing policy hinges on public acceptability. Stakeholder involvement and trust are essential for successful implementation (Banister, 2008). Distrust in policy motives, doubts about effectiveness, and concerns about revenue use can all undermine support (Nikitas et al., 2018). Trust increases when the policy is perceived as fair and when the benefits are seen to support communities (Musselwhite & Lyons, 2009). Sustained public support is critical not only for political backing but also for the economic viability of the scheme (Plessis & Joubert, 2012). Factors such as perceived effectiveness, fairness, transparency in revenue use, and public participation all influence this acceptance (Niskanen et al., 2003).

One of the most direct ways to shape public perceptions is through the redistribution of revenues (Santos & Rojey, 2003). How these funds are used—whether for transportation, social services, or environmental improvements—can significantly influence whether road users view the policy as fair and beneficial. This study therefore also aims to investigate what kinds of revenue allocation strategies are seen as fair and acceptable by the Dutch public.

All these objectives lead to the main research question:

What factors influence the Dutch public's perception of fairness and acceptance of road pricing policies?

To be able to answer the main question, there are also sub-questions to gain further insights into the connections and dynamics between the various factors that could influence the perception of fairness and acceptance:

1.   What fairness concerns arise within the context of road pricing policies, and what methods exist for assessing fairness within such a policy?

2.   To what degree does the perceived fairness impact the acceptance of a pricing scheme in the Netherlands?

3.   What influence does revenue redistribution have on the acceptance and fairness of the policy?

4.   What is the Dutch public's view on road pricing according to experts and the Dutch population?

To answer these questions, various research methodologies will be used. Sub-question 1 will be answered through literature research and expert interviews. The second question also uses these methods, but also this will be researched through a survey, which will be open to the Dutch population. The same holds for the third question, also using those three methods. The last sub-question will mainly focus on the interviews and survey, as stated in the question itself. The main research question will then be answered through these sub-questions, hence using all three methodologies.

1.2.   Research Scope

This study focuses on public perceptions of fairness and acceptance of road pricing schemes in the Netherlands. The primary emphasis is on how different revenue allocation strategies influence these perceptions. The empirical research is limited to the Dutch context, as fairness concerns are shaped by cultural, political, and institutional factors specific to each country. However, the literature review does provide international research and examples to gain a better understanding of existing road pricing policies.

The study is structured around three key methodological stages. First, the current literature will be analyzed to understand what is already known. Second, semi-structured interviews with transportation experts and policymakers provide qualitative insights into fairness considerations and revenue allocation strategies in road pricing policy. These interviews help refine the conceptual model and inform the design of the last stage: a large-scale survey of Dutch residents. The survey quantitatively assesses the public's perceptions of fairness and acceptance.

The research does not focus on the technical efficiency or economic feasibility of road pricing but instead investigates public attitudes. While policymakers and experts are consulted for their insights, the primary focus remains on how the general public perceives fairness and what factors influence these perceptions.

1.3.   Scientific and Societal Relevance

One objective, next to the proposed research questions, is to provide scientific and societal relevance within the field of transportation policies, with a focus on road pricing in the Netherlands. This section will further explain the relevance.
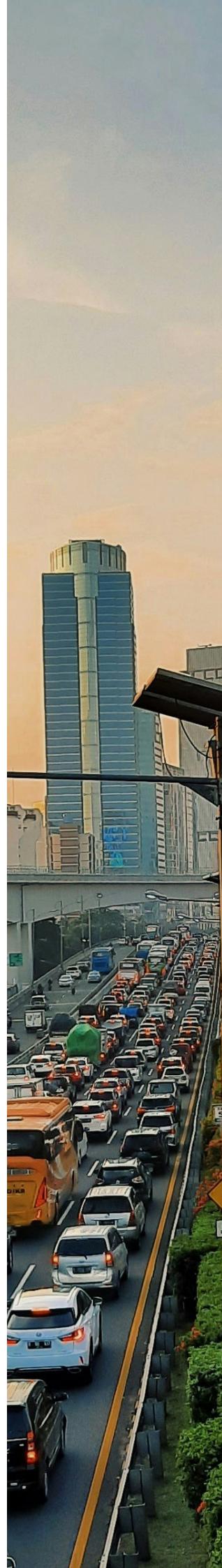
1.3.1. Scientific Relevance

This research contributes to the academic discourse on public acceptance of road pricing by examining how perceptions of fairness shape attitudes toward such policies. While previous studies have explored the economic and environmental benefits of road pricing (*see* Chapter 2), less attention has been given to the role of fairness in influencing public acceptance, particularly in the Dutch context. By combining qualitative insights from experts with quantitative public survey data, this study offers a more nuanced understanding of the factors that drive fairness perceptions.

Furthermore, this research engages with theories of distributive and procedural justice in transport policy, providing empirical evidence on how these fairness dimensions manifest in debates over road pricing. The findings will help refine existing conceptual models and contribute to ongoing discussions on the design of equitable policies in transportation systems.

1.3.2. Societal Relevance

Public resistance is one of the main challenges in implementing road pricing policies. Understanding what drives fairness perceptions can help policymakers design road pricing schemes that are perceived as more acceptable, thereby increasing the likelihood of successful implementation. Insights from this study can inform strategies for communicating and implementing road pricing in a way that addresses public concerns, ensuring that policies are not only practical but also socially sustainable.

More broadly, this research contributes to discussions on equity in mobility policies. As road pricing becomes an increasingly relevant policy tool in addressing congestion, emissions, and infrastructure funding, ensuring that it is perceived as fair is crucial for gaining public trust. The study's findings may offer valuable lessons for policymakers in the Netherlands and beyond, particularly in societies where fairness considerations strongly influence policy acceptance.

1.4. Thesis Outline

The outline of the upcoming chapters is as follows: Chapter 2 presents the literature review conducted to gain insights into relevant topics related to the research questions. Chapter 3 shows the methodology that is further used in this research. Chapter 4 presents the analysis of the expert interviews, and Chapter 5 provides the survey analysis. All these sources of information will be further discussed in Chapter 6, with a conclusion in Chapter 7. The resources used are listed at the end of this document, followed by appendices that provide detailed research information.

2. Methodology

This thesis followed a multi-stage research approach, combining literature review, semi-structured interviews, and a survey. This structure was chosen to build a deeper and more well-rounded understanding of how the Dutch public views road pricing schemes. Each stage informed the next, starting with the literature to establish a theoretical basis and identify key themes. The interviews then added personal, expert perspectives that helped refine the initial ideas and brought in real-world nuances that theory alone might miss. Finally, the survey allowed these insights to be tested on a broader scale, helping to see which patterns hold across the sample group. By moving through these steps, the conceptual model (Figure 7, Section 3.5) was continuously developed and tested. This step-by-step process helped to answer the main and sub-questions in Section 1.1.

2.1. Stage 1: Literature research

The first stage consists of a literature review focused on fairness perceptions and acceptance of road pricing schemes. This review draws from academic articles, policy documents, and prior studies related to transport equity, behavioral responses to pricing, and evaluation frameworks in mobility policy. It serves as the foundation for developing the conceptual model and guiding the design of interviews and survey instruments.

Objectives:
• Obtain a better understanding of the term "fairness" within transport policies.
• Examine how fairness has been measured and evaluated in previous (pricing) policies.
• Identify knowledge gaps and practical challenges in road pricing policy, providing input for the following stages of this research.
• To generate hypotheses about how various fairness mechanisms might influence acceptance, which are tested in later stages.
• Design the basis of the conceptual model showing the factors that play a role in the perceived fairness and acceptance of a road pricing policy in the Netherlands, which is used for the following stages of this research.

The literature review can be found in Chapter 3, where it has been divided into the various topics.

2.2. Stage 2: Semi-Structured Interviews

The second stage involves conducting semi-structured interviews with key stakeholders, including transportation experts and policymakers. These interviews helped gain deeper insights into the practical considerations and perceptions surrounding fairness in road pricing in the Netherlands. The interviews are used to (partially) answer sub-questions 1 through 4.

Objectives:
• The interviews will assess the fairness issues identified in the literature review and uncover any additional topics relevant to the Dutch context. This tested the conceptual model and added connections between existing or new factors.
• Stakeholders will provide feedback on existing evaluation frameworks in the field of transport policies, with a focus on road pricing, and suggest modifications or new approaches tailored to the Dutch setting.
• Interviews will explore how stakeholders perceive fairness in congestion pricing and how these perceptions affect their acceptance of such schemes.
• Interviewees will discuss their preferences and perceptions regarding various revenue redistribution strategies, providing qualitative data to inform the subsequent survey.

The interviews were semi-structured to gather diverse viewpoints on the fairness, evaluation, acceptance, and revenue allocation strategies related to a road pricing scheme. The questions covered four key areas:

1. General Experience – Participants were asked about their background in road pricing policies and their expectations regarding the potential implementation of such policies in the Netherlands.
2. Fairness Issues in Policy Design – Questions focused on identifying fairness concerns related to road pricing, the specific groups that might be disproportionately affected, and the factors shaping perceptions of fairness. Additionally, participants shared insights on how revenue allocation influences perceptions of fairness and suggested equitable redistribution strategies.
3. Evaluation Frameworks – Experts provided input on how fairness should be measured, discussing current evaluation frameworks and ways to incorporate fairness principles into policy design and evaluation.
4. Public Perceptions and Acceptance – The final set of questions examined how the Dutch public sees road pricing as perceived by the experts. The role of fairness in shaping public acceptance, as well as whether concerns about fairness outweigh the environmental and economic benefits, were also discussed. Interviewees also discussed how personal circumstances (e.g., income, commuting distance) and revenue allocation strategies influence acceptance.

The complete list of interview questions can be found in Appendix C. Eight participants, representing a variety of roles and expertise, were interviewed, as outlined in the following structure: A# for academics from different universities and B# for policymakers working at the Ministry of Infrastructure and Water Management. Four of each group were interviewed. Participants in the interviews were asked to sign a consent form in advance, as recordings of the interviews would be made. These were transcribed for further analysis. The data was analyzed by categorizing responses under each sub-question and identifying recurring themes. The insights gained from these interviews will be used to refine the survey questions. For privacy reasons, their pronouns will not be used in the written analysis; instead, the interviewees will be referred to by "they" rather than "he" or "she."

2.3. Stage 3: Survey

This stage involves surveying a sample of the Dutch public. The survey was designed based on the findings from the literature review and interviews, ensuring that it addressed the key issues of fairness and acceptance identified in the earlier stages. The target population is residents of the Netherlands, with no further limitations regarding gender, age, or other socio-demographic factors. The goal is to gain a diverse sample to see how various individuals and groups respond to the survey questions. However, with limited time and resources, there is a high chance of a biased sample.

Objectives:
*   The survey will assess how perceived fairness impacts public acceptance of road pricing schemes.
*   The survey will ask respondents to evaluate different revenue redistribution strategies to determine which are most effective in enhancing perceived fairness and acceptance.
*   The survey will test any claims made in the literature review and interviews, thereby re-testing the conceptual model presented in Figure 7 (Section 3.5) while also strengthening existing relationships between factors and/or identifying new relationships and factors.

The survey results provided quantitative and qualitative data to complement the qualitative insights gained from the literature review and expert interviews. While the literature and interviews

help establish a theoretical and expert-driven understanding of fairness in road pricing, the survey allows for direct input from the Dutch public. By integrating both perspectives, this approach ensures a more comprehensive analysis of how fairness is perceived and its influence on public acceptance of road pricing policies.

Participants were recruited over 18 days using multiple strategies. The survey link was shared via LinkedIn, Instagram, WhatsApp, and through flyers with QR codes placed in public areas like educational buildings and supermarkets. Additionally, SurveyCircle was used to reach more respondents. No compensation or prize was offered to avoid collecting unnecessary personal data.

The survey included open-ended, Likert scale, ranking, and multiple-choice questions, resulting in a mix of ordinal and nominal data. A full list of questions is in Appendix E. The survey was structured in sections to separate topics. It began with an introduction to five road pricing strategies—distance-based, emission-based, congestion pricing, toll roads, and cordon pricing—followed by questions on perceived fairness and a ranking of the schemes. Next, participants responded to statements on general acceptance and ranked revenue allocation strategies by fairness. Further questions addressed potential benefits and drawbacks to assess overall attitudes. An optional open-ended section allowed participants to share additional views, generating qualitative data analyzed for common themes and links to the research questions. The survey concluded with socio-demographic questions, analyzed as categorical data, to explore potential influences on factors like status quo bias and perceived personal impact.

After the survey closed, the data were analyzed using SPSS. Claims from the literature and interviews were tested to confirm, refute, or expand on existing insights. Relationships within the conceptual model (Figure 7, Section 3.5) will be explored, including links between socio-demographic factors and fairness perceptions. Depending on group sizes, Mann-Whitney or Kruskal-Wallis tests will be applied to ordinal and categorical data. Other key analyses include the impact of revenue allocation on fairness and acceptance (sub-question 3), and the relationship between perceived fairness and acceptance, tested with Spearman's correlation. The next paragraphs provide specific examples of the statistical methods used.

The Mann-Whitney U test was applied to compare differences between two independent groups. A p-value of 0.05 was used for testing significance within this test type. This test was used, for example, to assess whether car ownership influenced perceptions of fairness regarding the road pricing policy. Since fairness was measured on an ordinal scale, the Mann-Whitney U test was appropriate for detecting differences between car owners and non-car owners.

For comparisons involving three or more independent groups, the Kruskal-Wallis test was conducted, again with a p-value of 0.05 to test significance. This test investigated, for example, whether residential location (urban, suburban, rural) affected fairness perceptions or revenue allocation preferences. If the Kruskal-Wallis test indicated significant differences, post hoc pairwise comparisons (using Bonferroni-adjusted Mann-Whitney U tests, with a significance level of $p = 0.05$) were performed to determine which groups differed.

In addition, Spearman's rank correlation was used to explore associations between ordinal variables, such as the relationship between perceived fairness and the likelihood of accepting a scheme. A stricter p-value of 0.01 is used to prevent false positives. Here, only stronger, more reliable correlations will be considered significant. Spearman's correlation was chosen over Pearson's because the variables, such as age and income, were collected in categorical ranges, making them ordinal.

The results of these tests are presented in Chapter 5, with additional details provided in Appendix F.

3. Literature Review

This section examines fairness in transportation policy design and evaluation, with a focus on road pricing strategies in Sections 3.1 and 3.2. It will also explore public acceptance in the Dutch context in Section 3.3 and how revenue allocation influences perceived fairness and support in Section 3.4. Finally, a conceptual model will be presented in Section 3.5, illustrating these relationships and highlighting gaps for further research that align with the objectives of this thesis.

3.1. Fairness in transport policy design

Fairness is a critical consideration in transport policies, particularly as these policies shape accessibility, economic burden, and public support. In the transportation sector, achieving fairness often means balancing various social and economic impacts across diverse populations. Research highlights that perceived fairness plays a significant role in the public acceptance of these policies (Van Wee & Mouter, 2021). Fairness in transport policy, especially in pricing schemes, encompasses multiple dimensions, including opportunity and outcome equity. As a road pricing policy affects all road users, creating an equitable policy is a complex task that requires thorough consideration and expert input. However, equity should always be a guiding principle in these schemes (Yu et al., 2016). The multi-dimensional nature of policy equity, often leading to disagreements among policymakers and experts, underscores the need for thorough consideration and expert input in its implementation (Martens et al., 2019).

3.1.1. Equity definitions

There are various types of equity, as equity has multiple definitions. An overview is shown in Figure 1. The four equity types presented—opportunity, horizontal, vertical, and geographical equity—were selected because they together offer a comprehensive and policy-relevant framework for analyzing fairness in road pricing. These dimensions are well-established in transport literature and apply to the Dutch context, where debates around pricing often involve procedural fairness, socioeconomic disparities, and regional differences in accessibility. Focusing on these types allows for a structured yet manageable analysis that captures the most critical aspects of public perceptions of fairness.

Horizontal and vertical equity frequently overlap or conflict (Camporeale et al., 2016). A decision might appear fair under one criterion but inequitable under another. For instance, horizontal equity demands that users cover the costs of their transportation facilities and services, while vertical equity often calls for subsidies to assist disadvantaged individuals. One cannot argue that Stockholm and London are fully horizontally equitable, as discounts and exemptions are available. Additionally, the revenue from the Stockholm and London pricing schemes is allocated towards public transportation (Gu et al., 2018). Research indicates that low-income individuals and women tend to derive greater benefits from this type of revenue allocation (Eliasson & Mattsson, 2006), which would make the pricing schemes in Stockholm and London partially vertically equitable.

Equity

Equity can be defined in various ways. Bruzzone et al. (2023) define equity as **a concept linked to reducing inequalities**, whereas Di Ciommo and Shiftan (2017) define equity as **the allocation of costs and benefits among users**. Equity can be divided into opportunity equity and outcome equity.

Opportunity Equity

Opportunity equity is defined by Levinson (2010) as the degree to which there is equitable access to the planning and decision-making process (procedural justice).

Procedural justice shapes policy design by ensuring fair decision-making processes that include diverse perspectives and meaningful participation from affected communities. This leads to more equitable policies that address the needs of disadvantaged populations and promote justice (Karner et al., 2020).

Outcome Equity

Outcome equity regards the extent to which the outcomes of a decision or policy are seen as fair (Levinson, 2010). There are various dimensions of outcome equity, however, their goals may conflict due to the differences within these dimensions, necessitating difficult decisions and trade-offs (Musgrave, 1990). These conflicts and trade-offs underscore the weight of policymakers' decisions to pursue equity in road pricing policies.
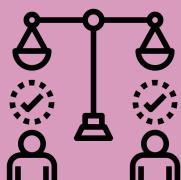
Horizontal Equity

Equal treatment for similar users.

People in the same situation should pay the same (El-Geneidy et al., 2016).

Example:
London & Stockholm charge the same fee per vehicle (Urban Access Regulations in Europe, n.d.; Transport for London, n.d.).

Challenge:
Ignores socio-economic differences (Kaplow, 2000).

Vertical Equity

Fairness based on needs and capabilities.

Costs should reflect income and mobility limitations (Sen et al., 2022; Eliasson, 2016).

Example:
Discounts for low-income users, subsidies for public transport (Randal et al., 2020).

Challenge:
Hard to balance fairness with revenue needs (Craik & Balakrishnan, 2022).

Geographical Equity

Impact depends on location.

Costs affect people differently based on their access to transport (Parkhurst et al., 2006).

Example:
Revenue used to improve transport in under-served areas (Santos & Verhoef, 2011).

Challenge:
Impact depends on public transport availability (Ecola & Light, 2009).

Figure 1: Definitions of equity.

Congestion Pricing

More equitable than flat tolls or fuel taxes (Eliasson, 2016).

Can include subsidies/exemptions for low-income groups (Eliasson, 2016).

Fuel Taxes

Often regressive.

Low-income individuals pay a higher share of income (Teixidó & Verde, 2017; Eliasson et al., 2018).

Efficient for reducing emissions but may harm equity (Sterner, 2007).

Toll Systems

Revenue funds infrastructure (Gideon & Alouis, 2013; Suwarto et al., 2021)**.**

Can lead to geographical inequities.

Depends on location and access (Ecola & Light, 2009).

Figure 2: Taxing methods.

3.1.2.   Comparing fairness in (road pricing) policies

Road pricing policies can be compared to other taxing methods worldwide, as shown in Figure 2. There are also existing pricing policies in various countries, as illustrated in Figure 3.

While no policy instrument is perfectly fair, road pricing often stands out as the most flexible in ensuring that costs can be distributed in line with usage and ability to pay, such as through vertical equity, compared to fuel taxes and flat tolls.

As shown in the international examples (Figure 3), approaches to ensuring fairness in road pricing policies vary significantly across countries, reflecting diverse cultural, social, and economic contexts. These international examples demonstrate how different regions address fairness in road pricing, often incorporating various equity considerations—geographical, vertical, and environmental—depending on the policy goals and societal needs.

3.2.   Fairness evaluation in transport policies

Evaluating the fairness of road pricing schemes is essential, as it impacts public acceptance and the equitable distribution of costs and benefits. This chapter will discuss the importance of evaluating fairness and the typical criteria, including horizontal and vertical equity, as well as geographical equity. Ethical theories will also be touched upon here. Methods for assessing fairness will be reviewed, and examples from case studies will be presented to illustrate how fairness has been evaluated in practice. Finally, the challenges involved in evaluating fairness will be explored.

3.2.1.   Criteria for fairness

When evaluating transport policies, fairness is a criterion that must be considered to ensure that transportation systems serve all members of society equitably. In this context, fairness goes beyond simple efficiency or cost-effectiveness; it addresses the social implications of transportation access, resource distribution, and the ability of individuals from different socioeconomic backgrounds to benefit from mobility solutions. A fair transport policy should seek to reduce inequalities in access to services and minimize the disproportionate burdens borne by disadvantaged groups (Pereira et al., 2016).

There is no single way to evaluate the fairness of transport policies. Different criteria can be used for this evaluation, as shown in Table 1. These criteria can be based on various equity types, such as horizontal equity, or vertical equity, as discussed in Section 3.1.1. Another approach is to apply ethical theories, which provide normative foundations for assessing fairness, as also defined in Table 1.

Singapore - Dynamic Pricing

Charges vary based on congestion levels (Menon & Guttikunda, 2010).

Uses real-time data.
Fairness based on actual road usage (Goh, 2002).

Stockholm - Revenue Redistribution

Charges central city residents, reinvests in public transport (Eliasson, 2016; Gu et al., 2018).

Supports low-income commuters.
Public transport benefits those outside the city center (Eliasson & Mattsson, 2006).
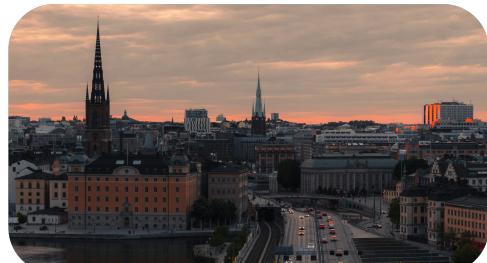
London - Flat Fee System

Same charge for all vehicles entering the zone (Willumsen, 2004).

Equity concerns.
Short trips may be overcharged, long trips undercharged (Willumsen, 2004).

Milan - Environmental Pricing

Fees based on vehicle emissions (Gibson & Carnovale, 2015).

Polluters pay more.
Older, high-emission vehicles face higher costs (Wessel, 2020).

Figure 3: International examples of pricing policies.

Criteria	Key Concepts	Strengths	Challenges
Horizontal Equity	Fairness among people in **similar situations**; equal treatment of road users by **minimizing external costs** (delays, risks, pollution) and ensuring users "pay for what they get" (Litman, 2022).	Promotes **equal cost-sharing** and **reduces negative externalities** like congestion & pollution (Litman, 2022).	Does **not consider differences** in income, accessibility, or personal needs (Litman, 2022).
Vertical Equity	Fairness based on **differences in need and ability to pay**. Includes inclusivity (ensuring access for all) (Martens, 2018), **income fairness** (redistribution via public transport investment or discounts) (Di Ciommo & Lucas, 2014), and **social justice** (addressing inequalities) (Litman, 2022).	Helps **vulnerable groups**, ensures **universal access**, and can **redistribute benefits** to low-income users (Di Ciommo & Lucas, 2014).	Difficult to define **who qualifies for benefits**; risk of **inefficiency** in redistribution (Martens, 2018).
Utilitarianism	Maximizing **overall welfare** by ensuring transport policies **benefit the most people**. Prioritizes efficiency over individual needs (Pereira et al., 2016).	Promotes **cost-effective** policies and **maximizes total benefits** (Van Wee & Roeser, 2013).	**Neglects minority needs**; can increase **inequality** if certain groups benefit more than others (Martens et al., 2014).
Egalitarianism	Strives for **equal access and fairness** in transport. Includes **Rawls' Theory of Justice** (fair distribution) (Rawls, 1971) and the **Capabilities Approach** (ensuring people have the means to access opportunities) (Nussbaum & Sen, 1993).	Ensures **equal rights**, supports **freedom of movement**, and prioritizes **improving accessibility for disadvantaged groups** (Pereira et al., 2016).	Hard to **define fairness**, as improving access for some may disadvantage others (Van Wee & Roeser, 2013).
Libertarianism	Emphasizes **individual freedom** and **free markets** in transport policy. Believes **the market should dictate road pricing**, with minimal government intervention (Stacey, 2015).	Supports **personal choice** and **private sector efficiency** in infrastructure development (Adli & Chowdhury, 2021).	Can lead to **inequality** as low-income groups may be priced out of essential travel (Rouhani, 2022).
Sufficientarianism	Focuses on ensuring that **everyone has a minimum acceptable level of transport access**, rather than equal distribution (Shields, 2020).	Guarantees a **basic level of access** for all, prioritizing **those most in need** (Martens et al., 2014).	Defining the "**sufficiency threshold**" is difficult; may overlook those **just above** the threshold (Van Der Veen et al., 2020).

Table 1: Possible criteria for fairness. Pink items refer to the various types of equity (Figure 1) and gray items refer to ethical theories.

3.2.2. Methods for fairness evaluation

There are various methods for evaluating transport policies, as outlined in the overview in Table 2. For a more detailed description containing calculation methods, see Appendix A. These three evaluation methods—Cost-Benefit Analysis (CBA), the Gini Coefficient, and Multi-Criteria Decision Analysis (MCDA)—were chosen because they each capture different aspects of equity in transport policy. CBA is widely used and focuses on economic efficiency, but can be adapted to include equity considerations. The Gini Coefficient helps assess how equally accessibility is distributed across groups, offering a clear, quantifiable measure. MCDA goes a step further by allowing for the inclusion of various social and environmental factors, while also encouraging stakeholder involvement. Together, these methods provide a well-rounded perspective on how equity can be evaluated in the context of road pricing.

3.2.3. Real-world applications of evaluating road pricing policies

In addition to the methods for evaluating transport policies, the literature also provides examples of how these methods have been applied. This section presents four case studies of how existing or self-designed frameworks and methods have been applied to evaluate road pricing schemes and other transportation policies. Table 3 provides an overview, and Appendix A provides more details.

The four case studies examined transport fairness using different frameworks, each offering unique insights. In Lyon, Raux and Souche (2004) analyzed tolling schemes and found that they often worsen vertical and geographical inequity, leading to social opposition. In Latin America, Humberto (2023) applied justice principles—equality, sufficiency, and priority—to assess transport systems, showing that perceptions of fairness depend on the chosen metric, such as travel time or emissions. Maruyama and Sumalee (2007) used the Gini coefficient in Japan to compare congestion pricing schemes, revealing that area-based schemes create more spatial inequity than cordon-based ones. Meanwhile, in Tuqiao, Beijing, Cao et al. (2019) used the Capabilities Approach to highlight how transport inequalities affect different socio-demographic groups. Although all studies focus on equity, their varying methods provide different perspectives on designing fairer transport policies.

3.2.4. Challenges in evaluation

Policies impact travel times, reliability, accessibility, safety, environmental concerns, and costs for both public and private entities, making transport policy evaluation essential and challenging (Van Wee & Mouter, 2021). Fairness can have different meanings, as various equity types and ethical theories explain. This makes it challenging for policymakers to determine what is fair, as multiple ideas on equity can lead to diverse policies (Pereira et al., 2016). Researchers have not agreed on which equity dimensions should be considered or which measures should be used (Levison, 2010). In evaluations, insights are often gained through quantitative results. Thus, policies can be evaluated through ratios, expenditures, and other numerical results. This makes it difficult to measure (perceived) fairness, as it is challenging to translate moral values into numerical values (Van Wee & Roeser, 2013). Mainstream evaluation methods, such as CBA and MCDA, face criticism because major projects often suffer from budget overruns, underperformance, unforeseen consequences, lock-ins, decision-making impasses, and resulting delays (Te Boveldt et al., 2020).

Method	Key Concepts	Strengths	Challenges
Cost-Benefit Analysis (CBA)	Evaluates whether the **monetary benefits** of a transport project outweigh its costs. Traditionally **utilitarian**, prioritizing overall economic efficiency (Van Wee & Geurs, 2011).	Simple, widely used, and effective for **economic efficiency** assessments. Can be modified for equity by assigning **distributional weights** or using **social values** (Martens, 2006).	Overlooks **distributional effects** and **equity concerns** unless explicitly adjusted. Requires **modifications** like incorporating equity indicators (Martens, 2006).
Gini Coefficient	Measures **inequality in accessibility** by assessing how transport benefits are distributed among the population (Gini, 1912). Used to compare equity before and after policy implementation (Zhou et al., 2018).	Provides a **quantifiable measure** of accessibility equity. Helps assess policy impact on different groups (Luo & Mo, 2015).	Does not explain causes of inequality; may oversimplify **complex socio-spatial disparities** (Zhou et al., 2018).
Multi-Criteria Decision Analysis (MCDA)	Considers **multiple evaluation criteria** beyond economic benefits, including social and environmental factors (Brauers et al., 2008). Promotes **stakeholder involvement** for a fairer decision-making process (Barfod & Leleur, 2014).	Accounts for **qualitative and quantitative** aspects, allowing for more balanced decisions. Encourages **transparency and inclusivity** (Barfod & Leleur, 2014). More **suitable** for integrating equity considerations **compared to CBA** (Thomopoulos et al., 2009)	Can be **time-consuming and complex** due to many stakeholders and subjective weighting of criteria (Macharis & Bernardini, 2014). Unclear if applications are practical or purely academic (Annema et al., 2015).

Table 2: Transport policy evaluation methods.

Case Study	Framework Used	Key Insights on Equity	Main Takeaways for Policymakers
Lyon (Raux & Souche, 2004)	Economic **efficiency** & three types of **equity** (vertical, horizontal, geographical)	• **Vertical equity** is harmed when tolls are too high without sufficient time savings or discounts. • **Geographical equity** worsens when infrastructure charges increase, disproportionately impacting certain areas. • **Horizontal equity** issues arise as toll operators profit while drivers lose surplus.	Road pricing **must address all equity types** to be publicly acceptable.
Latin America (Humberto, 2023)	**Metrics** based on **justice principles**: equality, sufficiency, priority	• **Equality = Horizontal equity** (everyone is treated equally). • **Sufficiency** relates to ensuring minimum accessibility levels (sufficientarianism). • **Priority = Vertical equity**, helping those who are worse off. • **Fairness evaluation varies** based on chosen metrics (e.g., travel time vs. emissions).	The **choice of fairness metric** influences results, affecting policy perceptions.
Japan (Maruyama & Sumalee, 2007)	**Gini coefficient** to assess spatial equity in congestion pricing	• **Higher toll levels** increase inequity. • **Cordon-based pricing** is more equitable than area-based pricing. • **Larger pricing zones** increase spatial inequity as they affect more trips.	Congestion pricing should **balance efficiency and equity** to maintain fairness.
Tuqiao, Beijing (Cao et al., 2019)	**Capabilities Approach (CA)** measuring real vs. actual travel opportunities	• **Vulnerable groups** (women, elderly, migrants, low-income, non-car owners) face transport barriers • **Access to key services** (hospitals, shopping, education) is unequal.	The **Capabilities Approach** is useful for assessing transport-related social inequities.

Table 3: Application of frameworks and methods.

3.3. Acceptance of a pricing scheme in the Netherlands

The following sections will discuss the acceptance of transport policies and the Dutch contextual factors that could influence the implementation of a road pricing scheme.

3.3.1. Factors influencing acceptance

In road pricing schemes, gaining public acceptance is critical for successful implementation, as seen in the introduction (Section 1.1). Various strategies can positively influence acceptance, including clear communication, stakeholder involvement, and transparency regarding the scheme's benefits, as seen in Figure 4. By addressing public concerns early and incorporating feedback, policymakers can build trust and ensure that the scheme is perceived as fair, effective, and beneficial. Public acceptability can be influenced by factors such as the general aversion to new or increased fees, as well as the complexity of charging methods and technology (Niskanen & Nash, 2008).

Communication

Road pricing must be framed as a **solution**, not a tax (Langmyhr, 1997).

Trust depends on policymakers **keeping promises** (Van Wee & Mouter, 2021).

Clear messaging, **transparency**, and multichannel outreach improve acceptance (Higgins et al, 2010).

For example, Stockholm's congestion tax gained support due to **neutral, credible communication** (Sørensen et al, 2013).

Public Engagement

Involving the public **early** increases fairness perception (Hsieh, 2022).

Public discussions, feedback trials, and referenda help (Horsman, 2001).

Opportunity equity/**procedural justice** ensures fairness (Levinson, 2010; Zhou et al, 2018; Karner et al, 2020).

Gradual Implementation & Trials

Trials legitimize pricing and **increase acceptance** (Sørensen et al, 2013).

In Stockholm **support grew** from <30% to ~70% after a **trial period** (Eliasson, 2008).

Phased implementation **reduces resistance** and allows policy refinement (Ieromonachou et al, 2005; De Palma et al, 2006).

Figure 4: Factors positively influencing acceptance.

3.3.2. Links between fairness and acceptance

People value equity and fairness, so opposition arises when policies appear to be unfair. This is why offering toll-free alternatives and tolling new roads rather than existing ones tends to gain more public support by ensuring everyone has a choice (Walker, 2011). Huber et al. (2019) also state that if a policy is considered unfair, it will receive less individual support. Fairness in cost, privacy, security, value, and performance directly impacts public acceptance of road pricing schemes (Grush, 2010). High costs, privacy concerns, or security risks can reduce trust and lead to resistance. Conversely, if these factors are well-managed, acceptance increases as the scheme becomes more fair and reliable. Opportunity equity, also known as procedural fairness (explained in Figure 1), can also play a role in acceptance. Positive expectations of outcomes and beliefs in procedural fairness were linked to a more favorable attitude toward the taxes after implementation (Nilsson et al., 2016).

3.3.3. Dutch contextual factors

The introduction of road pricing in the Netherlands is influenced by various contextual challenges that have shaped public perception and political discourse. These factors have reinforced resistance to the policy despite its potential advantages. In this section, key contextual elements are examined, including the negative image of road pricing, political dynamics, and the impact of status quo bias, all of which affect the feasibility and acceptability of the policy. Figure 5 provides an overview of these factors.

Figure 5: Contextual challenges.

Negative Public Image

Road pricing is seen as an **added financial burden**, as people are being asked to pay for something they already use (Ardıç et al., 2015).

Cars symbolize **freedom**, making people resistant to change.

Many view road pricing as **just another tax**, doubting its effectiveness (Tillema et al., 2012).

Political Barriers

Proposed since 1987 but faced delays due to public opposition and **lack of political consensus** (Boot et al., 1999).

ABvM Plan (2007) aimed at shifting to usage-based fees, but **never implemented** (Walker, 2011).

Despite **initial support** (68% in ANWB survey), parliament opposed the minister's approach, leading to **policy stagnation** by 2010 (Vonk Noordegraaf, 2016).

Road pricing is unlikely to be implemented on a large scale due to significant barriers including **privacy concerns and regulatory incentives** (Verhoef et al., 1995).

Status Quo Bias

People **prefer familiar systems**, even if flawed (Fernandez & Rodrik, 1991).

Many believe roads are "free", overlooking their **unequal impact** (Manville, 2019).

Clear, accessible communication can reduce resistance and shift the bias (Hazan et al., 2020).

Public **acceptance tends to grow post-implementation**, as people are used to the new system (Börjesson et al., 2016).

3.4. Revenue redistribution and its influence on perceived fairness and acceptance

Revenue redistribution is critical in enhancing the fairness and acceptance of road pricing policies (Santos & Rojey, 2003). This section explores how redistribution can promote fairness and increase acceptance, then analyzes challenges and opportunities in allocating revenue effectively.

3.4.1. Redistribution and fairness

Pricing schemes without revenue redistribution often benefit higher-income individuals, whereas redistribution can improve outcomes for lower-income groups (Ecola & Light, 2009). A fair pricing revenue allocation can consider all groups equitably, directing more resources to the most disadvantaged individuals or groups (Krumholz & Forester, 2011; Li et al., 2018), which aligns with justice theories such as sufficientarianism. Moreover, the method of revenue recycling is crucial to maximizing the welfare effect of congestion taxes; effective redistribution can reduce the regressive impact of congestion pricing by offsetting the costs for lower-income users and addressing existing economic imbalances (Parry & Bento, 2001). Successful road pricing programs, as described by Taylor et al. (2010), often allocate toll revenues to transit and highway improvements surrounding tolled areas, addressing equity concerns and benefiting all users. Allocating revenues is crucial in shaping the equity effects of congestion charging reforms (Eliasson, 2016). Various approaches to revenue use will be discussed in section 3.4.3.

3.4.2. Redistribution and acceptance

Road pricing acceptability is closely linked to revenue allocation. According to Schade (2017), Schuitema & Steg (2008), and Schuitema et al. (2005), transport pricing is more acceptable when revenues are allocated in ways that directly benefit car users, such as reducing car-related taxes or reinvesting in the transport system, like public transport improvements. However, acceptability decreases if people believe the funds will be allocated to general state or municipal purposes instead of transport-related benefits. This suggests that public support for transport pricing policies rises when users feel compensated for potential negative consequences.

In the Netherlands, the acceptability of road pricing hinges on the allocation of revenue. A study by Ubbels & Verhoef (2006) found the highest support for using revenues to replace car ownership taxes, followed by reducing fuel taxes. Improving or building new roads was somewhat acceptable, while allocating funds to the general government budget was the least popular. Acceptance is primarily influenced by whether the measures are perceived to reduce congestion and provide personal benefits. The preferences for revenue allocation can also vary among individuals. Verhoef et al. (1997) created a questionnaire for Dutch road users in the Randstad region. The analysis revealed that lower-income individuals tend to favor tax reductions, especially on fuel, over road investments, likely due to financial concerns. Conversely, those expecting compensation for road pricing tend to prefer allocations like road investments and public transport subsidies, as these provide additional benefits beyond existing tax relief.

3.4.3. Types of revenue redistribution

Revenue from a road pricing scheme could be used for various purposes. The distribution of net benefits heavily depends on how toll revenues are used since these are usually much larger than the efficiency gains (Anas & Lindsey, 2011). Table 4 provides an overview of these allocation purposes, along with their benefits and challenges.

Flexible and Combined Approaches: Van Dender (2019) advocates for flexibility in revenue allocation, suggesting that funds should be directed to projects with the highest social returns rather than strictly earmarked for specific uses. This view aligns with Farrell & Saleh's (2005) findings that combining public preferences—such as supporting public transport and moderate tax relief—could create more balanced, acceptable packages. This flexible approach is also observed in Norway's road pricing schemes (Figure 6), where allocations are adjusted to maximize social benefits.

Revenue Use	Key Benefit	Challenges & Considerations
Public Transport Investment	**Most preferred** use of revenue, as it reduces congestion and supports equitable transit access (Vrtic et al., 2007; Farrell & Saleh, 2005). Helps shift travelers to public transport, **aiding low-income groups** (Levinson, 2010). **Reliability, fare reductions, and network expansion** make public transit more appealing (Farrell & Saleh, 2005). Road users favor pricing when revenue **directly funds transit** (De Borger & Proost, 2011).	High-ridership areas benefit more, creating potential **regional inequities** (Santos, 2004). **Rural residents & night-shift workers** may see fewer benefits due to limited service (Cain & Jones, 2008). Rail infrastructure requires **large investments**, making funding distribution complex (Santos, 2004). Support is stronger among non-car users, meaning **acceptance may be uneven** (Vrtic et al., 2007; Farrell & Saleh, 2005).
Tax Reductions	Popular among drivers as it **offsets congestion fees** (Small, 1992; Ubbels & Verhoef, 2006). **Lower fuel & vehicle taxes** improve acceptance (Santos & Rojey, 2003). **Reassures users** that road fees provide direct financial relief (Hau, 2005). Particularly appealing to car users, who bear the **direct costs** of road pricing (Jaensirisak et al., 2005; Ubbels & Verhoef, 2006).	Using revenue for fee or tax reductions is **easily reversible** and may lack sustained impact (Anas & Lindsey, 2011). May be perceived as **less equitable** compared to public transport investments, especially by **non-drivers** (Jaensirisak et al., 2005; Vrtic et al., 2007; Farrell & Saleh, 2005).
Road Infrastructure	Supports new roads, upgrades & expansions, **improving accessibility, safety, and congestion** (Lindsey, 2012). Expanding road networks is **popular with drivers**, improving travel conditions (Small, 1992; Ubbels & Verhoef, 2006). **Marginal cost pricing** can manage demand & optimize road use (Hau, 2005). Can gain **near-equal support to tax reductions** when not compared with other specific policies (Schuitema & Steg, Study 3, 2008).	Infrastructure must **match demand trends** to avoid overexpansion (Hau, 2005). Support may vary if users do not perceive **direct improvements** or cost savings (Schuitema & Steg, 2008).

Table 4: Revenue allocation strategies.

Economic Efficiency and Long-Term Strategy: Several sources recommend strategic long-term planning to ensure economic efficiency. Hau (2005) argues for a model based on short-run marginal cost pricing to control demand within the existing infrastructure while gradually adjusting capacity to meet future demand. This long-term approach aligns with the benefits of infrastructure investments but also requires balancing them with immediate, visible benefits, such as tax reductions or public transportation improvements, to maintain public support.

In conclusion, these findings suggest that combining approaches—such as moderate tax relief, infrastructure investment, and enhancements in public transport—may offer a balanced solution. As Van Dender (2019) suggests, flexible allocation models that consider the highest social returns are crucial in designing road pricing schemes that cater to diverse preferences and enhance public acceptability.

● Road projects

● Public transport, safety, and environmental projec...
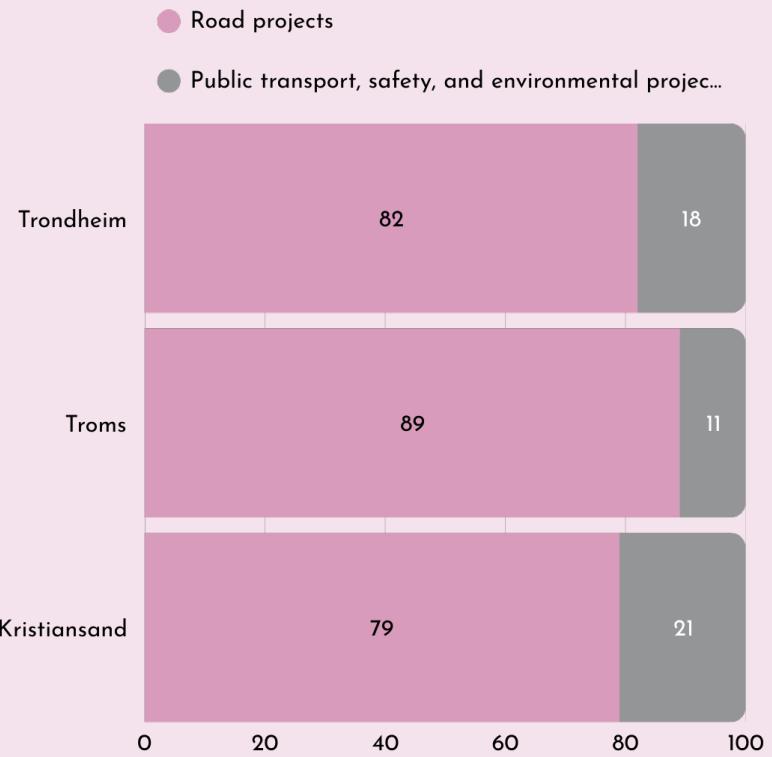
Figure 6: How revenue is allocated in three Norwegian cities (Langmyhr, 1997).

3.5.   Conceptual model

The conceptual model (Figure 7) illustrates how various factors influence the perceived fairness of road pricing. Existing research (represented by the black arrows labeled A#) summarizes the current knowledge, as shown in Table 5, with detailed descriptions in Appendix B. However, the factors shaping perceived fairness itself remain less explored.

To address these gaps, the model includes hypothesized relationships (gray, striped arrows) that require further research. These potential connections will be examined using alternative methodologies, including expert interviews and a survey, as outlined in Chapter 2.

It became clear that the revenue allocation plays a role within the entire system. Although it is part of the design of the policy, there are also connections specifically between the allocation and other factors, hence, there is a distinction made within the conceptual model.

The conceptual model presented in Figure 7 is designed to address the knowledge gap outlined in Chapter 1, which centers on the limited understanding of how the Dutch public perceives the fairness and acceptability of road pricing policies. Although road pricing has long been debated in the Netherlands, existing research offers limited insight into the underlying factors that shape public attitudes, particularly regarding perceptions of fairness and the allocation of revenues generated by such policies.

This study further seeks to fill that gap by examining how fairness concerns and revenue redistribution strategies influence public acceptance. The proposed model explicitly links these components to better understand the dynamics at play. By investigating these relationships, this research aims to generate valuable insights for the design and implementation of road pricing schemes.

Link	Sources
A1	(Huber et al., 2019; Van Wee & Mouter, 2021)
A2	(Hårsman, 2001; Hsieh, 2022; Karner et al., 2020)
A3	(Craik & Balakrishnan, 2022; Ecola & Light, 2009; Eliasson, 2016; Parkhurst et al., 2006; S. Sen et al., 2022; Wessel, 2020)
A4	(Randal et al., 2020)
A5	(Gu et al., 2018; Eliasson, 2014).
A6	(Cain & Jones, 2008; Ecola & Light, 2009; Farrell & Saleh, 2005; Vrtic et al., 2007)
A7	(Raux & Souche, 2004)
A8	(Pereira et al., 2016).
A9	(Banister, 2008).
A10	(Hau, 2005; Niskanen et al., 2003; Schade, 2017; Schuitema et al., 2005; Schuitema & Steg, 2008)
A11	(Hazan et al., 2020; Higgins et al., 2010; Sørensen et al., 2013; Tillema et al., 2012)
A12	(Higgins et al., 2010).
A13	(De Palma et al., 2006; Ieromonachou et al., 2005; Sørensen et al., 2013)
A14	(Börjesson et al., 2016; De Palma et al., 2006)
A15	(Grush, 2010)
A16	(Manville, 2019).
A17	(De Borger & Proost, 2011; Krumholz & Forester, 2011; Levinson, 2010; Li et al., 2018; Santos & Verhoef, 2011; Small, 1992; Taylor et al., 2010)
A18	(Ubbels & Verhoef, 2006; Verhoef et al., 1997)

**Table 5: Overview of literature sources for the conceptual model.**
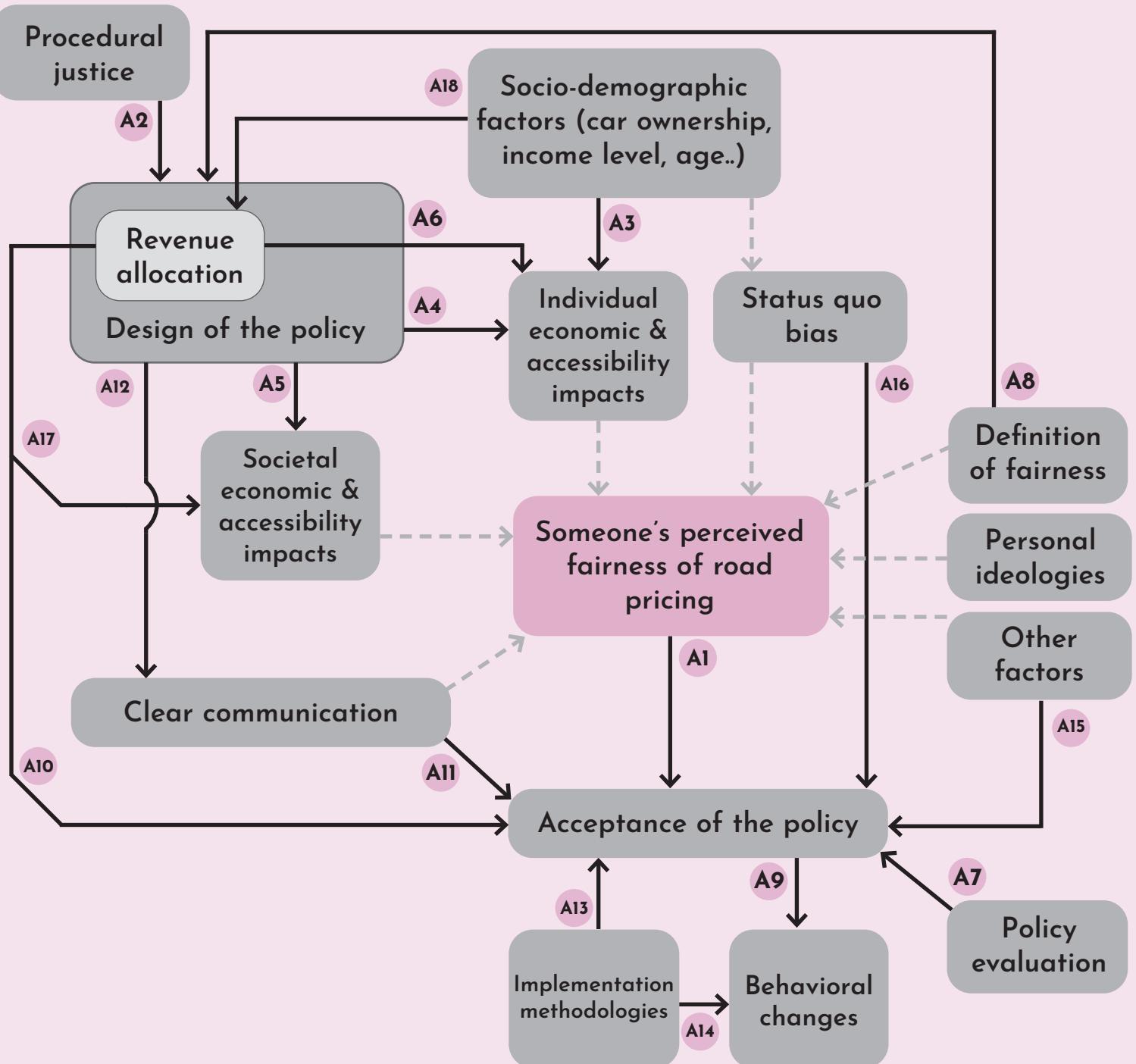
Figure 7: Conceptual model after literature review.

4. Interview Analysis

This chapter presents the findings from the interviews conducted with academics and policymakers to explore perspectives on road pricing in the Dutch context. These interviews aimed to address the sub-questions outlined in Section 1.1 and to uncover key themes and insights relevant to the broader research question. A full analysis can be found in Appendix D. This chapter provides an overview of the most important insights.

The findings are organized as follows: First, the chapter provides an overview of the items that arose during discussions of the sub-questions and their relevant topics inspired by the literature review in Chapter 3. Following this, a comparison between the A and B groups (academics vs. policymakers) will provide insights into the similarities and differences in the answers. Finally, the emerging topic of politics will be discussed.

By examining the perspectives, this chapter seeks to provide a nuanced understanding of the complexities of implementing road pricing in the Netherlands while contributing to the ongoing policy debate.

4.1. Fairness in transport/road pricing policy

Figure 8 provides an overview of three topics that emerged during interviews in response to discussions on fairness in transport policy, which was initially explored in Section 3.1.

Policy Design

Policy fairness can be viewed through **utilitarian, egalitarian, and sufficiency-based lenses** (A3).

Pay-per-kilometer aligns cost with usage but may **disadvantage those with no alternatives** (A3, A2).

Revenue redistribution (e.g., tax cuts or transit investment) can improve perceived fairness (A2, B3, B2).

Ignoring **individual circumstances** in road pricing creates perceptions of unfairness (A1).

Pricing policies often **favor wealthier individuals**, worsening equity concerns (A1).

Impacts on Specific Groups

Rural residents face higher travel costs, making them more vulnerable to road pricing (A4).

Car-dependent/rural regions may feel unfairly burdened due to **limited alternatives** (B3, B1).

Frequent drivers may feel unfairly charged under a **flat kilometer fee** (A2).

Congestion pricing can disproportionately impact low-income groups (A2).

Public Perception and Communication

Complicated pricing can **seem unfair** if people don't understand the charges (B2).

Clear communication is crucial for **public understanding and trust** (B2, A1, A4).

Simplicity and transparency **increase acceptance** of road pricing (A4).

Procedural fairness plays an important role regarding the public perception of a road pricing policy (A1, A4).

Many **resist change** as their lives are structured around current cost systems (A4).

Figure 8: Fairness issues according to interviewees.

In short, the fairness of (road pricing) policies comes down to a few key issues according to the interviewees. First, there is a need for transparency and simplicity—people want a transparent system that takes into account their individual circumstances. Economic factors also play a significant role, such as how pricing affects lower-income groups or those who rely more on their cars. Revenue redistribution—using the money raised to improve public transportation or reduce other car taxes—can make a significant difference in how fair the system appears. Ethical questions, such as balancing fairness and practicality, also matter, especially for individuals who have no choice but to drive. Additionally, the system's impact on specific groups and regions, as well as the ways in which people adapt to it, are significant concerns. Finally, if the system is too complex or poorly explained, it risks being perceived as unfair. Getting all these aspects right is crucial to making road pricing effective and feel fair to everyone.

4.2.   The fairness evaluation of road pricing policies

Figure 9 provides an overview of the topics that arose during discussions on the evaluation of fairness in road pricing policies, as discussed in the literature in Section 3.2.

A few key points stand out regarding fairness when evaluating a pricing scheme. Current methods for evaluating transport policies often fail to provide a comprehensive view of how they are perceived regarding fairness and other qualitative aspects. It is important to analyze how the scheme affects different groups. This includes examining income levels, regional disparities, and specific cases, such as those who require driving long distances or using heavier vehicles. Thorough impact assessments, both quantitative and qualitative, are key to understanding these effects. Ethical


Evaluation Methods

Traditional tools like **CBAs** and **environmental impact assessments** should incorporate qualitative aspects to reflect lived experiences and fairness perceptions (A1).

Utilitarianism, **egalitarianism**, and **sufficiency-based fairness** help evaluate if pricing policies maximize value, reduce inequalities, and protect the most vulnerable (A3, B2).

Thorough impact assessments using both **qualitative and quantitative** methods ensure fairness (B1).

Distibutional Effects

Losses for vulnerable or politically significant groups should be weighted more heavily, reflecting **loss aversion** (A2).

Understanding **the effects on different** income **groups**, regions, and specific cases (e.g., long-distance commuters) is crucial (B2).

Practical Considerations

A pricing scheme should **cover maintenance costs**, be transparent and simple, and **consider group-specific impacts** (A4).

Gradual introduction helps people adjust behavior and cost expectations (A4).

Evaluations should consider **tariff structures, revenue redistribution, regional effects, and system costs** (B3).

Figure 9: Fairness evaluation discussion.

considerations also matter—principles like utilitarianism, egalitarianism, and sufficientarianism can help evaluate whether the scheme adds overall value, reduces inequalities, and ensures no one is too badly off. Practical factors, such as the tariff structure, regional impacts, and implementation strategy, must be considered. Gradual rollouts can help people adapt, and keeping the system simple and transparent ensures it is easier to evaluate and accept. All these elements together create a comprehensive framework for assessing fairness.

4.3.   Acceptance of a pricing policy in the Netherlands

Figure 10 provides an overview of the topics that arose during the discussion of acceptance and the Dutch context, based on the research presented in Section 3.3. Some themes overlap with previous sections, but the context is slightly different, as it now refers more to acceptance rather than fairness, as discussed in sections 4.1 and 4.2.

The perceived fairness of a pricing scheme has a significant impact on whether people in the Netherlands accept it. First, personal circumstances play a large role—people are more likely to support the scheme if they do not feel worse off. Concerns about lower-income groups or those who need to travel long distances often influence whether people see the scheme as fair.

Compensation and redistribution are also key. Measures such as lowering motor vehicle taxes or improving public transportation can help people feel that the system benefits society. Clear messaging that highlights these benefits and ensures the scheme feels fair to most people is critical for public buy-in. Transparency and communication are equally important. When the system is straightforward, and people understand exactly what they are paying for and why, they are more likely to accept it. Overcomplicated systems, on the other hand, tend to feel unfair and erode trust. Gradual implementation can also help. Giving people time to adapt their behavior or finances makes the transition smoother and reduces resistance.

Lastly, public trust is essential. Acceptance will drop if people believe the government will use the scheme as an extra tax rather than a replacement for existing charges. Without fairness and trust, public and political support for the scheme will struggle to take off. Fairness is at the heart of how well a pricing scheme is received.

Personal Impact

People accept pricing schemes more if they **do not feel personally worse off**, with income level strongly shaping fairness perceptions (A2).

Fairness concerns are the biggest obstacle to road pricing, especially for lower-income individuals and **long-distance travelers** (A3).

Personal factors like **income, location, and necessity to drive** must be considered in fairness evaluations (B2).

Revenue Redistribution

Compensating affected groups through lower vehicle taxes or public transport investments can boost acceptance (A2).

Acceptance increases when people see the scheme as **fair and beneficial** to society as a whole (B1).

Communication of the Scheme

Transparency and simplicity in pricing improve acceptance, as people need to understand what they pay for and its benefits (A4).

Complex systems feel less fair and reduce acceptance; **clear government communication** is key (B2).

Implementation

Phased introduction helps mitigate resistance by allowing people to adapt behaviors and costs over time (A4).

If people perceive the scheme as unfair, **resistance** rises, making implementation difficult (B3).

Public Trust & Policital Viability

Public trust is crucial— if the scheme feels like an extra charge rather than a tax replacement, acceptance drops (A3).

Political viability improves with compensation, helping gain enough public support for implementation (A2).

Figure 10: Acceptance of a road pricing policy in the Dutch context.

4.4.   The influence of revenue redistribution on fairness and acceptance

Figure 12 provides an overview of the topics concerning revenue redistribution, which were initially explored in Section 3.4.

What can be observed is that revenue redistribution has a significant impact on the acceptance and fairness of road pricing. Public support increases when revenues are used to fund visible benefits, such as public transportation, infrastructure improvements, or lower taxes. Transparency is key—people are more likely to accept the system if they understand how their payments are used. Regional tailoring, such as prioritizing public transportation in cities or road maintenance in rural areas, makes the system feel more equitable. Cross-subsidization, where wealthier regions or groups support less affluent ones, can boost equity but may spark political debate. Overall, transparent and targeted redistribution is crucial for fairness and support.

4.5.   Comparison of answers between groups A (academics) and B (policymakers)

To better understand how equity is interpreted and applied in practice, this section compares the perspectives of academics and policymakers, as gathered through interviews. While both groups recognize the importance of fairness and public acceptance, they approach equity from different angles—academics tend to emphasize theoretical and procedural fairness, while policymakers focus on practical implications and political feasibility. This comparison adds depth to the analysis by revealing not just shared concerns but also key gaps between theory and implementation. Bridging this divide helps identify where alignment is needed to design equitable and accepted policies. The main similarities and differences are summarized in Figure 11.

Group A (Academics)

Emphasizes **theoretical fairness principles** (utilitarianism, egalitarianism, sufficiency-based fairness).

Focuses on **procedural fairness** and addressing **misconceptions**.

Uses **qualitative & quantitative evaluation methods** (e.g., cost-benefit analysis, environmental impact assessments).

Similarities

Fairness Concerns: Both recognize fairness issues (procedural fairness, personal circumstances).

Public Acceptance: Both agree that perceived fairness is crucial for acceptance.

Revenue Redistribution: Both discuss using revenues to benefit the public to improve fairness & support.

Group B (Policymakers)

Prioritizes **practical considerations** (impact on specific groups, regional differences).

Stresses **clear communication & transparency** in road pricing schemes.

Highlights **political aspects** and public **stakeholder engagement** in evaluation.

Figure 11: Differences and similarities between interview groups.

Direct Benefits

Public acceptance increases when people **see direct benefits**, such as improved public transport, road infrastructure, or lower car taxes (A1).

Redistributing revenue to those who pay enhances fairness and acceptance, especially if specific groups negatively impacted are compensated (A2).

Transparency

Acceptance grows when revenue use is **clearly linked**, making the system feel fair and legitimate (A4).

Clear communication on how fees are calculated strengthens public trust and fairness perceptions (B2).

Targeted Redistribution

Urban investment in bike lanes, footpaths, and public transport increases acceptance, but may cause **tensions in rural areas** with fewer benefits (A4).

Regional flexibility in revenue use, like provincial road tax surcharges, aligns with local needs and boosts support (A4).

Cross-Subsidization

Wealthier regions subsidizing poorer ones is seen as fairer, ensuring rural areas benefit from urban revenue (A4).

Balancing costs and benefits ensures **the majority perceives the system as fair** (B3).

Political Considerations

Revenue redistribution is **highly political**, fairness depends on who benefits and who pays (B3).

Public transport subsidies may be seen as **fair** by some but as an **unfair** burden on motorists by others (B3).

High implementation costs could be unfair if passed to motorists or covered by general taxes, **affecting acceptance** (B3).

Figure 12: Revenue redistribution discussion.

4.6.   Emerging topic: Politics

As with the literature review, the political context of policies also emerged in the interviews. Although no specific questions were asked during the interviews, every interviewee touched on the topic. In this section, a summary of this topic will be given.

A1 notes that the likelihood of introducing a new road pricing policy within the next ten years has decreased under the current cabinet, which does not prioritize it. They explain that different motivations across the political spectrum can influence political support for road pricing, but the current cabinet's unclear focus and electoral considerations complicate its adoption. Similarly, A2 expresses skepticism about implementing new road pricing policies, given past experiences and the lack of coalition agreement. They emphasize that fairness is ultimately a political judgment and that politicians should seek designs that minimize negative distributional effects.

A3 highlights the difficulty in getting a political majority to support road pricing due to fears of losing votes and concerns about the functionality and cost of ICT systems. They also point out that the Netherlands excels at making plans but struggles with their implementation, resulting in slower progress compared to other countries. B1 mentions that the political feasibility of road pricing remains uncertain and that public sentiment and election outcomes will play a crucial role. They note that a more progressive government might favor road pricing while a conservative one may not, emphasizing that societal acceptance and broad support are crucial for the feasibility and implementability of such systems.

A4 is critical of the political approach to road pricing, noting that politics often shows concern but fails to frame the issue effectively. They perceive that the issue is approached too technically and that politicians lack the courage to implement new policies, often deferring action to future cabinet periods. They also criticize the opportunistic and short-sighted nature of political reasoning over the last decade. B2 notes that political influence plays a significant role in the development and implementation of policies. While they work on creating fair and logical policies, the final decisions are made by politicians. They emphasize their role in informing and advising politicians, but the ultimate choice lies with political leaders.

B3 states that political factors heavily influence the implementation of road pricing and that its success depends on political support. They emphasize that fairness is a political question, as different groups may be affected differently, and it is up to politicians to judge whether the system is fair. They underscore that political support and the political constellation at any given time are crucial for pursuing or implementing road pricing policies.

All interviewees agree that political support and decision-making are crucial for implementing road pricing policies. They highlight the challenges of electoral considerations and the need for broad societal acceptance. However, they differ in their emphasis: A1 and A2 focus on the current cabinet's priorities and past experiences, respectively; A3 emphasizes the Netherlands' implementation issues and political risk aversion; B1 highlights the influence of government type on policy feasibility; A4 criticizes the technical approach and lack of political courage; B2 stress the ultimate decision-making power of politicians; and B3 underscores the periodic nature of political support and the importance of political judgment in determining fairness.

5. Survey Results

This chapter provides the survey results. The list of questions can be found in Appendix E. The section is divided into several parts, beginning with a sample analysis. The population sample will be compared to the Dutch population to see to what extent it is representative. In Section 5.2, the analysis presents the statistical tests conducted, categorizing them into significant and non-significant results. Finally, as the survey also included some optional open-ended questions for respondents, a summary of their answers will be presented.

5.1.   Survey sample vs. Dutch population

To determine whether the survey sample is representative of the Dutch population, various demographic characteristics were compared from the survey and the Dutch National Database (CBS). The survey received 107 respondents. All the comparisons can be seen in Table 6.

First, the ages of the respondents were compared. There are differences in the ranges, so some ranges in the survey were combined and then compared with the CBS data to gain better insights and see apparent differences. One difference is the older participants. Only 3.7% of survey respondents were 65 years or older, whereas in the Netherlands, 20% of the population is 65 or older. This group is underrepresented in the survey. On the other hand, the younger demographic is also underrepresented. According to CBS, 21% of the Dutch population is 20 years old or younger. In the survey, all respondents were at least 18 years old, as there were zero responses in the category "under 18 years old". Although underrepresented, this age group often has little to no driving experience and, hence, probably also little knowledge regarding the topic of road pricing systems.

Next, the living areas of respondents are compared. In the survey, respondents could choose from three options; however, in the CBS data, they were divided into five categories: very strongly urbanized, strongly urbanized, moderately urbanized, little urbanized, and not urbanized. For this comparison, the first two categories were combined as "urban," the next two as "suburban," and the remaining area as "rural." Through these comparisons, it becomes apparent that the rural respondents are underrepresented, while the urban respondents are overrepresented.
The following demographic is related to car ownership. It can be observed that the Dutch population has more car owners than the survey sample, and therefore, car owners are underrepresented in this research, with a difference of approximately 10%.

Additionally, gender was also compared. Where the CBS shows that the distribution is almost evenly split between males and females, the survey has a higher proportion of male respondents. Another difference is that the survey offered the option of "other," whereas the National Database does not include this.

Another comparison can be made regarding the income levels. Here, it can be seen that the survey contains relatively lower incomes than the

		Survey	National Demographics
Age (Centraal Bureau voor de Statistiek, 2022a)	18-24	29%	
	<20		21%
	25-44 (survey) / 20-40 (CBS)	40.1%	26%
	45-64 (survey) / 40-65 (CBS)	27.1%	33%
	65+	3.7%	20%
Residential area (CBS Statline – Stedelijkheid, 2024)	Urban	62.6%	50.3%
	Suburban	29.9%	33.2%
	Rural	7.5%	16.4%
Car ownership (Centraal Bureau voor de Statistiek, 2024)	Owns a car	40.6%	50.9%
	Does not own a car	59.4%	49.1%
Gender (Centraal Bureau voor de Statistiek, 2022b)	Female	33.7%	50.3%
	Male	61.3%	49.7%
	Other	0.9%	-
Income levels (CBS Statline – Inkomen, 2024)	< €10.000	24.3%	11.7%
	€10.001 – €20.000	17.5%	16.5%
	€20.001 – €30.000	6.8%	18.8%
	€30.001 – €40.000	12.6%	14.5%
	€40.001 – €50.000	10.7%	12.1%
	€50.001 – €100.000	24.3%	22%
	€100.001 – €200.000	3.9%	3.8%
	> €200.000	-	0.6%
Nationality (Centraal Bureau voor de Statistiek, 2021)	Dutch nationality	86.5%	86%
	Other nationality	13.5%	14%
Most frequent mode use (CBS Statline – Mobiliteit, 2024)	Car	37.1%	72.3%
	Bike	31.4%	13.1%
	Public transport (survey)/Train (CBS)	31.4%	14.6%
Occupation (CBS, 2022; Centraal Bureau voor de Statistiek, 2024a, 2024b; PNO, 2024)	Student	36.4%	8.1%
	Unemployed	2.8%	2.3%
	Part-time job	13.1%	29.2%
	Full-time job	36.4%	31.7%
	Entrepreneur	8.4%	8.1%
	Retired	2.8%	20.5%

Table 6: Socio-demographic comparisons.

CBS data. The categories of €30,001 and higher are quite similar to the survey data. The most significant differences can be observed in the categories of €10,000 and below and €20,001–€30,000.

The comparisons of nationality are almost identical to one another. Within the category "other Another comparison can be made regarding the most frequent mode use. Notably, the CBS only defines trains, while the survey combines all public transport options (including buses, trams, and metros) into a single category. Another variance in the datasets is that the CBS looks at a daily average (of traveled kilometers), whereas the survey asked for weekly averages. Regarding the differences in results, the survey shows an almost equal split between the three options, whereas the national dataset indicates a more frequent use of cars.

The final comparison shows the occupations of the respondents. Most of the differences in previous demographics can be explained through this comparison. It can be observed that the survey respondents were predominantly students (36.4%), compared to 8.1% in the Dutch population. There are also significant differences in the number of part-time jobs and the number of retired people. The latter is also linked to the differences in age representation, as shown in Table 6. Also, the differences in car ownership are likely linked to the significant student representation, as only 7% of students own a car, according to the national dataset (CBS, 2018), and 15.4% of the students in the survey.

Overall, there are some significant differences between the sample and the actual population, meaning the survey data is not fully representative of the Dutch population. Generally speaking, females and non-binary/other genders, older people, retired or part-time workers, frequent car users, and rural residents are underrepresented in the survey data. In contrast, males, students, low-income individuals, and urban residents are overrepresented. There is undoubtedly a sample bias, which is evident in the tables above. A high number of students participated in the survey, most of whom presumably study at the faculty of Civil Engineering, which can also influence their perception of road pricing, as they might already have some knowledge in the field of transportation policies. This could also be the reason why there is a higher percentage of low-income respondents, as students typically do not earn much money while pursuing their studies. The gender ratio could be due to a bias within the TU Delft, as more male students are studying in this city than female. The urban overrepresentation occurs because most students reside near the university or in large cities surrounding Delft (e.g., Rotterdam, The Hague).

5.2.   Descriptives and tests
This subsection provides an overview of the analyses conducted regarding quantifiable data. Various tests were used, as shown in Section 2.2. Further information can be found in Appendix F.

5.2.1.   Descriptives
The survey consisted of a few questions that respondents had to answer to the extent they agreed with the statements. An overview will be provided in this subsection to show the consensus regarding the perceived fairness and acceptance of a road pricing policy. For all figures, the x-axis are percentages.

The first statement that was answered was: "I find road pricing fair, disregarding type." The result is shown in Figure 13, where it becomes clear that the majority finds it fair, as most respondents (over 80%) answered "agree" or "strongly agree."

"I find road pricing fair, disregarding type."
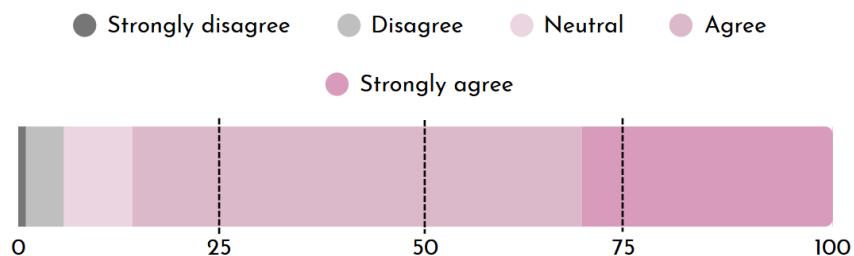
Figure 13: "I find road pricing fair, disregarding type."

To gauge how survey respondents felt about the six defined road pricing types (which also included the current system), they were asked to express their level of agreement with the fairness of each type. The statement was, "I find [type of road pricing] fair." The results are presented in Figure 14. Distance-based and emission-based are scored the highest regarding fairness levels, whereas other scheme types have more variance within the answers. Congestion pricing could be seen as the least fair, as this type contains the largest amount (around 40%) of negative responses (disagree and strongly disagree combined).

"I find [type of road pricing] fair."
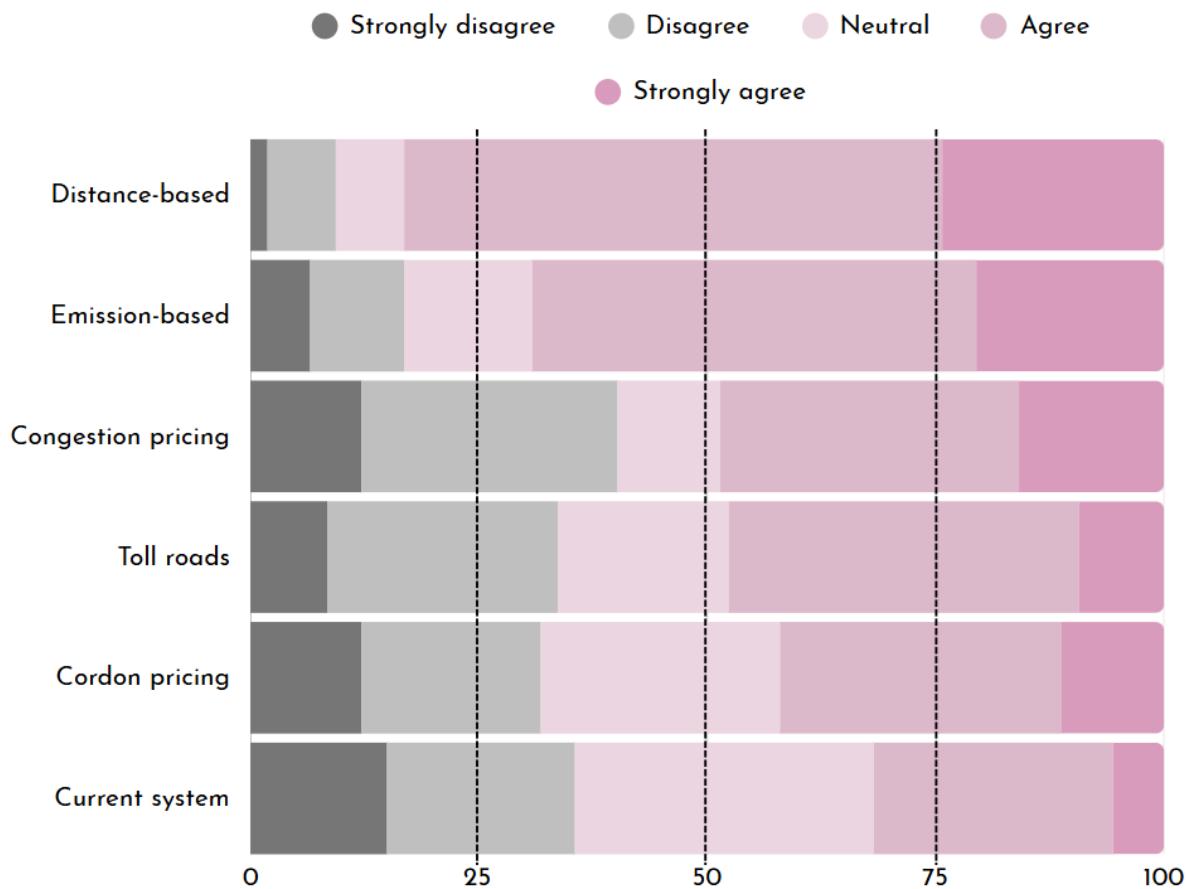
Figure 14: "I find [type of road pricing] fair."

Next to perceived fairness, the acceptance of road pricing policy was also explored within the survey. With the three statements presented in Figure 15, it becomes clear which factors can lead to more support for a road pricing policy. It is evident how important good communication is for acceptance, as a large majority (around 80%) answered "agree" or "strongly agree" here. Over 50% of respondents agree that they would support the implementation of a road pricing scheme (disregarding variant type). Regarding the last statement, 50% of survey respondents expect a road pricing policy to affect them positively.

Statements regarding acceptance.
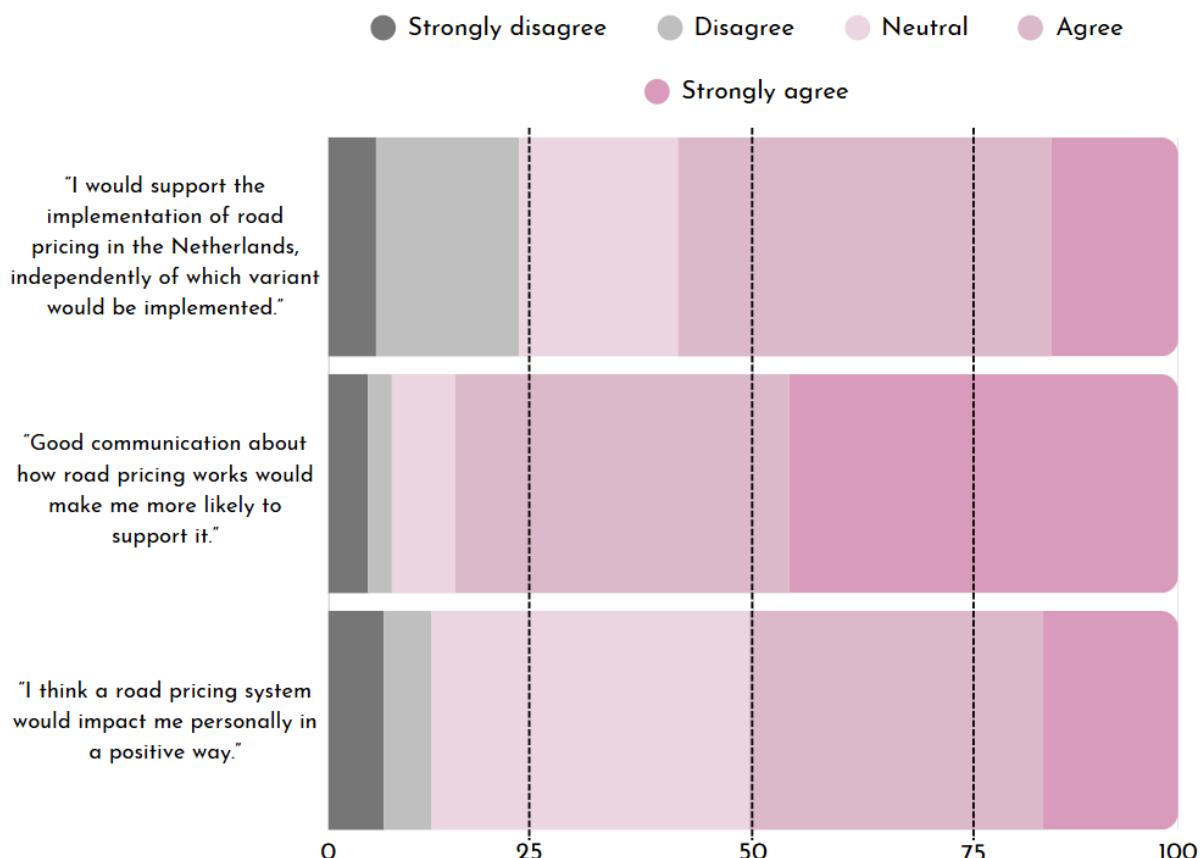
Figure 15: Statements regarding acceptance.

Furthermore, the influence of revenue allocation types was examined among survey respondents. Four types of revenue allocation were presented, and respondents were asked to indicate the extent to which each type would influence their support. These results are illustrated in Figure 16. A majority (75%) would support a road pricing policy more if the revenue goes towards public transport investments. Reducing car taxes and investing in road infrastructure are also strategies to gain more support, as a large number of respondents showed (55% and 70% respectively).

"I am more likely to support road pricing if the revenue is used for …"
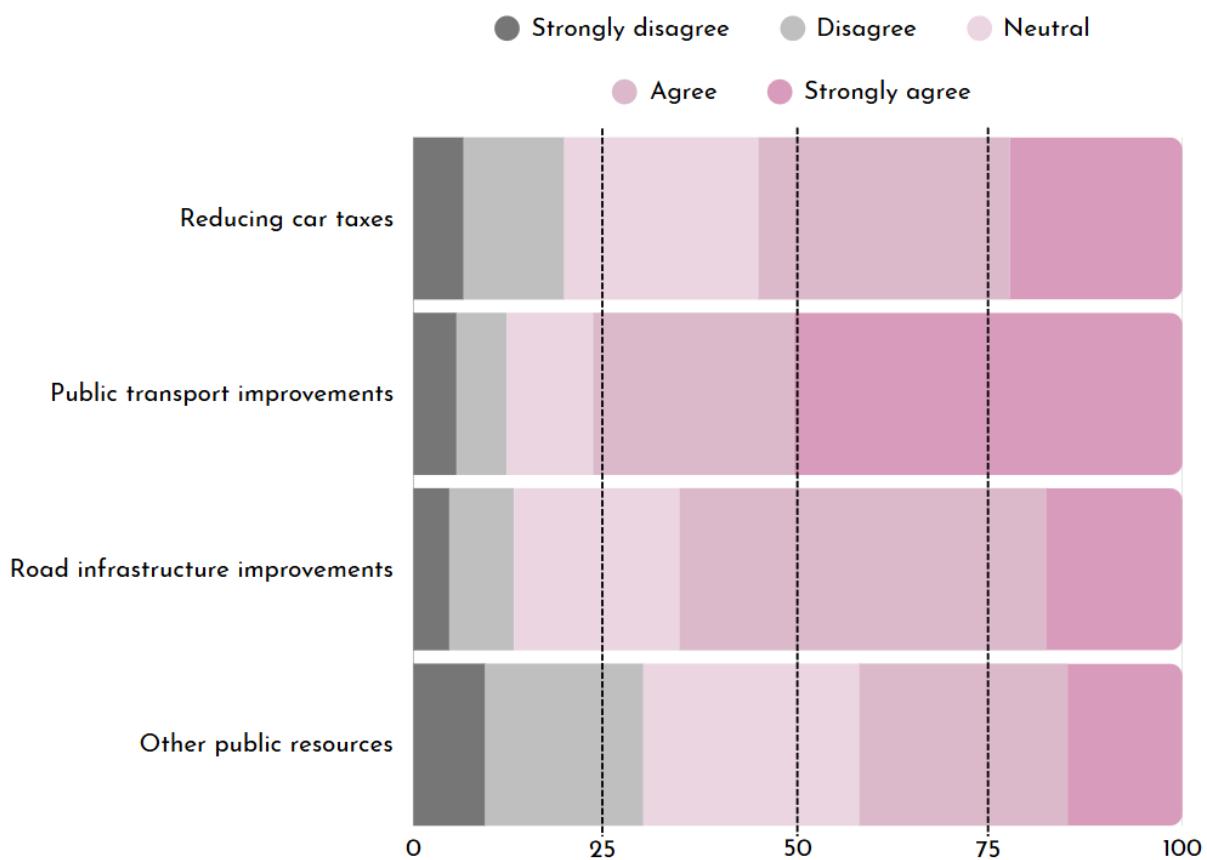
Figure 16: *"I would support road pricing more, if revenue went towards .."*

As the literature and interviews emphasized the importance of communication, it was also explored whether the communication of revenue allocation would influence the extent of support for a road pricing scheme. The respondents had to answer the following: "I am more likely to support a road pricing scheme if it is transparent how the revenue is spent." It becomes evident in Figure 17 that being transparent has a positive influence on acceptance, as over 75% agreed.

"I am more likely to support a road pricing scheme if it transparent in how the revenue is spent."
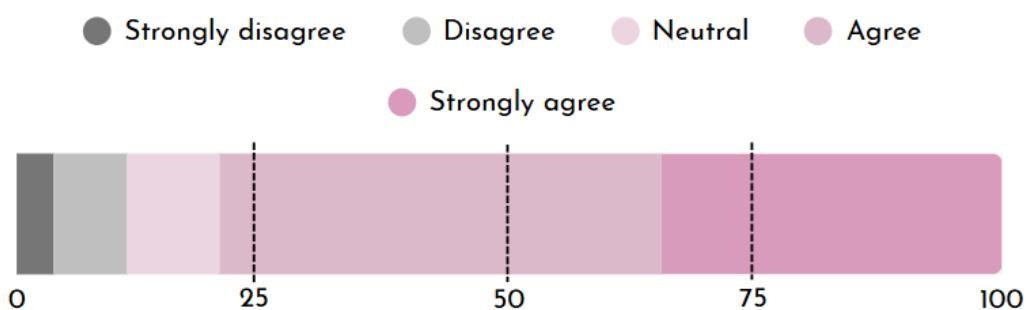
Figure 17: *"I am more likely to support a road pricing scheme if it is transparent how the revenue is spent."*

Finally, there were some statements regarding the potential benefits and concerns around a road pricing policy. This was explored to gain further insights into the perception of these types of policies, as literature and interviews suggested a negative outlook and misconceptions. Figure 18 shows the results of these statements. The second statement includes reversed wording (adding "not"), explaining why the majority (60%) answered "disagree" here. Thus, it can be concluded that respondents hold a positive view of road pricing policy, as over 50% of respondents agree with the other three statements.

Statements regarding benefits and concerns.
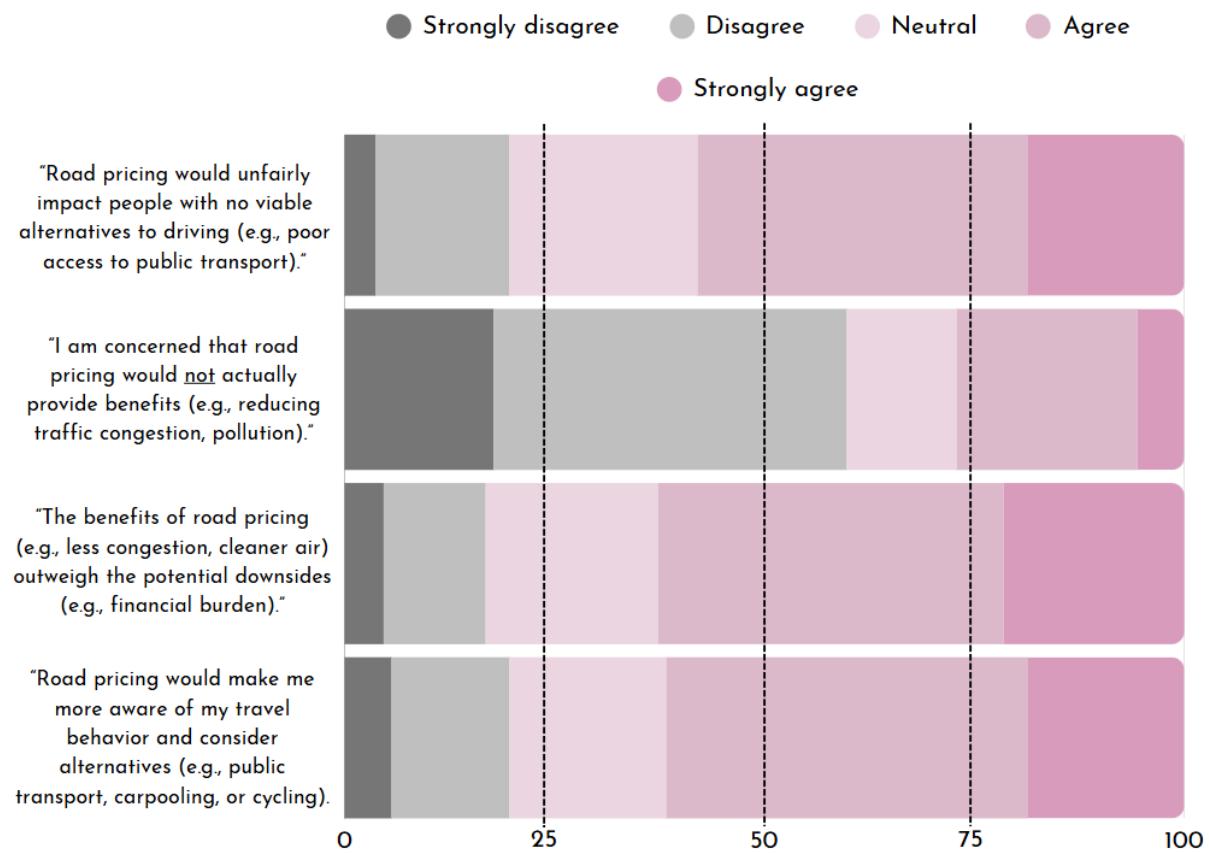
Figure 18: Statements regarding the benefits and concerns regarding road pricing.

5.2.2.   Statistically Significant Tests
Car Ownership
Car ownership significantly influences perceptions of fairness, but not in general; instead, it affects perceptions of fairness for specific pricing mechanisms. Mann-Whitney tests show that non-car owners perceive distance-based pricing (p = 0.020), emission-based pricing (p = 0.007), and congestion pricing (p = 0.006) as fairer than car owners do. However, this difference is not significant for toll roads (p = 0.155) or cordon pricing (p = 0.097).

Car ownership also affects preferences for revenue allocation. A Kruskal-Wallis test reveals that non-car owners exhibit a stronger preference for tax reductions (p = 0.024) and investment in public transportation (p = 0.002) compared to car owners. In contrast, preferences for road infrastructure (p = 0.299) and other public resources (p = 0.151) do not significantly differ.

Residential Area
Although residential area does not significantly impact general fairness perceptions (as discussed in the next section), it does influence preferences for revenue allocation. Urban residents are significantly more likely to favor tax reductions compared to suburban residents (p = 0.008).

Similarly, pricing preferences vary by residential area. Differences are significant for emission-based pricing (p = 0.010 between urban and suburban residents), cordon pricing (p = 0.018 between urban and rural residents), and the current system (p = 0.012 between urban and suburban residents).

Communication, perceived fairness, and acceptance
Clear and transparent communication significantly improves public acceptance of road pricing, though its impact varies. A weaker correlation (Spearman's rho = 0.267, p = 0.006) was found between general support for road pricing and the belief that good communication increases acceptance, suggesting that while communication plays a role, other factors also influence support. However, a stronger correlation (Spearman's rho = 0.562, p < 0.001) was observed when focusing on the link between transparency and acceptance, indicating that clear explanations and openness about the policy play a crucial role in gaining public trust. These findings highlight that while communication always matters, greater transparency leads to significantly higher acceptance. Additionally, individuals who believe they would not be negatively affected by the policy are significantly more likely to accept it (= 0.465, p < 0.001).

Perceived fairness also plays a significant role in policy acceptance. There is a positive correlation (= 0.398, p < 0.001) between perceiving a policy as fair and supporting it. A correlation was examined between the statements "I would support road pricing, disregarding pricing type" and "I think road pricing would positively affect me." The results showed a weak but significant positive correlation (= 0.215, p = 0.026). This suggests that individuals who expect to benefit from road pricing are more likely to support it.

5.2.3.   Non-Significant Tests
Car Ownership & Use
While it was expected that non-car owners would perceive road pricing as fairer overall, this hypothesis was not supported by a Mann-Whitney test (p = 0.133). Instead, the differences emerge only when examining specific pricing schemes, as outlined in the significant findings.

"Frequent drivers may feel unfairly charged under a flat kilometer fee," was a claim from the interviews. A Kruskal-Wallis test was used to analyze this. When asked whether charging road users based on distance is fair, car users agreed less than public transport users and cyclists. This suggests that drivers who would pay more under such a system are less supportive of it, though the difference was not statistically significant (p = 0.309).

Residential Area
Contrary to expectations, people living in rural areas do not perceive road pricing as significantly less fair than those in urban or suburban areas (Kruskal-Wallis test, p = 0.730). However, the results did show a lower mean rank for the perception of fairness among rural residents. Due to the p-value, it cannot be determined with certainty.

While interviews suggested that rural residents feel unfairly burdened due to fewer transport alternatives, survey data contradict this claim. The hypothesis is that rural residents find road pricing less fair. This was analyzed using a Kruskal-Wallis test, as the resident type had three alternatives, and the statement "road pricing unfairly impacts those with no viable alternatives to driving (e.g., poor access to public transport)" was assessed through a Likert scale question. Contradicting the literature and interviews, rural residents agreed the least with the statement, yet the hypothesis cannot be rejected (p = 0.261).

Income Level

It was hypothesized that lower-income groups would be disproportionately affected by road pricing due to factors such as age and family responsibilities. However, a Spearman correlation test shows that lower-income individuals are, on average, younger rather than older (= 0.655, p = 0.001). Additionally, income level does not significantly influence whether respondents consider alternative transport options (= -0.071, p = 0.465), nor does age have a meaningful correlation with this consideration (= 0.095, p = 0.331).

Concerns about the fairness of congestion pricing across income groups were also examined. Although lower-income individuals, particularly those earning between €30,001 and €40,000, expressed the strongest concerns about unfairness, these differences are not statistically significant (p = 0.372).

5.3. Qualitative answer analysis

The survey included a few open-ended questions. These were optional to answer, preventing the survey from becoming too lengthy and resulting in fewer responses. An analysis of these answers will be provided in this subsection. The numbers behind each item refer to the frequency at which the topic was mentioned.

5.3.1. Fairness issues in road pricing policy

Geographical disparities significantly influence how road pricing is perceived. People in rural or less densely populated areas often drive longer distances, making distance-based pricing feel unfair (4). Additionally, residents near tolled roads bear a disproportionate financial burden (2). Socioeconomic inequality further complicates the issue, as lower-income individuals may not be able to afford fuel-efficient or electric vehicles, leading to higher costs under emissions-based pricing (5). Meanwhile, wealthier people can afford to live closer to work, avoiding high commuting costs (2).

Limited choice in travel behavior is another concern. Many find congestion pricing unfair because not everyone can adjust their travel times or work from home (3). Essential workers and those with fixed schedules face unavoidable higher costs (3). Work-related impacts also emerge, with emissions-based pricing disproportionately affecting commercial vehicles, such as diesel vans, which are often necessary for work (1). Similarly, congestion charges financially pressure people to adjust their work hours, which may not be feasible for all (1).

Systemic disadvantages arise as road pricing mechanisms can reinforce existing inequalities, making it harder for disadvantaged groups to access opportunities (2). Unfair policy implementation adds to the issue, particularly with cordon-based pricing, which is problematic due to arbitrary boundary-setting, impacting those unable to relocate (1). Perceived excessive taxation also fuels opposition, as some believe road pricing adds an unnecessary financial burden in an already highly taxed country (1).

There are mixed views on distance-based pricing. Some argue it is fairer since people pay for how much they drive (2). Others argue that it disadvantages those who need to travel long distances, such as for work or to visit family (2). Overall, while many respondents see "paying for usage" as fair in principle, how it is implemented significantly affects perceptions of fairness.

5.3.2.   Acceptance of a road pricing policy

Communication plays a crucial role in the acceptance of road pricing. Clear communication makes the system more user-friendly and helps with acceptance (1). A well-communicated system encourages people to adjust their driving habits (1), while a lack of proper communication may lead to unexpected costs, reducing overall acceptance (1).

Behavioral changes are another key factor. Knowing the exact cost per kilometer would encourage people to think more about their car use (2). Some may shift to alternative modes of transport, such as cycling for short trips (1). While reduced car usage could lead to more crowded public transportation, it might also become more affordable (1).

Acceptance and support for road pricing vary depending on individual circumstances. People without a car are less directly affected, and their support depends on additional factors such as price and regional implementation (1). The overall impact of a well-designed policy could reduce congestion and emissions, leading to positive societal effects (1).

5.3.3.   Revenue allocation strategies

Public transport investment is a key consideration in road pricing discussions. Many believe that revenue from car subsidies should be redirected to public transportation to improve accessibility and sustainability. Lowering ticket prices and investing in public transport is seen as a fairer, future-proof approach (3). Some support public transport investment but argue that car users should not have to fund it, as they may not directly benefit from it (2). Others emphasize that road pricing should disincentivize car use by providing viable public transport alternatives rather than maintaining or upgrading roads (2).

Infrastructure investment is another major topic. A user-pays system is considered the fairest, meaning revenue from road users should primarily be reinvested in road maintenance and infrastructure (3). While some acknowledge the need for public transport improvements, they stress that road maintenance should remain linked to usage (1). There is also concern that car use should not become a general revenue source for unrelated government expenses (1).

Reducing car taxes is a widely supported measure. Many agree that road pricing should replace, not add to, existing car taxes to maintain public acceptance. If it is introduced, current car taxes should be lowered or eliminated (3). However, some caution that public transport funding should not be dependent on car usage levels, as that contradicts sustainability goals (1).

Beyond transport, some believe that mobility policies are part of broader societal issues and should be decided through democratic processes. Others argue that revenue should benefit as many people as possible, including through public services beyond transport (2).

Other considerations include the complexity of direct redistribution, as government revenue is often pooled into general budgets, making allocation politically sensitive (2). A few responses were influenced more by political ideology than fairness concerns (1). While improving public transport reduces congestion for drivers, some believe car users should directly benefit from the revenue they generate (1). Additionally, the Netherlands' public transport system has limitations compared to those of other countries, and its roads are already well-maintained (1). Many argue that road pricing revenue should remain within the transport sector rather than being used to fund unrelated services, such as healthcare, as these are already covered by other taxes (1).

6. Discussion and Implications

This section will interpret the results from the previous sections and examine the differences within the literature review, interview analysis, and survey results. Further on in 6.3, the strengths and limitations of this research will be discussed.

6.1.   Empirical results main findings

Chapters 4 and 5 present the findings from the expert interviews and the public survey, which together provide valuable insights into the factors influencing the acceptance of road pricing. Both experts and the survey sample agree that fairness and transparency are fundamental. However, it is important to acknowledge that the survey sample may be biased, which could influence the generalizability of the findings. Ensuring that different groups—such as frequent drivers and lower-income individuals—feel their specific needs are considered is essential for creating a sense of fairness.

A structured approach to fairness—using ethical frameworks and comprehensive impact assessments—was strongly emphasized in the interviews. These frameworks can help clarify the benefits and costs of road pricing, ultimately increasing trust. Frameworks for evaluating fairness were not discussed within the survey, as this would require additional explanation, making the survey longer. Clear, open communication was repeatedly highlighted as crucial for public acceptance, both in the expert discussions and by a few survey respondents who mentioned it independently in the open-ended section. The same applies to gradual implementation, alongside efforts to address the personal impact on different user groups, which was also seen as a means to improve support.

Revenue allocation emerged as another critical factor, which is addressed in sub-question 3. Directing funds towards public transport improvements or tax reductions helps balance public preferences and increases acceptance. However, preferences for specific strategies vary across socio-demographic groups, making it difficult to determine a single, universally accepted approach. It became clear from the responses that there is no "one size fits all" approach to such a policy, as the perceived fairness rankings of both the road pricing scheme type and the revenue allocation strategy varied.

While experts highlighted common misconceptions about road pricing, survey responses generally reflected a positive outlook, which was unexpected given the findings from the literature research and interviews. Within the literature review, it was seen that road pricing in the Netherlands experiences resistance due to social and political barriers and that despite the ongoing discussions, public opposition (rooted in the visible financial burden, attachment to car freedom, and skepticism about effectiveness) blocks the large scale implementation of a road pricing policy. The expert interviews also showed similar results, saying that support for road pricing is weak. They argue that the political context also plays a role, as shifting priorities, electoral considerations, and fear of voter loss make politicians hesitant to support or implement such policies.

The open-ended responses in the survey provided additional perspectives, offering respondents the opportunity to voice their concerns and suggestions. 18 respondents highlighted fairness issues, such as geographical disparities, socioeconomic inequality, limited travel options, and systemic disadvantages. Transparency and clear communication were seen as crucial, particularly in helping individuals adjust their driving habits based on known costs. Revenue allocation preferences leaned towards public transport investment and reducing car taxes, with many respondents favoring strategies that directly benefit road users.

Overall, the combined findings highlight three key priorities for enhancing public acceptance of road pricing: addressing diverse fairness concerns such as the impact on various socioeconomic groups and geographical disparities. Ensuring transparency around the scheme communication, and implementing revenue allocation strategies to address the fairness concerns, and that are directly beneficial for road users, are also priorities.

An overview of the findings is presented in Figure 19. It illustrates the connections discussed in the literature (A#), supplemented by additions from the interviews (B#) and the survey results (C#). The striped lines show the assumptions previously made in Section 3.5. Pink (striped) lines have been supported by empirical research presented in this thesis. Most connections to perceived fairness have been demonstrated through interviews and/or survey results. In addition to the assumptions made in Section 3.5 (pink, striped lines), some further links were also demonstrated to be true (pink, solid lines). The gray, striped lines did not emerge in this research, but they are still assumed to be connected to perceived fairness.

The conceptual model shows how perceived fairness can be influenced by several factors. The empirical research indicates that psychological aspects such as status quo bias, economic and accessibility impacts, communication, procedural fairness, and socio-demographic factors all play a role in shaping this perception.

Firstly, the status quo bias affects perceived fairness negatively. Individuals who are heavily influenced by this bias tend to evaluate new pricing schemes, such as distance-based, emission-based, or congestion pricing, as less fair, particularly when they are accustomed to the current system or already own a car. The research also suggests that socio-demographic characteristics such as car ownership and residential area influence the strength of this bias.

Secondly, individual and societal economic and accessibility impacts are key influences. People are less likely to perceive a pricing scheme as fair if it makes them personally worse off, or if they observe that other societal groups are disproportionately negatively affected. These impacts are directly tied to perceptions of fairness and policy acceptance.

In contrast, clear communication has a positive effect on perceived fairness. Both survey respondents and interviewees indicated that when the scheme is well-explained and transparently presented, they are more likely to consider it fair.

Procedural fairness emerged as another important factor. Interviewees highlighted the importance of a transparent and inclusive policy design process—one that acknowledges individual circumstances and ensures that people feel heard and treated fairly. This procedural dimension strengthens perceived fairness beyond just the outcome of the policy.

Finally, socio-demographic factors also influence how people evaluate and accept road pricing schemes. The interviews confirmed that characteristics such as car ownership and residential area shape preferences for the type of road pricing (e.g. emission-based or cordon pricing) and influence attitudes toward revenue allocation strategies. These insights suggest that incorporating socio-demographic perspectives into policy evaluation is crucial, as it helps clarify the varied impacts across different groups and improves the perceived fairness of both the scheme itself and how revenues are used.

Table 7 provides an overview of the proven links, with references to the sections where this information can be found. The references from the interviews also include which interviewee discussed this connection. The literature links can be found in Section 3.5.
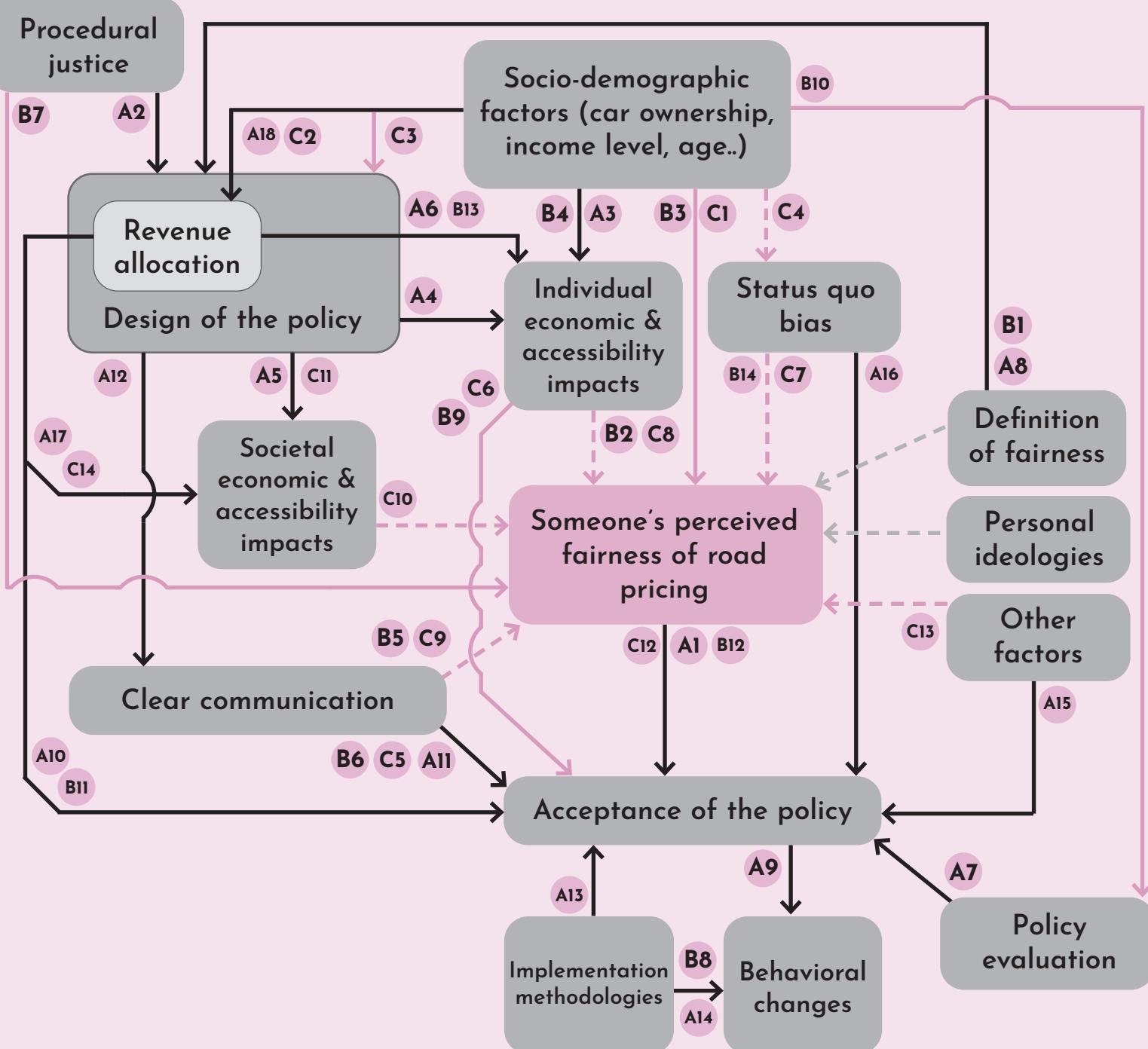
Figure 19: Conceptual model after empirical research.

Link	Reference
B1	Section 4.1 (A3)
B2	Section 4.1 (A1)
B3	Section 4.1 (A1)
B4	Section 4.1 (A4, B3, B1)
B5	Section 4.1 (B2), Section 4.3 (A4, B2), Section 4.4 (B2)
B6	Section 4.1 (A4, B2), Section 4.3 (A4, B2)
B7	Section 4.1 (A1, A4)
B8	Section 4.2 (A4), Section 4.3 (A4)
B9	Section 4.3 (A2), Section 4.4 (A1)
B10	Section 4.2 (B2)
B11	Section 4.3 (A2), Section 4.4 (A2)
B12	Section 4.3 (B1, B3)
B13	Section 4.4 (A2)
B14	Section 4.1 (A2)
C1	Section 5.2.2: Car Ownership, Section 5.2.3: Residential Area, Section 5.2.3: Car Ownership & Use
C2	Section 5.2.2: Residential Area, Section 5.2.2: Car Ownership
C3	Section 5.2.2: Residential Area
C4	Section 5.2.3: Income level
C5	Section 5.2.1: Figure 15, Section 5.2.2: Communication, perceived fairness, and acceptance; Section 5.3.2
C6	Section 5.2.2: Communication, perceived fairness, and acceptance
C7	Section 5.2.3: Car Ownership & Use
C8	Section 5.2.2: Communication, perceived fairness, and acceptance
C9	Section 5.2.2: Communication, perceived fairness, and acceptance
C10	Section 5.3.1
C11	Section 5.3.2
C12	Section 5.2.2: Communication, perceived fairness, and acceptance
C13	Section 5.3.3
C14	Section 5.3.3

Table 7: Overview of empirical sources for the conceptual model.

The main differences between the conceptual model after the literature review (Figure 7) and the version after the empirical research (Figure 19) lie in the validation and refinement of some assumptions and the addition of new insights. While the initial model was mainly based on existing theories, Figure 19 builds on both interview and survey findings, which helped confirm certain links and uncover new ones. For example, the updated model shows a clearer connection between individual experiences, like how road pricing might affect someone financially or in terms of accessibility, and their acceptance of the policy. It also emphasizes the role of socio-demographic factors, such as car ownership and place of residence, in shaping fairness perceptions, preferences for pricing types, and ideas about how revenues should be used. These factors weren't explicitly included in the original model. Another important change is the added focus on procedural justice and communication—both came up strongly in the interviews as important for perceived fairness and support. The influence of status quo bias also became more apparent, especially among people who are used to the current system and may be less open to change. At the same time, it's important to note that not all hypothesized links from the literature were confirmed, and the survey results should be interpreted with care due to some sample bias. The overrepresentation of students and urban residents, for instance, might have influenced which themes stood out most. Overall, Figure 19 gives a more complete picture of the factors that shape public acceptance, grounded in real-world responses.

6.2.   Differences between empirical research and literature

The survey results reveal notable differences from the literature and interviews regarding preferences for road pricing types, regional perceptions of fairness, and the perceived importance of system complexity. While existing research presents a relatively balanced perspective on various road pricing models, survey respondents exhibited a clearer preference for distance-based and emission-based pricing over congestion charges and toll roads. This suggests that participants may favor pricing schemes perceived as more directly linked to individual usage and environmental impact. One possible explanation is that distance- and emission-based pricing are more closely aligned with perceived principles of fairness and personal control, as individuals might feel better able to influence their costs through travel behavior or vehicle choice. However, this interpretation should be cautiously approached, as preferences may also be shaped by familiarity, perceived practicality, or the way options were presented in the survey. In contrast, congestion charges and toll roads could be viewed as more punitive or rigid, especially if respondents feel they lack viable alternatives.

A second notable difference concerns regional perceptions of fairness. The literature and interviews often emphasize the importance of accounting for regional differences in road pricing implementation, commonly suggesting that rural residents perceive such schemes as less fair due to more limited transport alternatives. However, the survey results did not reveal a significant difference in fairness perceptions across rural, urban, and suburban respondents. This unexpected finding may point to a growing convergence in mobility experiences or a broader acceptance of road pricing principles across regions. Alternatively, it might reflect limitations in the sample or question framing, or a shift in public understanding — for example, that road pricing revenues could be reinvested in infrastructure across regions, thereby addressing concerns about equity.

The final difference relates to how system complexity is perceived. Interview participants emphasized the importance of simplicity and transparency for public support. Survey respondents similarly valued transparency, but appeared less focused on system complexity. This discrepancy may stem from differing levels of familiarity with implementation challenges: interviewees, who are more closely involved in the field, may be more attuned to the risks of overly complex systems, whereas survey participants may focus more on overarching concerns such as fairness and affordability. It is also possible that respondents assume complexity will be managed by authorities, and therefore do not prioritize it in their assessments.

Even though these differences were found in the research, it should be noted that a sample bias exists. In Section 5.1, the various socio-demographics were compared. There are several differences between the survey sample and the general Dutch population, indicating some sample bias. Students are notably overrepresented (36.4% vs. 8.1% nationally), which likely explains the lower average age, lower income levels, and reduced car ownership in the sample. Older adults, rural residents, and frequent car users are underrepresented, while urban residents, males, and public transport or bike users are overrepresented. These patterns can largely be explained by the survey's likely distribution within TU Delft, where many students, especially from Civil Engineering, may already have some familiarity with transport policy. As such, the findings offer useful insights but should be interpreted with caution, as they may not fully reflect the views of the broader Dutch population.

6.3.   Strengths and limitations

This research provides new insights into road pricing policies by examining how the survey sample perceives a national road pricing scheme. This has not been studied in recent years. Specifically, factors were examined that influence the perceived fairness and acceptability of such a scheme, including socio-demographic factors (e.g., car ownership), the policy's impact on both individual and societal levels, and the allocation of revenue. The conceptual model presented in Section 6.1 illustrates these key influences, offering a structured view of how public opinion is formed.

This research also had its limitations. Most limitations pertain to the survey, as it became clear that a sample bias exists. The sample is not representative of the Dutch population, as seen in Sections 5.1 and 6.2. Even with a limited number of respondents, a relatively large number of responses were received to the open-ended questions, which were optional for respondents to answer. Here, they shared any thoughts or concerns that might not have been apparent in the quantitative results, providing additional insights next to the obligatory survey questions.

Additionally, it was sometimes challenging to verify the claims made in the literature and interviews. This could have been prevented by asking more questions in the survey or by rewording some of the current questions. With surveys, there is always a trade-off to be made between the minutes spent filling out the survey and the number of respondents. Further research could allow for more detailed testing. Within the interviews and literature, it became clear that road pricing policies are a political discussion, as trust in the government is needed from the public to increase acceptance, but the cabinet of the Netherlands (or another country, for that matter) should also be willing to discuss and implement it. The survey did not touch upon this topic, so it was not tested how the sample felt towards the (Dutch) political context of road pricing policy. Further research suggestions can be found in Section 7.1.1.

7. Conclusion

This thesis examined how people in the Netherlands perceive the fairness of road pricing and what factors influence their willingness to support it. Fairness can mean different things to different people—it can be about equal opportunities, fair outcomes, and what feels right. Views on fairness were closely tied to factors such as car ownership and residential location. Among the pricing options, distance-based and emission-based systems were perceived as the fairest, while congestion charges and toll roads were less popular, as seen in the survey results. Yet these preferences differ based on socio-demographic factors.

The conceptual model developed in this research highlights the complexity behind these perceptions. It shows that fairness is not just about the pricing system itself but also about how it is designed, communicated, and perceived. Procedural justice, revenue allocation, and societal impacts can all shape whether people see a policy as fair, as people often want to be a part of the process, know that the revenue will benefit them, and see that they are not personally worse off after the implementation of the scheme. Socio-demographic factors play a significant role, as do psychological elements, such as status quo bias, which makes people resistant to change.

Transparency emerged as a key factor to increase acceptance. People are more likely to support road pricing if they clearly understand how it works and what the revenues are used for, as the survey showed that around 80% of respondents agreed with these statements. Good communication can help clear up confusion and give people time to adjust their travel habits, making the system feel more predictable and fair. How the money is spent can also influence acceptance—in the survey, a strong preference emerged for reinvesting funds into public transport or lowering car-related taxes, ensuring visible benefits for society.

This research also revealed a gap between academic discussions and public perceptions. While literature often emphasizes regional inequalities or the complexity of pricing systems, survey respondents were more focused on broader themes, such as fairness, affordability, and trust. This suggests that policymakers could prioritize these aspects when designing and implementing road pricing policies, which will be further explained in Section 7.1.

Finally, while road pricing can be a controversial issue, this study shows that when it is fair, clearly explained, and delivers visible benefits, people are more likely to accept it. The insights from this research can provide valuable guidance for shaping future policies that balance economic, social, and psychological factors in a way that benefits both the public and policymakers.

While this study focused on the Dutch context, its insights can be valuable for other Western countries considering road pricing. Concerns about fairness, transparency, and trust are common across societies where policy success often depends on public support. For instance, Stockholm's experience shows that even initially unpopular congestion charges can gain acceptance when rolled out gradually, clearly communicated, and tied to visible benefits like public transport improvements. The importance of revenue use, procedural justice, and addressing socio-demographic differences, such as income or car dependency, is likely to resonate elsewhere, too. Though the findings can be most directly

relevant to Western nations with similar governance models and infrastructure, the underlying principles may still offer inspiration for non-Western countries, provided they are tailored to local realities. Ultimately, road pricing schemes that feel fair, make sense to people, and show tangible improvements stand a far better chance of being embraced by the public.

In addition to these practical insights, this research contributes to the academic understanding of fairness and acceptance in transport policy. It deepens the knowledge of how socio-demographic factors—like income, car ownership, and residential location— can shape perceptions of fairness and support for road pricing. It also empirically validates key fairness dimensions, such as horizontal, vertical, and geographical equity, and introduces a conceptual model that links fairness perceptions, individual characteristics, communication, and acceptance. The findings provide insight into how transparency, perceived personal impact, and psychological factors, like status quo bias, can influence public attitudes. Moreover, the study explores how different revenue allocation strategies affect support and highlights the gap between theoretical fairness concepts and everyday concerns. In doing so, it bridges academic theory and public perception, offering a more complete understanding of how fair and acceptable road pricing policies can be developed and communicated.

7.1.   Recommendations
The recommendations arising from this research can be categorized into suggestions for further research and key takeaways for policymakers.

7.1.1.   Research suggestions
As seen in the conceptual model (Figure 19), not all links have been appropriately tested. There are also presumably additional factors that can play a role, which have not yet been examined. The survey and interviews focused on fairness perceptions, which heavily influence acceptance, but the technical and economic feasibility were not examined. These are also items that could potentially influence the acceptance of a road pricing policy.

Additionally, the current focus is on a single type of pricing scheme (e.g., distance- or emission-based pricing) and a single type of revenue allocation method (e.g., public transport investments or tax reductions). It would be beneficial to research further how combining schemes and allocation methods influences perceived fairness and acceptance within the Dutch public. In the survey, an optional open question allowed respondents to discuss their views on different road pricing types, which provided some interesting insights. Responses revealed that fairness concerns are highly context-dependent—rural and low-income respondents, for example, often feel disproportionately burdened by certain schemes due to longer travel distances or limited alternatives. Acceptance was also shown to hinge on personal circumstances, with clear communication playing a key role in building support and prompting behavioral change. In terms of revenue use, people generally supported reinvesting in transport-related improvements (like public transport or road maintenance), though opinions varied on whether car users should fund broader public services. These nuanced responses suggest that a one-size-fits-all approach may not be effective. For revenue allocation, the assumption that only one method would be used may also be limiting, as seen in the literature and hinted at by respondents, distributing revenues across multiple areas could enhance perceived fairness and support. As it has been seen that communication plays a significant role, combining road pricing research with communication research could provide valuable insights on both academic and practical levels. Experimenting with various framing strategies may reveal opportunities for optimization in the communication of a road pricing policy.

7.1.2.   For policymakers

Both interviewees and survey respondents emphasized that road pricing must be fair. Many worry that a one-size-fits-all approach could put too much pressure on lower-income drivers or people with fewer alternatives. To avoid this, the system should consider income disparities and mobility challenges. Some respondents suggested that better public transportation or alternative options must be in place to ensure that road pricing does not unfairly impact those who rely most heavily on their cars.

People are more likely to accept road pricing if they understand why it is being introduced and where the revenue is allocated. Both interviews and survey results showed that trust improves when the government clearly communicates its goals, whether it is reducing congestion, cutting emissions, or funding infrastructure. Many survey respondents also stated that they would be more willing to accept road pricing if they saw the revenue being reinvested in public transportation, road improvements, or tax reductions.

The more people feel heard, the more likely they are to accept change. Survey respondents and interviewees agreed that involving citizens, especially frequent drivers and those most affected, helps ensure the system is fair and addresses real concerns. Open discussions, pilot programs, and feedback opportunities were all suggested as ways to build trust and legitimacy.

Rolling out road pricing gradually can help people adjust. Both interviewees and survey respondents recommended testing the system in high-traffic areas with strong public transport, such as the Randstad, before expanding it further. Interviews also highlighted the need to consider individuals' personal situations, such as income levels and travel needs, to make the transition more equitable. One of the biggest concerns is whether road pricing will improve things. Respondents want proof that the money is being spent wisely. Many said they would be more supportive if the revenue were used to improve public transport, reduce car-related taxes, or maintain roads. The government must communicate these benefits clearly to gain public trust.

Interviewees warned that a complicated system could lead to confusion and resistance. They suggested that the goals and pricing structure should be easy to understand so people know exactly what they are paying for and why.

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Appendix
A: Full Literature Review

Fairness in transport policy design

Fairness is a critical consideration in transport policies, particularly as these policies shape accessibility, economic burden, and public support. In the transportation sector, achieving fairness often means balancing various social and economic impacts across diverse populations. Research highlights that perceived fairness plays a significant role in the public acceptance of these policies (Van Wee & Mouter, 2021). Fairness in transport policy, especially in pricing schemes, encompasses multiple dimensions, including distributive justice and public perception. Road pricing, for instance, affects individuals differently based on location, income, and household characteristics (see Section 1.2). The distribution of costs and benefits across these diverse groups is central to designing transport policies that are both effective and equitable.

An introduction of fairness within transport policies

Fairness is a highly relevant topic in public policies, certainly within the transportation sector. Policymakers also seek more research on fairness to gain public acceptance (Van Wee & Mouter, 2021). The perceived fairness influences the acceptability of these policies, which will be further discussed in section 3. The issues surrounding fairness within a pricing scheme policy are of several dimensions, including distributive justice and public perception. Transport policies, such as road pricing, affect various society groups on different levels. A person or group can experience the policy differently due to location, income level, household size, and more (see section 1.2). Their experiences differ because of the distribution of costs and benefits between these economic and sociodemographic factors.

Equity concerns in road pricing

As a road pricing policy affects all road users, creating an equitable policy is a complex task that requires thorough consideration and expert input. However, equity should always be a guiding principle in these schemes (Yu et al., 2016). The multi-dimensional nature of policy equity, often leading to disagreements among policymakers and experts, underscores the need for thorough consideration and expert input in its implementation (Martens et al., 2019).

Equity can be defined in various ways. Bruzzone et al. (2023) define equity as a concept linked to reducing inequalities, whereas Di Ciommo and Shiftan (2017) define equity as the allocation of costs and benefits among the users. Equity can be divided into opportunity equity and outcome equity. Opportunity equity is defined by Levinson (2010) as the degree to which there is equitable access to the planning and decision-making process. Zhou et al. (2018) also argue that a transport policy is fair if it allocates investments and services in a way that reduces inequality of opportunity. Outcome equity regards the extent to which the outcomes of a decision or policy are seen as fair (Levinson, 2010). There are various dimensions of outcome equity, which will be discussed in the following subsections. However, their goals may conflict due to the differences within these dimensions, necessitating difficult decisions and trade-offs (Musgrave, 1990). These conflicts and trade-offs underscore

the weight of policymakers' decisions to pursue equity in road pricing policies.

Horizontal Equity

Horizontal equity requires the same treatment between equals. In other words, people with similar needs should be treated similarly. In policies, this often means that a uniform distribution of the benefits and costs exists (El-Geneidy et al., 2016). Within the context of road pricing, an example could be that the individuals who use the same roads pay the same price regardless of their background or other (vehicle) characteristics. Kaplow (2000) mentions that by prioritizing horizontal equity, factors that may be morally irrelevant get importance, potentially at the cost of social welfare. In cities such as Stockholm and London, every vehicle pays the same price to enter the area or cross the cordon boundary, although the cost can differ between the days of the week and the time of day. In Stockholm, some vehicles are exempted from paying the fee (e.g., emergency vehicles, motorcycles, and military vehicles) (Urban Access Regulations in Europe, n.d.). Other than that, the scheme is almost entirely horizontally equitable. London already has more exemptions based on the user's residency, job, or health (Transport For London, n.d.). Apart from this, almost everyone pays the same price, making the scheme partially horizontally equitable.

Vertical Equity

Vertical equity distributes costs and benefits based on the user's needs and capabilities. Creating a vertically equitable scheme would imply that individuals experience more burdens due to their situation if a pricing scheme were implemented. Sen et al. (2022) mention that individuals with lower incomes or who are unemployed are more disadvantaged due to these characteristics. If the road pricing fee is considered a share of income, low-income travelers are mistreated, as they pay a higher percentage of their income than those with a higher income (Eliasson, 2016). However, with a vertically equitable pricing scheme, this could be avoided. Another reason for the low-income group to be affected more is that they are more likely to be older and have more children, and hence have a more difficult time switching to another mode of transport (Craik &

Balakrishnan, 2022). This group might have to cancel the trip if they cannot pay the pricing fee. Randal et al. (2020) argue that a fair transport policy is one where the most disadvantaged individuals have improved capabilities, which connects to the theory of vertical equity.

These two types of equity (horizontal and vertical) frequently overlap or come into conflict (Camporeale et al., 2016). A decision might appear fair under one criterion but inequitable under another. For instance, horizontal equity demands that users cover the costs of their transportation facilities and services, while vertical equity often calls for subsidies to assist disadvantaged individuals. One cannot argue that Stockholm and London are fully horizontally equitable as discounts and exemptions are available. Also, the revenue from the Stockholm and London pricing schemes goes towards public transportation (Gu et al., 2018). Research shows that low-income individuals and women gain more benefits in these cases due to this type of revenue allocation (Eliasson & Mattsson, 2006), which would make the pricing schemes in Stockholm and London partially vertically equitable.

Geographical Equity

Parkhurst et al. (2006) state that in urban areas, the impact on winners and losers and their income levels is primarily influenced by the location of different income groups concerning the charging zones. If low-income workers must drive during peak times and thus pay more to use the roads, the equity impact differs from regions where jobs are accessible by public transport (Ecola & Light, 2009). To promote geographical fairness, the revenue from the pricing scheme could be invested in improving transport infrastructure in rural or underserved areas (Santos & Verhoef, 2011).

Comparing fairness

The following subsections will compare transport policy instruments, such as road pricing, fuel taxes, and toll systems, to reveal important insights into their fairness. Furthermore, approaches to ensuring fairness in road pricing vary widely across countries, reflecting different cultural, social, and economic contexts, and thus various regions will be compared too.

Comparison to other transport policies
A comparative study by Eliasson (2016) on congestion pricing in Stockholm found that road pricing schemes are generally more equitable than flat tolls or fuel taxes. Eliasson highlights that congestion pricing schemes can be designed to incorporate progressive elements, such as subsidies or exemptions for low-income drivers, thus promoting both vertical and horizontal equity.

In contrast, as discussed by Teixidó and Verde (2017) and Eliasson et al. (2018), fuel taxes are often criticized for being regressive, meaning they disproportionately affect low-income individuals. Since lower-income drivers typically spend a higher percentage of their income on fuel, this policy violates vertical equity, which seeks fairness by accounting for individuals' ability to pay. Despite this, fuel taxes may still be seen as efficient in reducing emissions and promoting environmental goals (Sterner, 2007), though at the cost of equity.

Toll systems present another variation: charges are imposed for specific routes or bridges. While this can be an effective way to raise revenue for infrastructure maintenance (Gideon & Alouis, 2013; Suwarto et al., 2021), it can also lead to geographical inequities, as discussed previously by Ecola & Light (2009).

While no policy instrument is perfectly fair, road pricing often stands out as the most flexible in ensuring that costs can be distributed in line with usage and ability to pay (e.g., through vertical equity) compared to fuel taxes and flat tolls.

Comparison to other cities/regions

Approaches to ensuring fairness in road pricing vary widely across countries, reflecting different cultural, social, and economic contexts. Singapore, for example, is known for its Electronic Road Pricing (ERP) system, a dynamic road pricing model that charges drivers based on congestion levels (Menon & Guttikunda, 2010). According to Goh (2002), Singapore's system is designed with both efficiency and fairness, using real-time data to charge motorists based on their road usage, congestion level, and travel time.

In contrast, Stockholm's congestion pricing system, introduced in 2006, was explicitly designed with fairness considerations. Eliasson (2016) notes that the scheme incorporates geographical and vertical equity measures. Central city residents pay congestion charges, while revenues are reinvested in public transportation improvements, benefiting commuters from less connected suburban areas (Gu et al., 2018; Eliasson, 2014). This revenue redistribution helps balance the financial burden and ensures that low-income groups are not disproportionately affected by the pricing system (Eliasson & Mattsson, 2006).

London's congestion charge presents another perspective on fairness. Introduced in 2003, the scheme charges a flat fee to vehicles entering the central zone. However, as Willumsen (2004) points out, this flat-fee structure raises questions about equity. The broad structure of the scheme causes some drivers to overpay for short trips into and out of the charging zone while others underpay for multiple trips within the area. To address concerns about vertical equity, London's scheme includes exemptions, as stated in section 1.2.1, such as discounts for residents of the priced area.

Finally, Milan's Area C provides a case study of environmental fairness. Implemented in 2008, Milan's Ecopass focuses on reducing emissions rather than simply reducing traffic. As Gibson and Carnovale (2015) report, vehicles that pollute more are charged higher fees, thus promoting fairness through the lens of environmental justice. While this system effectively targets high-polluting vehicles, it has also raised concerns about vertical equity, as lower-income individuals may drive older, more polluting vehicles and therefore face higher costs (Wessel, 2020).

These international examples demonstrate how different regions address fairness in road pricing, often incorporating various equity considerations—geographical, vertical, and environmental—depending on the policy goals and societal needs.
Fairness is a central concern in transport policies, particularly road pricing schemes, as these policies affect different socio-economic groups in diverse ways. Horizontal equity

aims to treat users equally, while vertical equity seeks to distribute costs based on need, ensuring that disadvantaged individuals are not disproportionately affected. Geographical equity also plays a role, with the location of charging zones affecting income groups differently. Comparisons between various transport policies, such as road pricing, fuel taxes, and toll systems, reveal that road pricing offers greater flexibility in promoting fairness. International examples, like those from Singapore, Stockholm, London, and Milan, show that fairness is addressed through different approaches, balancing factors like congestion, income, and environmental justice to meet local societal needs.

Fairness evaluation in transport policies

Evaluating fairness in road pricing schemes is essential, as it affects public acceptance and the equitable distribution of costs and benefits. This chapter will discuss the importance of evaluating fairness and the criteria typically used, such as horizontal and vertical equity and geographical equity. Ethical theories will also be touched upon here. Methods for assessing fairness will be reviewed, and examples from case studies will be presented to illustrate how fairness has been evaluated in practice. Finally, the challenges involved in evaluating fairness will be explored.

Why it is important to evaluate policies

Literature shows multiple reasons as to why it is essential to evaluate transport policies. Social impact assessments are often overlooked in transport policy despite the varying effects these policies can have on different groups (Geurs et al., 2009). Conducting these assessments is essential to refine policies and ensure they achieve intended outcomes (Browne & Ryan, 2011) and address complex interactions, such as those between transportation, land use, and environmental impacts (Tsamboulas & Kopsacheili, 2003). Additionally, ethical considerations like equity and fairness must be explicitly evaluated to ensure policies align with moral standards (Van Wee & Roeser, 2013). Finally, these assessments contribute to a deeper understanding that supports the development of future projects and policies (Holl, 2006).

Criteria for fairness

When evaluating transport policies, fairness is a criterion that must be considered to ensure that transportation systems serve all members of society equitably. In this context, fairness goes beyond simple efficiency or cost-effectiveness; it addresses the social implications of transportation access, resource distribution, and the ability of individuals from different socioeconomic backgrounds to benefit from mobility solutions. A fair transport policy should seek to reduce inequalities in access to services and minimize the disproportionate burdens borne by disadvantaged groups (Pereira et al., 2016). The following sections discuss how fairness can be evaluated using existing theories.

Equity

There is no single way to evaluate the fairness of transport policies due to various factors, such as different equity types. Litman (2022) shows that transport equity can be measured differently within horizontal and vertical equity, which will be discussed below in a road pricing scheme.

Horizontal equity

This form of equity can be measured by minimizing the external costs for road users or enforcing a fair share of public resources (Litman, 2022). The former refers to decreasing delays, risks, and pollution for everyone. The latter is connected to equality, where everyone experiences "getting what they pay for and paying for what they get," according to Litman (2022).

Vertical equity

This type of equity can be defined in various ways. Firstly, vertical equity concerning need and ability (inclusivity). Looking at vertical equity through an inclusivity lens means that the design of the pricing scheme should not only look at the usability for all users but also at the extent to which a policy/transportation system ensures universal access to key destinations (e.g., jobs, healthcare, social connections) (Martens, 2018). There is also vertical equity in income (affordability). There are various methods to ensure affordability for all users of a pricing scheme, such as revenue redistribution (into public transport) (Di Ciommo & Lucas, 2014) or through discounts/exemptions, as

seen in section 1.2.1. Finally, Litman (2022) states that social justice is a form of vertical equity. Within social justice, how transportation systems/policies address structural injustices (e.g., racism, sexism) is being examined.

Ethical theories

In addition to these various types of equity, different ethical theories can be used as criteria for fairness evaluation. Figure 20 briefly explains these moral theories, which are further discussed in the following subsections.

Utilitarianism

Utilitarians focus on the practical value of trips, aiming to maximize overall utility by facilitating travel to activities that provide the most benefit (Pereira et al., 2016). From a moral perspective, the focus is on maximizing happiness or overall utility (Van Wee & Roeser, 2013). While utilitarianism treats all benefits equally, it does not account for different population groups' needs and circumstances. This can lead to inequities, as it fails to prioritize those needing the most benefits, such as individuals with low accessibility levels or those at risk of transport-related social exclusion (Martens et al., 2014).

Egalitarianism

Egalitarianism promotes equality for all by decentralizing power and ensuring everyone's equal political, economic, social, and civil rights based on the belief in equal moral worth (Adli & Chowdhury, 2021). A significant milestone in egalitarian justice is Rawls' theory of justice, which includes two fundamental principles: the fair distribution of rights and liberties and the importance of individual freedom of choice (Rawls, 1971). While some inequalities are inevitable due to social conditions, Rawls argues through the difference principle that inequalities are just if they benefit the least advantaged. One of the complexities of egalitarian theories is that it is hard to define fairness with the various effects on the winners and losers (Van Wee & Roeser, 2013). In transport planning, Rawlsian egalitarianism emphasizes two key points. First, freedom of movement is a fundamental right, so transport policies must respect individuals' rights, even if they improve accessibility. Second, transit accessibility is considered a public good, meaning that policies should prioritize improving accessibility for the

Utilitarianism
Utilitarianism focuses on maximizing overall societal benefits. In transport policy, it supports road pricing schemes that reduce traffic and pollution, aiming for the greatest benefit for the majority, even if some groups are disproportionately affected.

Egalitarianism
Egalitarianism emphasizes equality, arguing for equal access to transport resources and services. In road pricing, egalitarianism ensures that no group is unfairly burdened, advocating for the equal distribution of costs and benefits across different social groups.

Libertarianism
Libertarianism values individual freedom and minimal state intervention. In transport policy, libertarianism critiques road pricing schemes that restrict personal freedom or impose undue costs, favoring minimal government involvement in transportation choices.

Sufficientarianism
Sufficientarianism prioritizes ensuring everyone has enough, focusing on helping those below a certain threshold rather than achieving equality. It argues that benefiting the disadvantaged takes precedence over improving conditions for those already above the threshold.

Figure 20: Ethical theories according to Adli and Chowdhury (2021), Lewis et al. (2021), Martens et al. (2014), Pereira et al. (2016), Rawls (1971), and Van Wee (2011).

least well-off, ensuring that they benefit more than others (Pereira et al., 2016).

Another egalitarian theory is the Capabilities Approach. This approach emphasizes that well-being, equality, justice, or development assessments should focus on people's adequate opportunities to lead lives they value rather than solely on resources or mental states. Key concepts include "functionings," which refer to a person's achievements, and "capabilities," which are the real opportunities or freedoms to achieve these functionings (Robeyns, 2006;

Nussbaum & Sen, 1993). Policies based on this approach should ensure individuals have minimum access to essential services like food, education, healthcare, and employment, but this does not require everyone to have identical transport conditions (Pereira et al., 2016). Unlike Rawls' theory, Sen (2009) argues that wealth provides limited insight into well-being. The Capabilities Approach emphasizes well-being based on what individuals do and can potentially achieve (Luz & Portugal, 2021).

Libertarianism
Libertarianism is characterized by the belief that humans are rational beings who pursue their own self-determined goals (Stacey, 2015). In transportation planning, libertarianism, like utilitarianism, does not focus on how accessibility is provided or distributed. However, libertarianism prioritizes individual rights over collective well-being. It views the free market as the best way to provide and distribute accessibility, considering any market-driven outcome as inherently fair (Adli & Chowdhury, 2021). Liberals may favor privately operated road tolls driven by market mechanisms while opposing centrally-planned congestion pricing systems (Rouhani, 2022).

Sufficientarianism
Sufficientarianism evaluates decisions based on whether individuals have "enough," arguing that reaching this threshold is morally significant beyond improving overall welfare. Its positive thesis claims that having enough holds intrinsic value, such as acknowledging individuals' autonomy. In contrast, the shift thesis suggests that the reasons for benefiting people change once they attain sufficiency (Shields, 2020). However, the approach is criticized for its rigid threshold, which makes it difficult to justify a clear division between those just above and below the line. Prioritizing sufficiency can also lead to unfair outcomes, such as granting small benefits to those below the threshold at the expense of others and challenging standard views on fairness and efficiency (Martens et al., 2014). While setting this threshold is a normative step that deprioritizes those above it, current planning processes marginalize certain groups. Compared to egalitarian approaches, a sufficientarian method is preferable because it directly addresses the needs of those with the

most significant deficits (Van Der Veen et al., 2020).

Methods for fairness evaluation
There are various methods for evaluating transport policies, which will be discussed in the following subsections.

Cost-Benefit Analysis (CBA)
A standard cost-benefit analysis evaluates whether the benefits produced by a proposed transport project outweigh the monetary value of its associated costs. Van Wee and Geurs (2011) emphasize that equity and fairness are often overlooked in transport appraisals and cost-benefit analyses. CBA's utilitarian approach prioritizes maximizing overall benefits, frequently neglecting distributional effects and equity concerns. Addressing equity issues within cost-benefit analysis requires modifying the existing framework to provide insights into a transport project's economic efficiency and evaluate its equity impacts. Martens (2006) provides two methods to add equity considerations to the standard CBA:

Adjustments in CBA calculation methodology
This approach adjusts the calculation of CBA indicators to incorporate equity considerations. Social values assign non-market values to benefits or costs based on the recipient group, aiming to reduce societal gaps. Depending on the socio-demographic group, distributional weights assign varying importance to benefits or costs, supporting income redistribution. Both methods modify the net benefit calculation to reflect social priorities, ensuring that benefits for different groups are appropriately valued.

Adding equity indicators
This approach incorporates equity indicators into standard CBA metrics. The equity coefficient, like the Gini coefficient, assesses the distribution of benefits and costs among different groups. The equity impact sheet provides detailed tables illustrating how benefits and costs are allocated across population groups. This method offers a comprehensive view of equity impacts, enabling clear discussion and comparison of project alternatives and ensuring that equity considerations are fully integrated into the decision-making process.

The Gini coefficient

The Gini coefficient is a straightforward mathematical measure that reflects the overall level of inequality (Gini, 1912). The formula is as follows:

$$G = 1 - 2 \int_0^1 L(x)dx$$

Where L(x) represents the Lorenz curve, which shows the proportion of total transport access obtained by the bottom x proportion of the population.

For discrete data, the Gini coefficient is:

$$G = \frac{\sum_{i=1}^n \sum_{j=1}^n |\, y_i - y_j \,|}{2n^2 \bar{y}}$$

Where n is the number of individuals or groups, y_i and y_j represent transport access or benefits for individuals i and j, y is the mean transport access or benefit.

In Figure 21, Luo & Mo (2015) define the levels of (un)fairness according to this coefficient. In transportation equity, the coefficient is used to assess the concentration of accessibility among different regions or groups and to compare equity levels before and after implementing a policy or transport infrastructure (Zhou et al., 2018).

> **Absolute fairness**
> G < 0.2

> **Fairness**
> 0.2 ≤ G < 0.3

> **Relatively fairness**
> 0.3 ≤ G < 0.4

> **Relatively unfairness**
> 0.4 ≤ G < 0.5

> **Extremely unfairness**
> G ≥ 0.5

Figure 21: The Gini coefficients of (un)fairness according to the United Nations organizations (Luo & Mo, 2015).

Multi-Criteria Decision Analysis (MCDA)

Multi-criteria Decision Analysis (MCDA) is a decision-making framework that evaluates and compares multiple options based on criteria, often with conflicting priorities (Brauers et al., 2008). It helps decision-makers account for quantitative and qualitative factors, making it useful for complex problems involving trade-offs between different objectives. This method ensures equal representation, unlike market-based approaches where wealthier individuals have more influence (Barfod & Leleur, 2014). The same research argues that by involving stakeholders in setting alternatives, criteria, and weights, MCDA promotes transparency and inclusivity, ensuring diverse viewpoints are considered for a fairer decision-making process. Considering these factors, an MCDA-based approach appears more suitable than a CBA approach for integrating equity considerations into transport appraisal and evaluation (Thomopoulos et al., 2009). MCDA methods have become increasingly crucial for evaluating transport projects, but it is not always clear whether their applications are practical or purely academic (Annema et al., 2015). Due to the often large amount of stakeholders, the methodology can be time-consuming and complex (Macharis & Bernardini, 2014).

Case studies

This section will provide a few examples of how existing or self-designed frameworks and methods have been used to evaluate road pricing schemes and other transport policies.

Lyon

The framework by Raux and Souche (2004) was applied to a case study in Lyon, where two tolling schemes were compared. Figure 22 shows their framework, which discusses economic efficiency and the three types of equity in their eyes. The study found that charging for certain roads does not always balance out adverse effects, particularly regarding vertical and geographical equity. Vertical equity is compromised when high tolls make payment almost mandatory, and significant time savings or low fees are needed to address this. Geographical equity is also harmed when additional charges for infrastructure use are introduced, especially with high prices. Horizontal equity suffers as drivers lose surplus, while toll operators

Proposed framework by Raux and Souche (2004), based on Rawls' theory of justice + economic efficiency

Geographical equity
Everyone should have the right to access goods, services, and jobs regardless of their location.

Horizontal equity
This framework concerns the "polluter pays" principle, where users pay for the societal damage they cause, such as congestion. This follows tax principles defined by Pigou (1920). The second principle involves charging users for improved services in exchange for an extra fee.

Economic Efficiency
The framework discusses two conditions for economic efficiency. The first condition follows the principle of short-run marginal cost pricing: road users should pay a toll covering the congestion costs caused by their use. The second condition focuses on optimal investment: infrastructure should continue to be expanded as long as the future savings from reducing congestion equal the cost of building more infrastructure.

Vertical equity
Disadvantaged individuals or groups should have their travel conditions considered.

Figure 22: The framework by Raux and Souche (2004)

profit from this loss, fueling social opposition. This evaluation framework highlights the importance of considering different types of equity in transport policies. Ignoring them risks failure, making the framework a valuable tool for analyzing the acceptability of urban road pricing policies.

Latin America
The research by Humberto (2023) assessed transportation systems in five Latin American cities (Brasília, Ciudad de México, Montevideo, Santiago, and São Paulo). Although these systems did not include road pricing, the research still provides insights into transport policies. The five cities were assessed by various metrics, which were based on different principles of justice; equality, sufficiency, and priority, which are seen in Figure 23. Equality is similar to horizontal equity in that everyone gets treated equally, regardless of their background or other characteristics. Sufficiency refers to an individual having an adequate amount of something, which is connected to the ethical theory of sufficientarianism. Finally, priority can be compared to vertical equity, as it prioritizes those who are worse off to ensure they receive more benefits. The analysis of the five cities was repeated for various currencies, which Humberto defines as travel time, energy, NOx emissions, and PM emissions. The results show

that depending on which metric and currency is used, the cities score differently from one another, meaning that this choice can impact the evaluation of transport fairness significantly. As one city might have a fairer transportation system based on one of the metrics and currencies, it might score worse on another.

Japan
Maruyama and Sumalee (2007) used the Gini coefficient to determine the more equitable congestion pricing scheme. The research compares the efficiency and equity of cordon-based and area-based road pricing schemes using a trip-chain equilibrium model in Utsunomiya City, Japan. The Gini coefficient is used to measure spatial equity by assessing the distribution of user benefits after revenue recycling. Results show that higher toll levels increase spatial inequity, with area-based schemes slightly less equitable than cordon-based ones. More expansive coverage areas also lead to greater inequity, as they affect more trips and favor longer trip chains. This analysis provides valuable insights for policymakers on designing fairer congestion pricing strategies by balancing social welfare and spatial equity.

Tuqiao, Beijing
The Capabilities Approach (CA) was used by Cao et al. (2019) to measure differences

Coefficient of Variation (Equality)	**% ≤ threshold (Sufficiency)**	**Average of the 10% worst off (Priority)**
Ratio of the standard deviation of Travel time to the mean of Travel time	Share of trips with Travel time less than or equal to 20 min	Average Travel time of 10% of trips with longest Travel times
% ≤ average (Equality + Suffciency)	**FGT_2 > threshold (Sufficiency + Priority)**	**FGT_2 > average (Priority + Equality)**
Share of trips with Travel time less than or equal to the average Travel time	Squared sum of Travel times higher than 20 min minus 20 min	Squared sum of Travel times higher than the average minus the average
Ratio S10 / S90 income (Equality)	**% ≤ threshold of 10% poorest (Sufficiency)**	**Average 10% poorest (Priority)**
Ratio of the average Travel time of the 10% richest to the 10% poorest	Share of trips of the 10% poorest with Travel time less than or equal to 20 min	Average Travel time of the 10% poorest

Figure 23: The metrics used in Humberto's (2023) research, with an example using travel time.

between people's real opportunities for travel (capabilities) and their actual travel behaviors (functionings). Data was collected from 622 residents near the Tuqiao subway station in Beijing through face-to-face interviews covering socio-demographics and travel characteristics. Indices for capabilities and functionings, such as travel safety and access to shopping, hospitals, and education, were analyzed using F-tests across gender, age, hukou status (China's household registration system), income, and car ownership. The study revealed that females, older adults, migrants without hukou, lower-income groups, and non-car owners faced significant transport barriers. The CA offered a clear understanding of transport-related social inequities and identified areas needing improvement in accessibility and equity. Cao et al. (2019) argue that the CA is a valuable tool for evaluating transport-related social inequities and should be included alongside existing inequality measurement methods in the transport sector.

Challenges in fairness evaluation

Policies affect travel times, reliability, accessibility, safety, the environment, and costs for both public and private entities, making transport policy evaluation essential and challenging (Van Wee & Mouter, 2021). Fairness can mean different things, as the various equity types and ethical theories explain. This makes it difficult for a policymaker to decide what is fair, as various ideas on equity can lead to different policies (Pereira et al., 2016). Researchers have not agreed on which equity dimensions should be considered, or which measures should be used (Levison, 2010).

In evaluations, insights are often gained through quantitative results. Thus, policies can be evaluated through ratios, expenditures, and other numerical results. This makes it very difficult to measure (perceived) fairness, as it is very challenging to translate moral values into numerical values (Van Wee & Roeser, 2013). Mainstream evaluation methods face criticism because major projects often suffer from budget overruns, underperformance, unforeseen consequences, lock-ins, decision-making impasses, and resulting delays (Te Boveldt et al., 2020).

Evaluating fairness in road pricing schemes is critical, as it influences public acceptance

and ensures an equitable distribution of costs and benefits. This chapter highlighted the importance of fairness evaluations using criteria like horizontal and vertical equity, geographical fairness, and ethical theories. Various methods, such as cost-benefit analysis and the Gini coefficient, were reviewed alongside case studies demonstrating practical applications. Despite these methods, evaluating fairness remains challenging due to differing interpretations of equity, the complexity of quantifying moral values, and potential conflicts between social and economic goals. This complexity emphasizes the need for comprehensive approaches integrating quantitative data and ethical considerations into transport policy evaluation.

Acceptance of a pricing scheme in the Netherlands

To obtain more knowledge before the interviews and survey, literature was used to better understand road pricing policies' acceptance. The following sections will discuss acceptance and the Dutch contextual factors that could influence the implementation of a road pricing scheme.

The importance of public acceptance

The successful implementation of a radical change, such as a new road pricing policy, depends on public acceptability, which requires community and stakeholder commitment to the processes of discussion, decision-making, and implementation (Banister, 2008). Public acceptance is essential for the success of road pricing schemes, as it ensures political support and encourages behavioral changes needed to reduce congestion. Opposition to road pricing often stems from a lack of trust in its underlying motives, effectiveness, ease of use, administration, and how the collected revenue will be spent, especially in benefiting local communities (Nikitas et al., 2018). However, while trust is vital for success, losing is much easier than building. Acceptance builds trust in authorities, leading to better compliance, especially if the scheme is fair and its revenues are reinvested in transport improvements (Musselwhite & Lyons, 2009). Long-term success depends on continued public backing, which can be strengthened if people see clear benefits over time. In other words, transport projects' (economic) viability directly depends

on public acceptance (Plessis & Joubert, 2012). To summarize, acceptability can be expected only if people have confidence in the measure's effectiveness, revenue usage, system fairness and anonymity, and opportunities for participation in the decision-making process (Niskanen et al., 2003).

How to influence acceptance

In road pricing schemes, gaining public acceptance is critical for successful implementation, as seen in the previous section. Various strategies can positively influence acceptance, including clear communication, stakeholder involvement, and transparency regarding the scheme's benefits. By addressing public concerns early and incorporating feedback, policymakers can build trust and ensure that the scheme is perceived as fair, effective, and beneficial. This section explores the critical methods used to influence public acceptance and promote smoother adoption of road pricing policies. Public acceptability can be affected by factors such as the general aversion to new or increased fees and the complexity of the charging methods and technology (Niskanen & Nash, 2008).

Communication

Public acceptance of road pricing can diminish significantly if the fees are seen as "just another tax," making the policy appear more like a revenue grab than a solution to real problems (Langmyhr, 1997). A key aspect of fairness in road pricing goes beyond just the distribution of costs and benefits; it also involves keeping promises made by policymakers. As Van Wee and Mouter (2021) point out, if a minister or parliament pledges to fund a regional railway, failing to follow through would be perceived as unfair, even if the project's benefits are debatable. Breaking such promises, especially without a strong rationale, undermines trust in the policy and its proponents.

Effective communication, marketing, and public information are vital in successfully implementing road pricing schemes (Noordegraaf et al., 2013). Public skepticism can grow without transparent and credible messaging, leading to increased resistance. For example, the Swedish Road Administration provided transparent information during the Stockholm congestion

tax trial. It ensured that communication remained neutral and credible, which helped the public view the policy more favorably (Sørensen et al., 2013). This underscores the importance of having a trusted, impartial voice when introducing complex policies.

To ensure the success of road pricing, Higgins et al. (2010) suggest several critical strategies for communication. First, it is essential to clearly define and communicate the specific problem road pricing aims to solve, whether reducing traffic congestion, lowering emissions, or addressing funding shortfalls for infrastructure. Framing the issue in a way that resonates with those affected makes it easier for the public to understand the policy's relevance. Additionally, messages should be tailored to different stakeholder groups—drivers, public transit users, businesses, and environmental advocates—so each group can see how they benefit.

Equally important is ensuring that the communication is straightforward and free of technical jargon, making the policy accessible to the general public. Using multiple communication channels—such as websites, newsletters, social media, and public forums— can help reach a broader audience and provide detailed, easy-to-understand information about how the scheme will work its benefits, and its overall impact.

Lastly, addressing fairness concerns head-on is critical for public buy-in. Policymakers must clearly explain how the policy ensures equity across different income groups and geographic regions and how it is implemented overall. Transparency in how revenue will benefit the community further strengthens trust, demonstrating that the policy is designed to serve the public good and not just as a financial burden. In short, a road pricing policy's success hinges on its technical design and how well the public communicates, perceives, and trusts it.

Public engagement

The implementation process of a new transport policy can also impact the perception of fairness. When the public is more involved in the decision-making, they perceive the policy as more fair (Hsieh, 2022). This refers to opportunity equity, as defined previously by Levinson (2010) and Zhou et al. (2018). Introducing road pricing should begin with public and political discussions on traffic issues and the goals of urban transport policy. The public should actively participate in these discussions, with opportunities to suggest modifications and participate in assessment meetings (Hårsman, 2001). According to Hsieh (2022), policymakers promoting road pricing should engage the public early through decision-making processes, including discussions on pros and cons, implementation consultations, feedback trials, and referenda.

Gradual implementation, trials

A study by Sørensen et al. (2013) emphasizes that trials can build legitimacy and acceptance for road pricing schemes. In Stockholm, a trial followed by a referendum allowed the public to experience the policy firsthand before voting, which helped address legitimacy concerns and boost acceptance. This approach enabled political leaders to manage opposition by pointing to the forthcoming referendum. Eliasson (2008) explains that public support for congestion charges was under 30% before the trial. As the trial progressed and benefits clarified, support rose to over 50%. By the end of 2007, after reintroducing the charges, support reached nearly 70%, with 35% of people becoming more favorable during the trial.

Incremental approaches allow for learning and acceptance. Phasing in road pricing allows stakeholders and the public to adapt, gradually reducing resistance and building support. This method enables experimentation, builds trust through early successes, and addresses concerns before full implementation (Ieromonachou et al., 2005). By gradually implementing road pricing schemes, acceptability can be boosted by allowing time for adjustment and managing barriers. Phasing in measures helps travelers and stakeholders adapt incrementally rather than facing abrupt changes. This approach facilitates gradual changes in travel behavior, allows for feedback, and enables policy refinement, ultimately increasing public support and reducing resistance (De Palma et al., 2006).

The link between fairness and acceptance

People value equity and fairness, so opposition

arises when policies seem unfair. This is why offering toll-free alternatives and tolling new roads rather than existing ones tends to gain more public support by ensuring everyone has a choice (Walker, 2011). Huber et al. (2019) also state that if a policy is considered unfair, it will receive less individual support. Fairness in cost, privacy, security, value, and performance directly impacts public acceptance of road pricing schemes (Grush, 2010). High costs, privacy concerns, or security risks can reduce trust and lead to resistance. Conversely, if these factors are well-managed, acceptance increases as the scheme becomes more fair and reliable. As discussed in section 3.2.2, opportunity equity, also called procedural fairness, can play a role in acceptance. Positive expectations of outcomes and beliefs in procedural fairness were linked to a more favorable attitude toward the taxes after implementation (Nilsson et al., 2016).

Dutch contextual factors

The introduction of road pricing in the Netherlands is influenced by various contextual challenges that have shaped public perception and political discourse. These factors have reinforced resistance to the policy despite its potential advantages. In this section, key contextual elements are examined, including the negative image of road pricing, political dynamics, and the impact of status quo bias, all of which affect the feasibility and acceptability of the policy.

Negative image

Dutch academia Verhoef et al. (1995) claim that It is unlikely that road pricing will be implemented on a large scale soon due to a negative image base on significant social and political barriers, including privacy concerns, fairness issues, high costs, avoidance behaviors, pricing challenges, and regulatory incentives, leading to a shift in focus toward alternative traffic regulation measures like parking policies and peak hour permits. Not much has changed since then, as Ardıç et al. (2015) also show in their research. They argue that the Netherlands has not implemented a road pricing policy due to the following factors. Road pricing policies impose direct, visible costs on drivers, such as peak-hour or per-kilometer charges, which many perceive as an added financial burden (1). This,

coupled with the Dutch public's attachment to car use as a symbol of freedom (2), contributes to the policy's unpopularity and user resistance. Moreover, Tillema et al. (2012) explain that while road pricing is viewed as part of a shift from fixed taxation to a usage-based system, it lacks broad support, as many people in the Netherlands see it as another form of taxation. They doubt its effectiveness in changing travel behavior and view it as merely increasing the cost of travel, which is already considered high.

Politics

Political support has long been seen as essential for implementing road pricing schemes successfully (Vonk Noordegraaf et al., 2013). In the Netherlands, road pricing entered the political agenda in 1987 with the initial proposal for cordon charges, or "rekeningrijden" (Boot et al., 1999). In late 2007, the Dutch government proposed a national road pricing scheme called Anders Betalen voor Mobiliteit (ABvM), aimed at improving accessibility and quality of life by shifting from car ownership costs to usage-based charges (Walker, 2011). Despite broad political backing in 2006, largely encouraged by the positive recommendations of the Nouwen Committee, the policy encountered challenges in 2010, primarily due to the position of the ANWB, the largest motorists' association. The Minister of Transport maintained close contact with the ANWB and publicly weighed their survey results, which revealed 68% public support for the "pay for usage" principle. However, this approach angered parliament, which felt the final decision was their responsibility. Before the government's collapse in 2010, shifting political dynamics and ongoing public resistance led to the policy's eventual stall (Vonk Noordegraaf, 2016).

Status quo bias

Status quo bias (SQB) reflects a tendency for individuals to prefer the current situation and resist change, mainly when uncertainty surrounds potential outcomes and it is unclear who might benefit or lose from a new policy (Fernandez & Rodrik, 1991). This bias is closely tied to a fear of the unknown, as individuals often use familiar options as a benchmark, viewing new alternatives with skepticism and caution (H. Cao et al., 2009).

Complex views emerge arguing against road pricing as many people are habitual to 'free' roads. They do not realize that many free roads primarily serve the rich, increase traffic, and harm poor people due to pollution. Because of such circumstances, the normalization of such a condition makes people oppose pricing reforms irrespective of the fact that adequately implemented road pricing with revenue sharing can improve fairness and efficiency (Manville, 2019).

To address this, providing clear, detailed, and accessible information can reduce ambiguity and increase users' confidence in navigating change, especially in contexts like road pricing policies (Hazan et al., 2020). This approach can lessen resistance and build public acceptance of road pricing policy by helping drivers understand the policy's benefits, costs, and overall impact, as discussed in section 3.2.1. Moreover, support for such policies tends to grow after implementation as the policy becomes part of the established landscape and people adapt to its presence (Börjesson et al., 2016).

The success of road pricing policies largely hinges on public acceptance, which depends on transparent communication, public engagement, fairness, and adaptable strategies. Studies reveal that public support grows when the policy is perceived as beneficial, trustworthy, and fair, especially if revenues are allocated to improvements in public transport or infrastructure that serve community interests. Effective communication is crucial, as it helps the public understand the policy's goals and dispels fears of it being a mere tax increase. Trust can be fostered by involving citizens in decision-making and using incremental trials, as seen in Stockholm, which built legitimacy and reduced resistance. Political dynamics, cultural attachment to car usage, and status quo bias in the Netherlands challenge public acceptance. However, these can be mitigated with clear, accessible information and gradual adaptation. Emphasizing fairness in cost distribution, procedural transparency, and targeted social benefits can enhance public buy-in, ultimately leading to a more viable and equitable road pricing system.

Revenue redistribution and its influence on perceived fairness and acceptance

Revenue redistribution is critical in enhancing the fairness and acceptance of road pricing policies (Santos & Rojey, 2003). This section explores how redistribution can promote fairness and increase acceptance, then analyzes challenges and opportunities in allocating revenue effectively.

Redistribution and fairness

Pricing schemes without revenue redistribution often benefit higher-income individuals, whereas redistribution can improve outcomes for lower-income groups (Ecola & Light, 2009). A fair pricing revenue allocation considers all groups equitably, directing more resources to the most disadvantaged individuals or groups (Krumholz & Forester, 2011; Li et al., 2018). Moreover, the method of revenue recycling is crucial to maximizing the welfare effect of congestion taxes; effective redistribution can reduce the regressive impact of congestion pricing by offsetting the costs for lower-income users and addressing existing economic imbalances (Parry & Bento, 2001). Successful road pricing programs, such as those described by Taylor et al. (2010), often allocate toll revenues to transit and highway improvements around tolled areas, addressing equity concerns and benefiting all users. Allocating revenues is crucial in shaping the equity effects of congestion charging reforms (Eliasson, 2016). Various approaches to revenue use will be discussed.

Redistribution and acceptance

Road pricing acceptability is closely linked to revenue allocation. According to Schade (2017), Schuitema & Steg (2008), and Schuitema et al. (2005), transport pricing is more acceptable when revenues are allocated in ways that directly benefit car users, such as reducing car-related taxes or reinvesting in the transport system, like public transport improvements. However, acceptability decreases if people believe the funds will go toward general state or municipal purposes instead of transport-related benefits. This suggests that public support for transport pricing policies rises when users feel compensated for potential negative consequences.

In the Netherlands, road pricing acceptability hinges on revenue allocation. A study by Ubbels and Verhoef (2006) found the highest support for using revenues to replace car ownership taxes, followed by reducing fuel taxes. Improving or building new roads was somewhat acceptable, while allocating funds to the general government budget was the least popular. Acceptance is primarily influenced by whether the measures are perceived to reduce congestion and provide personal benefits. The preferences for revenue allocation can also differ for each individual. Verhoef et al. (1997) created a questionnaire for Dutch road users in the Randstad region. The analysis revealed that lower-income individuals favor tax reductions, especially on fuel, over road investments, likely due to financial concerns. Conversely, those expecting compensation for road pricing tend to prefer allocations like road investments and public transport subsidies, as these provide additional benefits beyond existing tax relief.

Types of revenue allocation

Revenue from a road pricing scheme could be used for various purposes. The distribution of net benefits heavily depends on how toll revenues are used since these are usually much larger than the efficiency gains (Anas & Lindsey, 2011). The following subsections explore these options, showing the opportunities and challenges alongside real-life situations.

Public Transport Investment

Research consistently shows that the public prefers revenue from road pricing schemes to be directed toward public transport improvements, with various studies highlighting this as an effective approach for reducing congestion and supporting equitable access to transit. Vrtic et al. (2007) found that public transport investment is the most favored spending option, as it helps manage transport demand and reduce congestion. Levinson (2010) adds that revenue toward enhancing public transit can ease the transition for those shifting from driving and assist low-income groups relying on affordable transportation.

Farrell and Saleh's (2005) study in Edinburgh also shows this preference, showing strong public support for using revenue from road-user charges to improve public transport services.

Their research highlighted the importance of real-time information, reliability, integrated ticketing, fare reductions, and expanded network coverage as measures that could increase public transport's appeal and reduce car dependency. However, despite positive findings, a road-user pricing scheme was never implemented in Edinburgh.

De Borger and Proost (2011) further indicate that road users support road pricing if revenue directly funds public transit, as they perceive this as a shared benefit rather than a generalized revenue return without specific impact. Nevertheless, Santos (2004) points out that allocating revenue to public transport poses certain challenges, particularly in areas requiring substantial investment, such as rail infrastructure. Moreover, emphasizing high-ridership areas can lead to inequities between suburban and inner-city communities.

Additionally, Cain and Jones (2008) note that certain groups, such as rural residents or night-shift workers, benefit less from public transport investments, as services may not be as accessible or frequent in these areas. Meanwhile, Anas and Lindsey (2011) suggest that investing in transport infrastructure offers long-term, lasting benefits, whereas using revenue for fee or tax reductions is easily reversible and may lack sustained impact.

These studies collectively emphasize that while public transport investment is widely supported, it requires careful planning to address diverse community needs and potential regional disparities.

Tax reductions

Research shows that many road users support using road pricing revenues to reduce vehicle-related taxes, seeing it as a way to offset congestion fees and provide tangible financial benefits. Small (1992) observes that these tax reductions can help balance the cost burden on those paying congestion fees, ultimately benefiting all road users. Similarly, Santos and Rojey (2003) argue that directing revenue to lower fuel and vehicle excise taxes can maintain the same overall charges for motorists while reducing congestion, creating a dual benefit.

Hau (2005) adds that road pricing schemes are likely to gain greater acceptance if the revenues are used to reduce vehicle-related taxes, as this compensation approach reassures users that toll payments translate into direct financial relief. Reflecting these findings, a Dutch survey by Ubbels and Verhoef (2006) reveals a strong preference among respondents for revenue to be allocated toward tax reductions, further emphasizing commuters' desire for options that lower their total car ownership costs. Together, these studies suggest that revenue allocation toward tax relief can effectively increase public acceptance of road pricing initiatives.

Road infrastructure

Lindsey (2012) identifies three primary types of road infrastructure investment: constructing new roads to improve access in remote or less-developed areas, upgrading existing roads to enhance safety and speed, and expanding road networks to alleviate congestion. Expanding roads to reduce congestion is particularly popular, as it directly addresses public demand and aligns with the purposes of road fees (Small, 1992).

For greater economic efficiency, Hau (2005) suggests using short-run marginal cost pricing to manage demand within existing road capacity, allowing for congestion reduction by ensuring users pay for the actual road usage costs. In the long term, infrastructure should adapt to demand trends, ensuring capacity matches future needs without unnecessary expansions. Reflecting this, Ubbels and Verhoef (2006) found that Dutch commuters widely support revenue allocation toward road infrastructure improvements, as it provides a direct solution to congestion and improves the overall driving experience.

Comparing strategies

Preference for Public Transport Improvements vs. Tax Reductions: There is a recurring theme of support for public transport improvements, particularly among non-car users. Studies by Vrtic et al. (2007) and Farrell & Saleh (2005) indicate that investing in public transport is widely favored as it provides congestion relief and benefits lower-income and non-car users. This contrasts with a preference for tax reductions primarily among car users, as noted

by Jaensirisak et al. (2005) and Ubbels & Verhoef (2006), who found that direct financial relief, such as tax cuts, appeals to those who bear the costs of car ownership and road usage fees.

Infrastructure Investment: Opinions on infrastructure investment vary widely. Lindsey (2012) points out that while infrastructure expansion to relieve congestion has public support, studies by Schuitema and Steg (2008) reveal a more complex perspective. Their three studies show that infrastructure investment can be less popular than tax reductions, especially if it does not directly improve user experience or reduce costs. However, in contexts where specific policies were not referenced (Schuitema & Steg, Study 3), infrastructure investments gained nearly as much support as tax cuts, highlighting that how revenue allocation is presented can influence public acceptability.

Flexible and Combined Approaches: Van Dender (2019) advocates for flexibility in revenue allocation, suggesting that funds should be directed to projects with the highest social returns rather than strictly earmarked for specific uses. This view aligns with Farrell & Saleh's (2005) findings that combining public preferences—such as supporting public transport and moderate tax relief—could create more balanced, acceptable packages. This flexible approach is also observed in Norway's road pricing schemes, where allocations are adjusted to maximize social benefits. Langmyhr (1997) examines the allocation of transport investment revenues in three Norwegian cities. In Tromsø, 89% of funds are directed toward road infrastructure, with 11% allocated to public transport, safety, and environmental projects. Kristiansand uses 79% of its revenue for a new bridge and related road projects, while 21% supports non-car transport modes and safety initiatives. Trondheim finances its transport package with 60% user fees and 40% state funds, allocating 82% to road construction and the remainder to public transport, safety, and environmental improvements.

Economic Efficiency and Long-Term Strategy: Several sources recommend strategic long-term planning to ensure economic efficiency. Hau (2005) argues for a model based on short-

run marginal cost pricing to control demand within existing infrastructure while gradually adjusting capacity to meet future demand. This long-term approach aligns with the benefits of infrastructure investments but also requires balancing with immediate, visible benefits, such as tax reductions or public transport improvements, to maintain public support.

In conclusion, while there is no single preferred strategy, the findings suggest that combining approaches—such as moderate tax relief, infrastructure investment, and enhancements in public transport—may offer a balanced solution. As Van Dender (2019) suggested, flexible allocation models considering the highest social returns seem essential in designing road pricing schemes that meet diverse preferences and enhance public acceptability.

Road pricing revenue allocation strategies vary in focus, offering distinct advantages for fairness, public acceptance, and efficiency. Redistribution is key to fairness, with lower-income groups benefiting most when revenues fund tax relief or public transport improvements. Public acceptance tends to be higher for allocations perceived to bring direct personal or community benefits, such as reduced vehicle taxes or enhanced transit options, rather than when revenues go to general budgets. Investments in public transport are widely supported for their congestion-reducing potential and equitable access, although effective planning is necessary to avoid regional disparities. Meanwhile, tax reductions appeal strongly to car users as they help offset the cost burden of road pricing. Infrastructure improvements, especially those aimed at reducing congestion, also find support but are less popular than options offering immediate financial relief. Flexible allocation models prioritizing high-impact projects are recommended to balance short- and long-term public benefits. This suggests that a combined approach—blending tax relief, transit enhancements, and targeted infrastructure upgrades—may yield the most broadly acceptable solution.

B: Conceptual Model Literature Overview

Link	Explanation
A1	Huber et al. (2019) state that if a policy is considered unfair, it will receive less individual support. Research highlights that perceived fairness plays a significant role in the public acceptance of policies (Van Wee & Mouter, 2021).
A2	Procedural justice shapes policy design by ensuring fair decision-making processes that include diverse perspectives and meaningful participation from affected communities. This leads to more equitable policies that address the needs of disadvantaged populations and promote justice (Karner et al., 2020). The implementation process of a new transport policy can also impact the perception of fairness. When the public is more involved in the decision-making, they perceive the policy as more fair (Hsieh, 2022). The public should actively participate in these discussions, with opportunities to suggest modifications and participate in assessment meetings (Hårsman, 2001).
A3	Sen et al. (2022) mention that individuals with lower incomes or who are unemployed are more disadvantaged due to these characteristics. If the road pricing fee is considered a share of income, low-income travelers are mistreated, as they pay a higher percentage of their income than those with a higher income (Eliasson, 2016). However, with a vertically equitable pricing scheme, this could be avoided. Another reason for the low-income group to be affected more is that they are more likely to be older and have more children, and hence have a more difficult time switching to another mode of transport (Craik & Balakrishnan, 2022). This group might have to cancel the trip if they cannot pay the pricing fee. Parkhurst et al. (2006) state that in urban areas, the impact on winners and losers and their income levels is primarily influenced by the location of different income groups concerning the charging zones. If low-income workers must drive during peak times and thus pay more to use the roads, the equity impact differs from regions where jobs are accessible by public transport (Ecola & Light, 2009). There are concerns about vertical equity, as lower-income individuals may drive older, more polluting vehicles and therefore face higher costs (Wessel, 2020).
A4	Randal et al. (2020) argue that a fair transport policy is one where the most disadvantaged individuals have improved capabilities, which connects to the theory of vertical equity.
A5	Central city residents pay congestion charges, while revenues are reinvested in public transportation improvements, benefiting commuters from less connected suburban areas (Gu et al., 2018; Eliasson, 2014).
A6	Cain and Jones (2008) note that certain groups, such as rural residents or night-shift workers, benefit less from public transport investments, as services may not be as accessible or frequent in these areas. Pricing schemes without revenue redistribution often benefit higher-income individuals, whereas redistribution can improve outcomes for lower-income groups (Ecola & Light, 2009). Studies by Vrtic et al. (2007) and Farrell & Saleh (2005) indicate that investing in public transport is widely favored as it provides congestion relief and benefits lower-income and non-car users.
A7	The evaluation framework by Raux and Souche (2004) highlights the importance of considering different types of equity in transport policies. Ignoring them risks failure, making the framework a valuable tool for analyzing the acceptability of urban road pricing policies.

Table 8: Complete overview of sources for the conceptual model (continued on the following pages).

Link	Explanation
A8	Fairness can mean different things, as the various equity types and ethical theories explain. This makes it difficult for a policymaker to decide what is fair, as various ideas on equity can lead to different policies (Pereira et al., 2016).
A9	The successful implementation of a radical change, such as a new road pricing policy, depends on public acceptability, which requires community and stakeholder commitment to the processes of discussion, decision-making, and implementation (Banister, 2008).
A10	Acceptability can be expected only if people have confidence in the measure's effectiveness, revenue usage, system fairness and anonymity, and opportunities for participation in the decision-making process (Niskanen et al., 2003). According to Schade (2017), Schuitema & Steg (2008), and Schuitema et al. (2005), transport pricing is more acceptable when revenues are allocated in ways that directly benefit car users. Hau (2005) adds that road pricing schemes are likely to gain greater acceptance if the revenues are used to reduce vehicle-related taxes, as this compensation approach reassures users that toll payments translate into direct financial relief. How revenue allocation is presented can influence public acceptability (Schuitema & Steg, 2008).
A11	Communication that remained neutral and credible helped the public view the policy more favorably (Sørensen et al., 2013). Higgins et al. (2010) suggest several critical strategies for communication; it is essential to clearly define and communicate the specific problem road pricing aims to solve. Tillema et al. (2012) explain that while road pricing is viewed as part of a shift from fixed taxation to a usage-based system, it lacks broad support, as many people in the Netherlands see it as another form of taxation (a misconception that can be addressed through clear communication). Providing clear, detailed, and accessible information can reduce ambiguity and increase users' confidence in navigating change, especially in contexts like road pricing policies (Hazan et al., 2020).
A12	Policymakers must clearly explain how the policy ensures equity across different income groups and geographic regions and how it is implemented overall. Transparency in how revenue will benefit the community further strengthens trust, demonstrating that the policy is designed to serve the public good and not just as a financial burden (Higgins et al., 2010).
A13	A study by Sørensen et al. (2013) emphasizes that trials can build legitimacy and acceptance for road pricing schemes. Phasing enables experimentation, builds trust through early successes, and addresses concerns before full implementation (Ieromonachou et al., 2005). This approach allows for feedback and enables policy refinement, ultimately increasing public support and reducing resistance (De Palma et al., 2006).
A14	The phased implementation approach facilitates gradual changes in travel behavior (De Palma et al., 2006). Support for such policies tends to grow after implementation as the policy becomes part of the established landscape and people adapt to its presence (Börjesson et al., 2016).
A15	Fairness in cost, privacy, security, value, and performance directly impacts public acceptance of road pricing schemes (Grush, 2010). High costs, privacy concerns, or security risks can reduce trust and lead to resistance.

Link	Explanation
A16	Complex views emerge arguing against road pricing as many people are habitual to 'free' roads. They do not realize that many free roads primarily serve the rich, increase traffic, and harm poor people due to pollution. Because of such circumstances, the normalization of such a condition makes people oppose pricing reforms irrespective of the fact that adequately implemented road pricing with revenue sharing can improve fairness and efficiency (Manville, 2019).
A17	To promote geographical fairness, the revenue from the pricing scheme could be invested in improving transport infrastructure in rural or underserved areas (Santos & Verhoef, 2011). A fair pricing revenue allocation considers all groups equitably, directing more resources to the most disadvantaged individuals or groups (Krumholz & Forester, 2011; Li et al., 2018). Successful road pricing programs, such as those described by Taylor et al. (2010), often allocate toll revenues to transit and highway improvements around tolled areas, addressing equity concerns and benefiting all users. Levinson (2010) adds that revenue toward enhancing public transit can ease the transition for those shifting from driving and assist low-income groups relying on affordable transportation. De Borger and Proost (2011) further indicate that road users support road pricing if revenue directly funds public transit, as they perceive this as a shared benefit rather than a generalized revenue return without specific impact. Expanding roads to reduce congestion is particularly popular, as it directly addresses public demand and aligns with the purposes of road fees (Small, 1992).
A18	Verhoef et al. (1997) created a questionnaire for Dutch road users in the Randstad region. The analysis revealed that lower-income individuals favor tax reductions, especially on fuel, over road investments, likely due to financial concerns. Ubbels and Verhoef (2006) found that Dutch commuters widely support revenue allocation toward road infrastructure improvements, as it provides a direct solution to congestion and improves the overall driving experience.

C: Interview Questions

General
- What is your experience with road pricing policies?
- How long have you been working in this field?
- Do you believe a new pricing policy will emerge in the Netherlands within the next ten years? Why (not)?

Fairness Issues
- In your view, what fairness issues might arise with the implementation of road pricing schemes?
- Are there any specific groups or individuals you believe might be disproportionately affected by road pricing schemes? If so, why?
- What factors influence how people perceive the fairness of road pricing schemes?
- From your experience, do fairness concerns vary depending on the characteristics of the scheme (e.g., the pricing structure, location, or timing)?
- Do you think that revenue allocation can influence the perceived fairness of a road pricing scheme?
- What would be the fairest way to redistribute revenue from road pricing in the Netherlands?

Refine Evaluation Frameworks
- How do you believe fairness in road pricing schemes should be measured or evaluated?
- Do you think the current frameworks for evaluating the fairness of road pricing are adequate? If not, how would you improve them?
- What are some practical ways to ensure that fairness is incorporated into the design of road pricing schemes?
- Are there specific fairness principles (e.g., equity, equality, sufficientarianism) that should guide the evaluation of road pricing schemes?

Explore Perceived Fairness and Acceptance
- How do you think the Dutch public generally perceives road pricing schemes? Are there any particular factors that increase or decrease acceptance?
- Can you share your thoughts on how perceived fairness impacts the overall acceptance of road pricing in the Netherlands?
- Do you think that concerns about fairness are more important than the potential environmental or economic benefits of road pricing? Why or why not?
- In your experience, how do personal circumstances (e.g., income level, commuting distance) affect someone's perception of fairness in road pricing?
- Does the revenue allocation affect public acceptance of road pricing schemes? If so, how?
- Are there any revenue redistribution strategies you believe would improve both fairness and acceptance of road pricing?

D: Interview Analysis

A# = Academics
B# = Policymakers
Pronouns changed to they/them for privacy; all interviews (except B2) were with individuals, whereas B2 was an interview with 2 individuals at once.

Politics

A1

The interview discusses the political dynamics and policy considerations surrounding road pricing in the Netherlands. They mention that the likelihood of introducing a new road pricing policy within the next ten years has decreased under the current cabinet, which does not seem to prioritize pricing policy. They explain that political support for road pricing can be influenced by different motivations across the political spectrum, such as environmental concerns on the left and maintaining government revenues on the right. However, the current cabinet's focus is unclear, and without a pressing need, significant progress is unlikely. Additionally, political dynamics, including electoral considerations and the risk of losing voters, complicate the adoption of road pricing policies.

A2

The interviewee mentions that road pricing received initial political support but was eventually dropped due to a lack of consensus. They express skepticism about the actual implementation of new road pricing policies, given past experiences and the fact that it is not currently part of the coalition agreement. They also note that fairness is ultimately a political judgment and that politicians should look for designs that minimize negative distribution effects. Additionally, they mention that the question of whether redistribution strategies for revenues would increase acceptance enough to make road pricing politically viable remains uncertain.

A3

The interviewee mentions that the implementation of road pricing in the Netherlands has been challenging due to political reasons. They state that it is difficult to get a political majority to support it because some parties are afraid of losing votes. They also highlight that risk aversion and concerns about the functionality and cost of ICT systems play a role in the political hesitation. Additionally, they note that the Netherlands is good at making plans but not at implementing them, which has led to a lack of progress compared to other countries.

"I fully understand that a VVD member might relate more to utilitarianism, that the SP might focus more on the lower-income groups, and that other parties might want to ensure the differences don't get too large. That's okay. There is no ONE good solution. There's no ONE definition of fairness. I think you should listen to what people think, but also to organizations that are important in the debate, and then map out what they need before they can take a stance. Yes. I think it's perfectly fine for different political parties to incorporate fairness in different ways."

B1

The interviewee mentions that the political feasibility of road pricing remains uncertain and that public sentiment and election outcomes will play a crucial role. They note that a more progressive government might favor road pricing, while a conservative one may not. They also highlight that societal acceptance and broad support are crucial criteria for the feasibility and implementability of such systems.

A4

The interviewee expresses a critical view of politics in relation to road pricing policy. They mention that politics often shows concern and intent to do something about road pricing but fails to frame it effectively. They perceive that the issue is approached too technically rather than addressing the fundamental question of who should pay for mobility. They also note that politics is dominated by economists and environmentalists, which they finds problematic. Additionally, they believes that politicians lack the courage to implement new road pricing policies and tend to defer action to future cabinet periods. The interviewee also criticizes the opportunistic and short-sighted nature of political reasoning over the last decade.

B2

The interviewees mention that political influence plays a significant role in the development and implementation of policies. One notes that while they work on creating fair and logical policies, the final decisions are made by politicians. They emphasize that their role is to inform and advise politicians, but ultimately, the choice lies with the political leaders. One adds that they try to gather as much information as possible to present to the Lower House and other stakeholders, but the final decision on policy implementation is made by politicians.

B3

They mention that the implementation of road pricing is heavily influenced by political factors. They state that the subject of road pricing comes up on the political agenda periodically and that its success depends on the political support it receives. They also note that the fairness of road pricing is a political question, as different groups may be affected differently, and it is up to politicians to judge whether the system is fair. The interviewee emphasizes that political support and the political constellation at any given time play a crucial role in whether road pricing policies are pursued or implemented.

Based on the (old) sub-questions:
What fairness issue may theoretically play a role in the perceived fairness of road pricing?
A1

According to the interview, the fairness issues that may theoretically play a role in the perceived fairness of road pricing include:
- Procedural Fairness: This involves the fairness of the processes and procedures used to implement and manage the road pricing system.
- Broader Idea of Justice: This encompasses the overall sense of justice and fairness in the system, which can be challenging to distinguish from fairness itself.
- They also highlight the importance of recognizing people's diverse circumstances and ensuring that individual positions are acknowledged. A lack of focus on these differences can lead to perceptions of unfairness and disengagement from sustainability transitions. For example, there is a sentiment that "the wealthy keep flying, but I'm not even allowed to have a barbecue in my backyard," which reflects a perceived inequity in how policies affect different segments of the population.

A2

Based on what they have said in the interview, the fairness issues that may theoretically play a role in the perceived fairness of road pricing include:
- Impact on Frequent vs. Occasional Drivers: A flat kilometer fee would mean frequent drivers pay more while occasional drivers pay less. Frequent drivers, especially those not reimbursed by employers, might feel disadvantaged.
- Congestion Pricing: Congestion pricing targets specific locations and times, like rush hours around major cities. Wealthier drivers are more likely to absorb the costs due to higher time valuations, while lower-income groups may avoid peak times altogether, potentially

disadvantaging them further.
- Impact on Specific Groups: Long-distance commuters and business travelers might be particularly affected by a flat kilometer fee. Urban commuters heading into major cities during peak hours would be affected by congestion pricing. Lower-income and lower-education groups typically have shorter commutes, slightly mitigating the impact for them.
- Procedural Fairness: Procedural fairness, or whether the process itself has been fair, is important to many people.
- Revenue Redistribution: How the revenues from road pricing are distributed can influence perceived fairness. If revenues benefit the people who pay, such as by lowering or abolishing motor vehicle taxes or investing in public transport, it might be perceived as fairer.
- Personal Circumstances: Personal circumstances, such as income level, strongly influence someone's perception of fairness. Perceptions of fairness are mainly determined by whether people see themselves as personally better or worse off.

A3
According to them, the fairness issues that may theoretically play a role in the perceived fairness of road pricing include:
- Utilitarianism: Whether the policy adds the most value overall.
- Egalitarianism: Reducing inequalities between people.
- Sufficiency-Based Fairness: Ensuring that those at the bottom of the scale are not too badly off.
- Pay-Per-Kilometer Charges: Generally considered fair because those who drive more pay more, and those who drive less pay less.
- Impact on Specific Groups: Concerns about people who have no choice but to drive at specific times or locations, such as lower-income individuals or those in rural areas with fewer transport options, being worse off.

B1
The interviewee identifies several fairness issues that may theoretically play a role in the perceived fairness of road pricing. These include:
- Affordability: Ensuring that road pricing does not disproportionately impact vulnerable groups, such as those with lower incomes or those living in rural areas who rely on cars.
- Restricting Choices: Whether road pricing restricts people's choices and their ability to meet basic needs like access to work or healthcare.
- Normative Justifiability: Some people might feel that they have already paid their share through taxes, affecting their perception of fairness.
- Dynamic Pricing Impact: Dynamic pricing, such as peak-hour charges, might disproportionately affect those living outside cities who rely on cars for work.

A4
The interviewee identifies several fairness issues that may theoretically play a role in the perceived fairness of road pricing:
- Current Inequality: They point out that the current system is already unequal. For example, people living in rural areas like East Groningen may already pay more for their car usage than those living in cities who can use bikes and make shorter trips.
- Impact on Vulnerable Groups: They mention that changes in the cost structure can disproportionately affect people who have organized their lives around the current system, particularly those who live far from work, have no alternatives to driving, or work shifts that make other forms of transport impractical. These groups often include less educated individuals and those in lower-income brackets.
- Resistance to Change: The interviewee notes that people are generally resistant to changes that disrupt their established cost structures. This resistance is particularly strong among those

who have optimized their lives based on the current costs of car ownership and usage.
- Perception of Disproportionate Impact: The interviewee discusses how people who drive a lot and have optimized their costs with fuel-efficient or diesel cars might feel disproportionately affected by road pricing changes, even though the current system already has inherent inequalities.
- Static vs. Dynamic Behavior: The interviewee argues that discussions about fairness often fail to account for the dynamic nature of people's behavior. They believe that people can and do adjust their behavior in response to new cost structures, but this flexibility is often overlooked in fairness debates.

In summary, the interviewee highlights that perceived fairness issues in road pricing stem from existing inequalities, the impact on vulnerable groups, resistance to change, and the failure to consider the dynamic nature of people's behavior.

B2

They discuss several fairness issues that may theoretically play a role in the perceived fairness of road pricing:
- Fee Structure and Distribution Effects: One mentions that the way the fee structure is conceived can significantly impact perceived fairness. For example, if the system is budget-neutral, an average person might spend about the same amount as before, but those who drive less would spend less, and those who drive more or have heavier cars would spend more. This can lead to different perceptions of fairness based on individual circumstances.
- Impact on Specific Groups: They highlight that specific cases, such as individuals who need to drive long distances for work or those with heavier cars, might perceive the system as unfair if they face higher costs. One adds that people in poverty or those who rely on driving long distances might find variable costs particularly challenging to manage.
- Complexity of the System: Both they agree that the more complex the system, the harder it is for people to estimate their costs, which can lead to perceptions of unfairness. For instance, if costs vary by location or time of day, it might be seen as unfair by those who have no choice but to drive during peak times or in certain areas.
- Communication and Clarity: They emphasize the importance of clear communication from the government about how the system works and how fees are calculated. If people understand the rationale behind the fees and there are no surprises, it can help in perceiving the system as fair.
- Distribution of Revenues: they discuss that while revenues from road pricing are typically not directly linked to specific expenditures in the Netherlands, if they were, it could influence perceptions of fairness. For example, if revenues were used to fund public transport, it might be seen as fairer.
- Principles of Justice: They mention using principles such as sufficientarianism, utilitarianism, and egalitarianism to evaluate fairness. These principles help in assessing how different policies impact various groups and whether they align with broader concepts of justice.
- Personal Circumstances: They acknowledge that personal circumstances, such as income, location, and the necessity to drive, can influence how fair individuals perceive the road pricing system to be. For example, someone living in an area with higher costs or needing to drive long distances might see the system as less fair.

Overall, they identify several theoretical fairness issues that could impact the perceived fairness of road pricing, including the fee structure, impact on specific groups, system complexity, communication, revenue distribution, principles of justice, and personal circumstances.

B3

The interviewee explains that the perceived fairness of road pricing can be influenced by several factors, depending on the specific variant of the system implemented. The key points they make:
- Redistribution Effects: Road pricing often leads to a redistribution of costs from frequent

drivers to infrequent drivers. For example, if a peak-hour charge is implemented, those who drive during peak hours in congested areas (like the Randstad region) would pay more. This can be seen as unfair by those who need to drive frequently for work or other essential activities.

- Regional Differences: People living in car-dependent regions, such as rural areas, may feel disproportionately affected because they rely more on their cars for daily activities. This could lead to a perception of unfairness if they have to pay more compared to those living in urban areas with better access to public transport.
- Vehicle Type and Usage: The fairness of road pricing can also be influenced by whether the charges are based on vehicle weight, fuel type, or other factors. For instance, if electric cars are given a discount, it could lead to a redistribution from fossil fuel vehicle drivers to electric vehicle drivers, which might be controversial.
- Personal Circumstances: Individual circumstances, such as income level or the necessity to drive long distances for caregiving or work, can also affect perceptions of fairness. People may view the system as unfair if it does not take into account their specific needs and situations.
- System Costs: The costs associated with implementing and maintaining the road pricing system itself can also play a role. If these costs are passed on to motorists, it could be seen as unfair, especially by those who do not drive frequently.

Overall, the interviewee highlights that the perceived fairness of road pricing is complex and depends on various factors, including how the system is designed, who is most affected, and how individual circumstances are considered.

How can a pricing scheme be evaluated in terms of fairness?

A1

They emphasize the importance of recognizing people's diverse circumstances and ensuring that individual positions are acknowledged. They also highlight the need to adapt existing tools like environmental impact assessments and cost-benefit analyses (CBAs) to better account for what people value most. This means going beyond traditional quantitative measures to include qualitative aspects that reflect people's lived experiences and perceptions of fairness.

In summary, a pricing scheme can be evaluated in terms of fairness by considering procedural fairness, distributive fairness, and the broader idea of justice, while also recognizing diverse individual circumstances and aligning with societal values.

A2

According to the interview, a pricing scheme can be evaluated in terms of fairness by:
- Considering Misconceptions: Addressing common misconceptions, such as the belief that road pricing doesn't reduce traffic, to ensure that opinions are well-informed.
- Evaluating Effects on Specific Groups: Analyzing the distributional effects on specific groups, especially those negatively impacted or politically significant, and weighing losses for certain groups more heavily, reflecting loss aversion.
- Procedural Fairness: Considering whether the process of implementing the pricing scheme is perceived as fair, regardless of the outcome.

These methods highlight the importance of both understanding public perceptions and addressing the actual impacts on different groups to evaluate the fairness of a road pricing scheme.

A3

According to the interviewee, a pricing scheme can be evaluated in terms of fairness by considering the following:
- Utilitarianism: Assessing whether the scheme adds the most value overall to society.
- Egalitarianism: Evaluating the distribution of benefits and costs to ensure inequalities are not too large, which can be measured using the Gini index.

- Sufficiency-Based Fairness: Focusing on the impact on those who are worst off to ensure they are not disproportionately affected.
- Accessibility: Considering the impact on people's ability to reach different places, including travel times and costs.
- Public Perception: Taking into account how the public perceives the fairness of the scheme, as this influences acceptance and implementation.

B1

The interviewee explains that a pricing scheme can be evaluated in terms of fairness through thorough impact assessments and engagement with affected groups. This involves using both qualitative and quantitative methods to analyze how policy choices influence equity and broader societal goals. The evaluation process includes discussions with stakeholders and interest groups to ensure that the policies reflect the needs of different groups and contribute to overall well-being, not just economic metrics.

A4

This interviewee suggests that a pricing scheme can be evaluated in terms of fairness by focusing on the following aspects:

- Cost Coverage: The primary goal should be to ensure that the revenue generated from the pricing scheme is sufficient to cover the costs of maintaining the road system. This ensures that the system is financially sustainable.
- Transparency and Simplicity: A fair pricing scheme should be simple and transparent. People should pay based on their actual road usage and the damage they cause. This makes the system easier to understand and more acceptable to the public.
- Impact on Different Groups: The evaluation should consider how the pricing scheme impacts different groups of people, particularly vulnerable groups who may be disproportionately affected. This includes people who live far from work, have no alternatives to driving, or work shifts that make other forms of transport impractical.
- Gradual Implementation: Introducing the pricing scheme gradually can help people adjust their behavior and cost structures over time. This reduces the immediate impact and allows for a smoother transition.
- Separate Issues: The interviewee argues against using the pricing scheme to solve multiple issues, such as environmental concerns or congestion. Instead, the focus should be on maintaining the road system, with other issues addressed through separate policies.
- Public Acceptance: Ensuring that the public understands and accepts the rationale behind the pricing scheme is crucial. This involves clear communication about how the revenue will be used and the benefits of the scheme.

In summary, they believe that a pricing scheme can be evaluated in terms of fairness by ensuring it covers maintenance costs, is transparent and simple, considers the impact on different groups, is implemented gradually, addresses issues separately, and gains public acceptance.

B2

They discuss several ways in which a pricing scheme can be evaluated in terms of fairness:

- Studies and Research: One mentions that various studies were conducted to evaluate the effects of different tariff structures and their impact on safety and income distribution. These studies aimed to provide insights into how different road pricing schemes would affect various groups and regions.
- Focus Groups and Public Perception: They mention that focus groups were used to gather public opinions on road pricing schemes. This feedback was considered in the development of fee structures and to understand how different groups might perceive the fairness of the system.
- Principles of Justice: One explains that they used principles such as sufficientarianism,

utilitarianism, and egalitarianism to evaluate the fairness of road pricing policies. These principles helped them assess how different policies would impact various groups and whether they aligned with broader concepts of justice.

- Impact on Specific Groups: They highlight the importance of understanding how the pricing scheme affects different income groups, regions, and specific cases such as individuals who need to drive long distances for work or those with heavier cars. This involves analyzing the distribution effects and ensuring that the policy does not disproportionately impact certain groups.
- Communication and Clarity: Both stress the importance of clear communication and transparency in the evaluation process. They believe that well-communicated policies, where the public understands how fees are calculated and the rationale behind them, can help gain acceptance and perceived fairness.
- Use of Existing Frameworks: They refer to the policy compass as a guiding tool for evaluating policies, including road pricing schemes. This framework helps them approach policy-making systematically by considering the problem, challenges, options, effects, and preferred solutions.
- Political Influence: One points out that while they conduct thorough evaluations and provide recommendations, the final decisions are made by politicians. They aim to inform politicians with clear and comprehensive data to help them make informed choices.
- Consideration of Personal Circumstances: They acknowledge that personal circumstances, such as income, location, and the necessity to drive, can influence how fair individuals perceive the road pricing system to be. Evaluating these factors helps in understanding the broader impact of the policy.

Overall, they highlight a comprehensive approach to evaluating a pricing scheme in terms of fairness, involving detailed studies, public feedback, principles of justice, clear communication, existing frameworks, political decision-making, and consideration of personal circumstances.

B3

The interviewee provides several insights into how a pricing scheme can be evaluated in terms of fairness:

- Tariff Structure: The evaluation should consider the tariff structure of the kilometer rate. This includes factors such as vehicle weight, fuel type, and whether the rate is differentiated by time or place (e.g., peak-hour charges).
- Redistribution Effects: Analyzing the redistribution effects is crucial. This involves assessing which groups of people will pay more and which will pay less under the scheme. For example, frequent drivers might pay more while infrequent drivers pay less, leading to a redistribution of costs.
- Regional Impact: The evaluation should look at regional differences. People in car-dependent regions might be more affected by road pricing, which could be perceived as unfair if they have to pay more due to their reliance on cars.
- Personal Circumstances: Considering personal circumstances, such as income level and travel distance, is important. The scheme should be evaluated on how it impacts individuals differently based on their specific needs and situations.
- System Costs: The costs associated with implementing and maintaining the road pricing system should be taken into account. Evaluating who bears these costs (motorists or the general public) is essential for assessing fairness.
- Use of Revenues: The distribution of revenues from the road pricing scheme can influence perceived fairness. For example, using the revenues to improve public transport or road infrastructure might be seen as fairer than simply adding them to general taxes.
- Policy Objectives: The evaluation should consider the policy objectives behind the road pricing scheme. Whether the goal is to reduce congestion, improve air quality, or achieve fairer taxation will influence how fairness is perceived.

How does the perceived fairness impact the acceptance of a pricing scheme in the Netherlands?

A1

According to the interviewee, in the interview, perceived fairness has a significant impact on the acceptance of a pricing scheme in the Netherlands. Surveys consistently show a strong correlation between perceived fairness and public acceptance. If people perceive a pricing scheme as fair, they are more likely to accept it. Conversely, if they perceive it as unfair, acceptance is likely to be lower.

They note that while it is challenging to establish a direct causal relationship between perceived fairness and acceptance, the association between the two is undeniable. From a policy perspective, the goal is to increase both support and perceived fairness, as these objectives align closely. Therefore, ensuring that a pricing scheme is perceived as fair is crucial for gaining public acceptance.

A2

According to the interview, perceived fairness has a significant impact on the acceptance of a pricing scheme in the Netherlands. Key points include:

- Personal Impact: People are more likely to accept a pricing scheme if they perceive that they are not personally worse off. Personal circumstances, such as income level, strongly influence someone's perception of fairness and, consequently, their acceptance of the scheme.
- Compensation and Redistribution: Acceptance can be increased if specific groups that lose out due to road pricing are compensated in some way. For example, lowering or abolishing motor vehicle taxes or investing in public transport to make it cheaper might help improve acceptance.
- Effectiveness and Misconceptions: Misconceptions about the effectiveness of road pricing can affect acceptance. People often think from their current situation, and any change is quickly perceived as negative. Ensuring that people are well-informed about the actual effects of road pricing could improve acceptance.
- Political Viability: Significant compensation might help increase acceptance enough to make the pricing scheme politically viable.

Overall, perceived fairness plays a crucial role in the acceptance of a road pricing scheme, with personal impact, compensation, and addressing misconceptions being key factors.

A3

According to the interviewee, perceived fairness significantly impacts the acceptance of a pricing scheme in the Netherlands. They note that fairness concerns are likely the biggest obstacles to implementing road pricing. People's stance on the scheme is mainly influenced by whether they think it is reasonable or fair. Specific factors that affect perceived fairness include:

- Impact on Lower-Income Individuals: If lower-income individuals are disproportionately affected, it is seen as more unfair.
- Travel Necessity: People who are forced to travel long distances, especially those in rural areas with fewer alternatives, perceive the scheme as less fair.
- Alternatives Availability: The availability of alternatives like public transport or cycling influences perceptions of fairness, with those in areas lacking such options feeling more unfairly treated.
- Personal Circumstances: Factors like income level and travel distance play a role in how fair people perceive the scheme to be.
- Public Trust: There is a concern that the government might use the scheme as an extra charge rather than replacing existing taxes, affecting trust and acceptance.

Overall, fairness concerns are seen as more critical than potential environmental or economic benefits when it comes to the acceptance of road pricing.

B1

The interviewee indicates that perceived fairness significantly impacts the acceptance of a pricing scheme in the Netherlands. They explain that for a pricing scheme to gain societal acceptance, it must be clearly explained as fair and beneficial to the country and its citizens. People need to believe that the system treats 95% of Dutch people fairly and that the overall result will benefit the country. Additionally, the system must be affordable, feasible, and not overly complex. Broad support and political feasibility are crucial, and the sense of urgency regarding issues like traffic congestion and accessibility can also influence acceptance.

A4

The interviewee explains that perceived fairness significantly impacts the acceptance of a pricing scheme in the Netherlands in the following ways:

- Resistance Due to Perceived Inequity: If people perceive the pricing scheme as unfair, particularly if it disrupts their established cost structures or disproportionately affects certain groups, they are likely to resist it. This resistance is especially strong among those who have optimized their lives based on the current costs of car ownership and usage.
- Impact on Vulnerable Groups: The perception that vulnerable groups, such as those living far from work or with no alternatives to driving, will be disproportionately affected can lead to significant opposition. People are concerned about the fairness of imposing additional costs on those who are already at a disadvantage.
- Transparency and Understanding: Acceptance is higher when the pricing scheme is transparent and easy to understand. If people know exactly what they are paying for and see the direct benefits, they are more likely to accept the scheme.
- Gradual Implementation: Introducing the scheme gradually can help mitigate resistance by allowing people time to adjust their behavior and cost structures. This approach can make the transition smoother and more acceptable.
- Clear Communication of Benefits: Ensuring that the public understands the rationale behind the pricing scheme and how the revenue will be used to maintain the road system can increase acceptance. People are more likely to support a scheme if they see it as necessary and beneficial.
- Avoiding Overcomplication: The interviewee suggests that the scheme should not be overcomplicated by trying to address multiple issues (e.g., environmental concerns, congestion) simultaneously. Keeping the focus on maintaining the road system can make the scheme more straightforward and acceptable.

In summary, perceived fairness impacts the acceptance of a pricing scheme in the Netherlands by influencing resistance, especially among vulnerable groups, and by affecting how well the public understands and supports the scheme. Transparency, gradual implementation, clear communication of benefits, and avoiding overcomplication are key factors in gaining acceptance.

B2

They discuss several ways in which perceived fairness impacts the acceptance of a pricing scheme in the Netherlands:

- Clarity and Communication: One emphasizes that the clarity and communication of how payments are calculated and processed are crucial. If people understand the system and there are no surprises, it can positively impact their acceptance of the pricing scheme. The other adds that unambiguous and clear communication from the government is essential for gaining public trust and acceptance.
- Complexity of the System: They both agree that the complexity of the system can affect acceptance. A more complicated system, with variable costs based on location or time of day, can be perceived as less fair and harder for people to estimate their costs. This complexity can lead to lower acceptance.
- Impact of Additional Levies: One mentions that if people receive unexpected additional levies due to driving more than planned, it can negatively impact their trust and acceptance of the

system. Ensuring that the processing speed is high enough to avoid backlogs and surprises is important for maintaining public confidence.

- Consideration of Personal Circumstances: They highlight that personal circumstances, such as income, location, and the necessity to drive, can influence perceptions of fairness. If the system is perceived to unfairly impact certain groups, it can lead to lower acceptance. For example, individuals who need to drive long distances for work or those living in areas with higher costs might see the system as less fair.
- Distribution of Revenues: Although not directly linked to specific expenditures in the Netherlands, they discuss that if revenues from road pricing were used for purposes that people support, such as funding public transport, it could positively impact acceptance. Conversely, if linked to unpopular expenditures, it could reduce acceptance.
- Principles of Justice: They mention using principles such as sufficientarianism, utilitarianism, and egalitarianism to evaluate fairness. Ensuring that the policy aligns with these principles can help in gaining public acceptance by demonstrating that the policy is just and equitable.
- Political Influence and Decision-Making: One points out that while they conduct thorough evaluations and provide recommendations, the final decisions are made by politicians. The acceptance of the pricing scheme can be influenced by how well politicians communicate and justify their decisions to the public.

Overall, they highlight that perceived fairness significantly impacts the acceptance of a pricing scheme in the Netherlands. Clear communication, system simplicity, consideration of personal circumstances, and alignment with principles of justice are key factors in gaining public trust and acceptance.

B3
The interviewee explains that perceived fairness is a crucial factor in the acceptance of a pricing scheme in the Netherlands. If people perceive the system as unfair, they are less likely to support it. They emphasize that fairness is a very important part of the acceptance process. Specifically, they states:
- Perceived Unfairness: If people think the system is unfair, they will not want it. This lack of support can significantly hinder the implementation and success of the pricing scheme.
- Target Groups: If certain target groups are seen as losers under the scheme, while others benefit, this can negatively impact acceptance. For example, if frequent drivers feel they are unfairly burdened, they are likely to oppose the system.
- Balancing Benefits and Costs: The system needs to balance the benefits and costs in a way that is perceived as fair by the majority. If the perceived benefits, such as reduced congestion or environmental improvements, do not outweigh the perceived costs, acceptance will be low.

In summary, the interviewee highlights that ensuring the perceived fairness of a road pricing scheme is essential for gaining public acceptance in the Netherlands. If the public views the system as equitable and just, they are more likely to support its implementation.

What impact does revenue redistribution have on acceptance and fairness?
A1
According to the interview, revenue redistribution significantly impacts both the acceptance and perceived fairness of a road pricing scheme. They explain that public acceptance of road pricing is much higher when people see the benefits of the revenues for themselves. If the revenues are reinvested in ways that directly benefit the public, such as improving public transport, road infrastructure, or lowering existing car taxes, it can enhance the perceived fairness and acceptance of the scheme.

For example, investing the revenues in public transport might convince car users that others will switch to transit, thereby freeing up road space for them. Alternatively, lowering existing car taxes might directly benefit car users. These approaches resonate with people's sense of fairness and

reinforce public support.

In summary, the way revenues from road pricing are redistributed plays a crucial role in influencing public acceptance and perceived fairness. Ensuring that the revenues are used in ways that provide tangible benefits to the public can significantly enhance the acceptance and fairness of the pricing scheme.

A2
According to the interview, revenue redistribution has a significant impact on both the acceptance and perceived fairness of a road pricing scheme. The following points were mentioned:
- Increased Acceptance: If revenues from road pricing are redistributed in a way that benefits those who pay, acceptance of the scheme is likely to increase. For example, compensating specific groups that lose out due to road pricing can help improve acceptance.
- Fairness Perception: The way revenues are redistributed can influence how fair the system feels. For instance, using revenues to lower or abolish motor vehicle taxes or investing in public transport to make it cheaper can enhance the perception of fairness.
- Political Viability: Significant compensation might help increase acceptance enough to make the pricing scheme politically viable, although full compensation is not possible.
- Sector-Specific Investments: Investing in public transport or road expansions within the transport sector could help with acceptance, although such investments often have a poor cost-benefit ratio and might not always be the most efficient use of funds.

Overall, effective revenue redistribution can play a crucial role in improving both the acceptance and perceived fairness of a road pricing scheme.

A3
Public acceptance of revenue allocation in a pricing scheme varies depending on how the funds are used. Allocating revenues to the transport system, particularly to benefit motorists, tends to be more acceptable than directing them toward public transport. For instance, replacing the MRB with a per-kilometer charge—designed to offset the lost MRB income—effectively reallocates revenue by abolishing the MRB. Studies have examined different uses of these proceeds, such as funding road projects in Scandinavian countries or public transport initiatives like London's congestion charge. Findings suggest that people generally prefer revenues to be reinvested in transport rather than being absorbed into general government funds.

B1
The interviewee explains that the impact of revenue redistribution on acceptance and fairness depends on how the funds are allocated. They note that if revenue from road pricing is reinvested in making the logistics sector more sustainable, as with the truck toll system, it can help gain industry support. Allocating funds to maintain affordability, build new roads, or invest in public transport might enhance perceived fairness and support among the public. However, if road pricing replaces existing tax systems, there could be significant budgetary challenges, which might affect acceptance and perceived fairness.

A4
The interviewee explains that revenue redistribution can have a significant impact on both the acceptance and perceived fairness of a pricing scheme in the following ways:
- Transparency and Legitimacy: If the revenue generated from the pricing scheme is transparently used to maintain the road system, it can enhance the perceived fairness and legitimacy of the scheme. People are more likely to accept the scheme if they understand that their payments are directly contributing to the upkeep of the infrastructure they use.
- Targeted Redistribution: Redistribution of revenue to fund public goods such as footpaths, bike lanes, and public transport can increase acceptance, especially in urban areas where

these amenities are more valued. However, this may create tension in rural areas where such amenities are less relevant.

- Regional Variations: Allowing regional variations in how the revenue is used, similar to provincial surcharges on road tax, can address local needs and preferences. This approach can make the scheme more acceptable by aligning it with regional priorities and ensuring that the benefits are felt locally.
- Cross-Subsidization: Redistribution that includes cross-subsidization, where wealthier regions or individuals subsidize poorer ones, can be seen as fairer and more equitable. For example, revenue from urban areas could help maintain roads in rural areas, benefiting those who might otherwise be underserved.
- Public Perception of Fairness: The way revenue is redistributed can influence public perception of fairness. If people see that the funds are being used for purposes they deem important and beneficial, such as improving accessibility and maintaining infrastructure, they are more likely to view the scheme as fair and support it.
- Avoiding Misuse of Funds: Ensuring that the revenue is not used for unrelated purposes or seen as a general tax can prevent negative perceptions. People are more likely to accept the scheme if they believe the funds are being used appropriately and not diverted to other areas.

In summary, the interviewee believes that revenue redistribution can positively impact the acceptance and perceived fairness of a pricing scheme by ensuring transparency, targeting funds to public goods, allowing regional variations, incorporating cross-subsidization, aligning with public priorities, and avoiding misuse of funds.

B2

They discuss the impact of revenue redistribution on acceptance and fairness in the following ways:

- Linking Revenues to Specific Expenditures: One mentions that in the Netherlands, budget rules typically separate revenue from specific expenditures, meaning that revenues from road pricing are not directly linked to particular spending items. However, they acknowledge that if revenues were linked to purposes that people support, such as funding public transport, it could positively impact acceptance and perceived fairness.
- Public Perception of Revenue Use: One adds that if revenues were linked to something negative or unpopular, it could decrease the perceived fairness and acceptance of the system. Conversely, if the revenue is used for purposes that the public agrees with, it could enhance the sense of fairness and acceptance.
- General Practice in the Netherlands: One reiterates that in the Netherlands, the general practice is to keep revenue and expenditure separate, and this was not included in their elaboration of the road pricing policy. Therefore, the direct impact of revenue redistribution on acceptance and fairness is not typically a consideration in Dutch policy-making.

Overall, they suggest that while revenue redistribution could potentially impact acceptance and fairness, it is not a common practice in the Netherlands to link revenues from road pricing to specific expenditures. However, they acknowledge that if such a linkage were made, it could influence public perception positively or negatively, depending on how the revenues are used.

B3

The interviewee explains that revenue redistribution has a significant impact on both the acceptance and perceived fairness of a road pricing scheme:

- Influence on Acceptance: The way revenues are redistributed can greatly influence public acceptance. People are concerned about what will be done with the money collected from the pricing scheme. If the revenues are used in a way that benefits the public, such as improving public transport or road infrastructure, it can enhance acceptance. Conversely, if the revenues are perceived to be unfairly distributed or not used for public benefit, acceptance may decrease.
- Perceived Fairness: Redistribution of revenues is closely tied to perceived fairness. For example, if the system is designed to be budget-neutral, meaning the proceeds from frequent drivers

are redistributed to infrequent drivers, it can be seen as fairer. However, if the system is used as an additional source of income without clear benefits to the motorists, it may be perceived as unfair.

- Political Considerations: The interviewee notes that decisions about revenue redistribution are highly political. Questions about who benefits and who pays are central to the debate on fairness. For instance, using revenues to subsidize public transport might be seen as fair by some, but others might view it as an unfair burden on motorists.

- System Costs: The costs of implementing and maintaining the road pricing system also play a role. If these costs are high and are passed on to motorists, it could be seen as unfair. Alternatively, if the costs are covered by general taxes, non-motorists might view it as unfair.

- In summary, the interviewee highlights that revenue redistribution is a critical factor in determining both the acceptance and perceived fairness of a road pricing scheme. How the revenues are used and who benefits from them are key considerations that can influence public support and perceptions of equity.

E: Survey Questions

The (English) survey questions can be found below, with a description of the question type. The lines indicate sections, users would have to finish one section to go to the following.

Voor Nederlands, kies de taal in de hoek rechtsboven.

Dear Participant,

Thank you for taking the time to complete this survey. This survey explores **how the Dutch public perceives the fairness and acceptance of various forms of road pricing, with particular attention to how the revenues are redistributed**. Your responses will help provide valuable insights into public opinions on this topic and contribute to a better understanding for policymakers. The survey will take approximately 7 minutes to complete.

Your participation is **anonymous and voluntary**, and the data will only be used for research purposes. If you have any questions or comments regarding this survey, please get in touch with **me.**

Thank you very much for your participation!

Kind regards,
Emma Dijkstra
TU Delft

1.   I agree that my data is only used for this research
o   Yes

_____

Fairness can mean different things to different people. In this survey, we're exploring how fairness is perceived in the context of road pricing. But before we dive into that, we'd like to know: what does fairness mean to you? How would you (**briefly**) describe fairness in your own words?
2.   Fairness means to me …
o   Open question

_____

Road pricing is a system where drivers pay for their road use. Instead of the annual road tax (motor vehicle tax - MRB) currently in place, motorists would pay taxes based on their car usage. The amount of tax may depend on factors such as the number of kilometers driven, the time of day, or the vehicle's emissions. Road pricing aims to distribute taxes more fairly, reduce traffic congestion, and contribute to a cleaner environment. There are various forms of road pricing, which are briefly explained below, along with the current Dutch road tax system:
1.   *Distance-based pricing*
You would pay based on the number of kilometers you would drive. The more you drive, the higher the costs.
2.   *Emission-based pricing*
You would pay based on how much your vehicle would contribute to air pollution (an estimation of emissions of CO and other harmful substances). Vehicles with lower emissions pay less.
3.   *Congestion charge*

You would pay extra when driving during peak hours or in areas with heavy traffic, aiming to reduce congestion.

4.   Toll roads

You would pay for the use of specific roads or tunnels. This system is similar to toll roads in other countries.

5.   Cordon pricing

You would pay to enter a specific area, such as a city center, to reduce traffic and pollution in that area.

6.   Current road tax system (fixed rate)

If you own a personal vehicle, you pay a fixed road tax based on its weight and type, regardless of how often or where you drive. This system is currently in place in the Netherlands.

3.   I think road pricing schemes are fair overall (independently of which variant would be implemented).

o   Scale 1-5

o   1 = Strongly disagree

o   5 = Strongly agree
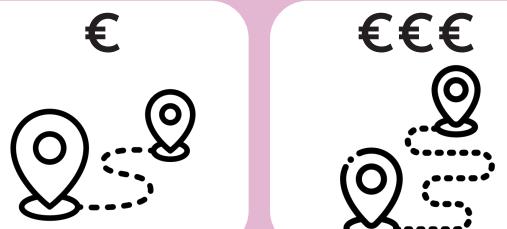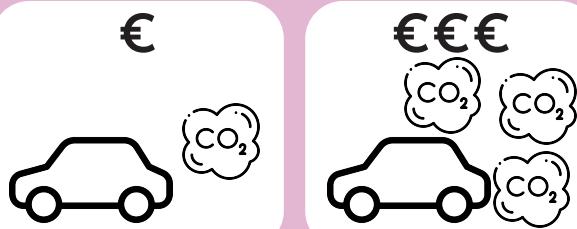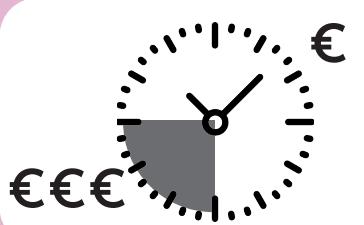
Figure 24: Visual explanation of road pricing policies in Dutch & English.

4.   It is fair to charge road users based on how much they use the road. (Distance-based pricing)
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

5.   It is fair to charge road users based on the emissions their vehicles produce. (Emission-based pricing)
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

6.   It is fair to charge road users based on what time they use the road. (Congestion charge)
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

7.   It is fair to charge road users based on where they use the road. (Toll roads)
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

8.   It is fair to charge road users based on which zone/area they use the road. (Cordon pricing)
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

9.   The current system is fair. (Fixed rate based on vehicle weight and type)
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

10.   Please rank the following types of road pricing based on how fair you find them, with 1 being the most fair and 6 being the least fair.
o   Ranking question, participants could move the boxes with pricing types in their preferred order

11.   Do you think combining different road pricing schemes could make the system fairer? If yes, which combinations and why? (optional)
o   Open question

12.   You can further elaborate on your previous answers here (optional)
o   Open question

_____

13.   I would support the implementation of road pricing in the Netherlands, independently of which variant would be implemented.
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

14.   Good communication about how road pricing works would make me more likely to support it.
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

15.   I think a road pricing system would impact me personally in a positive way.
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

16.   You can further elaborate on your previous answers here (optional)
o   Open question

_____

17.   I am more likely to support a road pricing scheme if it transparent in how the revenue is spent
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

18.   I am more likely to support road pricing if the revenue is used to reduce car taxes
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

19.   I am more likely to support road pricing if the revenue funds public transport improvements
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

20.   I am more likely to support road pricing if the revenue funds the improvement of road infrastructure
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

21.   I am more likely to support road pricing if the revenue is used for other public resources, such as healthcare, defense, or education
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

22.   Please rank the following ways of redistributing road pricing revenue based on how fair you find them, with 1 being the most fair and 4 being the least fair.
o   Ranking question, participants could move the boxes with allocation types in their preferred order

23.   You can elaborate on your previous answers here (optional)
o   Open question

---

24.   Road pricing would unfairly impact people with no viable alternatives to driving (e.g., poor access to public transport)
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

25.   I am concerned that road pricing would not actually provide benefits (e.g., reducing traffic congestion, pollution)
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

26.   The benefits of road pricing (e.g., less congestion, cleaner air) outweigh the potential downsides (e.g., financial burden)
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

27.   Road pricing would make me more aware of my travel behavior and consider alternatives (e.g., public transport, carpooling, or cycling).
o   Scale 1-5
o   1 = Strongly disagree
o   5 = Strongly agree

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28.   Do you have any thoughts or comments about the introduction of a road pricing scheme in the Netherlands? If yes, please feel free to share (optional)
o   Open question

29.   Is there anything else you would like to share regarding fairness, acceptance, or the impacts of road pricing? (optional)
o   Open question

30.   Do you have any suggestions or recommendations for policymakers that are considering implementing road pricing? (optional)
o   Open question

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31.   What is your age group?
o   <18
o   18-24
o   25-34
o   35-44
o   45-54
o   55-64
o   65+
o   Prefer not to say

32.   What is your gender?
o   Female
o   Male
o   Non-binary/Other
o   Prefer not to say

33.   What is your current employment status?
o   Student
o   Employed full-time
o   Employed part-time
o   Entrepreneur
o   Unemployed
o   Retired
o   Prefer not to say

34.   What is your personal net annual income?
o   Less than 10.000
o   10.001-20.000
o   20.001-30.000
o   30.001-40.000
o   40.001-50.000
o   50.001-100.000
o   100.001-200.000
o   >200.000
o   Prefer not to say

35.   Do you own (or lease) a private car?
o   Yes
o   No
o   Prefer not to say

36.   If previous question answered yes: What type of car is this?
o   The car is registered to my name
o   It's a private lease vehicle
o   Prefer not to say

37.   How many kilometers did this car drive in 2024? If you don't know the exact number, please estimate as accurately as possible.
o   <5.000 km
o   5.000-10.000 km
o   10.001-15.000 km
o   15.001-20.000 km
o   20.001-25.000 km
o   25.001-30.000 km
o   >30.000 km
o   Prefer not to say/I really don't know

38.   If question 35 answered no/prefer not to say: Did you use any of the following services/ cars in 2024? (Select all that apply)
o   I have a business lease car
o   Shared car services (e.g., MyWheels, GreenWheels)
o   Another person in my household owns a car, which I also make use of

o   I don't drive
o   Prefer not to say

39.   Which mode of transport accounts for your greatest distance (in kilometers) on an average week?
o   Car
o   Public transportation
o   Bicycle
o   Walking
o   Other (user could provide answer)

40.   Do you currently live in the Netherlands? If not, please state your country of residence.
o   Yes
o   Other (user could provide answer)

41.   Do you hold Dutch nationality?
o   Yes
o   No
o   Prefer not to say

42.   If previous question was no: What is your nationality? (You can also answer "Prefer not to say")
o   Open question

43.   How would you describe the area you live in?
o   Urban (dense population, good public transport options)
o   Suburban (residential area near a city, moderate public transport options)
o   Rural (low population density, limited public transport options)

Thank you very much for completing my questionnaire! If you have any questions or comments about this survey, please feel free to contact me at e.a.dijkstra@student.tudelft.nl.

F: Survey Analysis

Hypothesis/ statement	Source (literature, interviews, own reasoning)	Type of test	Test result	Significance value. A value is considered significant when it is lower than 0.05. (*) assumes significance when lower than 0.01
People who do not own a car (are more likely to) find a new road pricing policy fair, disregarding road pricing policy type.	Own reasoning	Mann-Whitney	The results show that non-car owners have a mean rank of 56.83, and car owners have a mean rank of 48.63. A higher score means that the group perceives it more fair.	0.133
There are differences in perceived fairness in the various road pricing policy types between non-car owners and car owners.	Own reasoning	Mann-Whitney	The following mean ranks were observed for non-car owners and car owners, respectively (higher mean rank = higher perceived fairness): Distance based: 58.56 vs. 46.08 Emission-based: 59.72 vs. 44.38 Congestion pricing: 60.09 vs. 43.85 Toll roads: 56.87 vs. 48.57 Cordon pricing: 57.47 vs. 47.69 Current system: 51.18 vs. 56.90	Distance-based: 0.020 Emission-based: 0.007 Congestion pricing: 0.006 Toll roads: 0.155 Cordon pricing: 0.097 Current system: 0.332
Rural residents find road pricing less fair.	Own reasoning	Kruskal-Wallis	The mean ranks are as follows: urban residents, 54.57; suburban residents, 54.69; rural residents, 46.50. The lower mean rank indeed indicates that rural residents perceive road pricing as less fair.	0.730

Table 9: Overview of statistical tests (continued on the following pages).

Hypothesis/ statement	Source (literature, interviews, own reasoning)	Type of test	Test result	Significance value. A value is considered significant when it is lower than 0.05. (*) assumes significance when lower than 0.01
A residential area influences whether someone has a preference for the revenue to be allocated towards tax reductions.	Own reasoning	Kruskal-Wallis	The mean ranks for the various residential types are as follows: urban residents, 60.99; suburban residents, 42.19; and rural residents, 42.75. Here, lower values indicate preferences, as the revenue allocation methods were ranked 1-4, with 1 being the greatest preference.	0.008, but only for differences between urban and suburban residents, as indicated by the pairwise comparisons used in the post-hoc analysis.
A residential area influences the preference for different types of road pricing.	Own reasoning	Kruskal-Wallis	As 18 mean ranks are provided in the analysis (three residential areas and six road pricing variations), only pricing policies with significant differences are shown. Emission-based: urban, 47.98; suburban, 67.31; rural, 51.19.\n\nCordon pricing: urban, 49.11; suburban, 57.83; rural, 79.63.\n\nCurrent system: urban, 60.16; suburban, 41.36; rural, 52.94.\n\nAgain, a lower mean rank indicates a higher preference.	Emission-based: 0.010 between urban and suburban.\n\nCordon pricing: 0.018 between urban and rural.\n\nCurrent system: 0.012 between urban and suburban.\n\nOther pricing types show no significant variation by residential area.

Hypothesis/ statement	Source (literature, interviews, own reasoning)	Type of test	Test result	Significance value. A value is considered significant when it is lower than 0.05. (*) assumes significance when lower than 0.01
Car ownership influences the preference for revenue allocation methods.	Own reasoning, interviews (B3) partially (regarding public transport investment)	Kruskal-Wallis	The following mean ranks were observed for non-car owners and car owners, respectively: Public transport investments: 46.27 vs. 64.09. Road infrastructure investments: 55.94 vs. 49.92. Tax reductions: 58.90 vs. 45.59. Investments in other public resources: 50.32 vs. 58.16	Public transport investments: 0.002. Road infrastructure investments: 0.299. Tax reductions: 0.024. Other public resources: 0.151
Low-income groups are affected more because they are older and have more children, and hence have a more difficult time switching to another mode of transport.	Literature (Craik & Balakrishnan, 2022)	Spearman correlation	Here, three things were tested: Low-income groups are older. Spearman's rho = 0.655, indicating that older individuals tend to have higher incomes. Low-income groups are less likely to consider travel alternatives. Rho = -0.071, suggesting that as income increases, people are more likely to consider alternatives when traveling. Younger people are less likely to consider travel alternatives. Rho = 0.095, indicating that as people age, they are more likely to consider travel alternatives.	0.001* 0.465 0.331

Hypothesis/ statement	Source (literature, interviews, own reasoning)	Type of test	Test result	Significance value. A value is considered significant when it is lower than 0.05. (*) assumes significance when lower than 0.01
The Dutch public has a negative image regarding road pricing policies.	Literature (Ardıç et al., 2015; Tillema et al., 2012).	Descriptives	Four statements regarding the pros and cons were presented with a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The means of these statements will be presented below: Road pricing would have unfair benefits for people who do not have feasible alternatives for driving: 3.48. I am afraid road pricing would not be beneficial: 2.57. The benefits of road pricing (e.g., less congestion, cleaner air) outweigh the potential negative effects (e.g., financial burden): 3.58. Road pricing would make me more aware of my travel behavior and make me consider travel alternatives: 3.56	
Good communication of the road pricing policy influences acceptance.	Literature (Higgins et al., 2010; Langmyhr, 1997; Sørensen et al., 2013) Interviews (B2, A4)	Descriptives	"Good communication about how road pricing works would make me more likely to support it." Respondents also answered this with a Likert scale (1 = strongly disagree, 5 = strongly agree). The mean score was 4.19, showing that most respondents agreed with the statement.	

Hypothesis/ statement	Source (literature, interviews, own reasoning)	Type of test	Test result	Significance value. A value is considered significant when it is lower than 0.05. (*) assumes significance when lower than 0.01
People are more likely to accept a pricing scheme if they perceive that it does not personally disadvantage them.	Interviews (A2)	Spearman correlation	The correlation was analyzed between the statements "I would support road pricing, disregarding pricing type" and "I think road pricing would positively affect me." Spearman's rho: 0.465, this suggests a moderate positive correlation.	<0.001*
Acceptance of a pricing scheme is higher when the scheme is transparent and clear.	Interviews (A4)	Spearman correlation	The correlation was analyzed between the statements "I would support road pricing, disregarding pricing type" and "Good communication about how road pricing works would make me more likely to support it." Spearman's rho: 0.562, this suggests a moderate positive correlation.	<0.001*
Rural regions may feel unfairly burdened due to limited alternatives.	Interviews (B3, B1)	Kruskal-Wallis	An analysis was done to see how the various regions scored the statement, "Road pricing would have unfair benefits for people who do not have feasible alternatives for driving." With the following mean ranks (higher = agree more): Urban, 52.28; suburban, 60.28; rural, 43.31. This indicates that rural residents agree the least with the statement, which contradicts the findings from the interviews.	0.261

Hypothesis/ statement	Source (literature, interviews, own reasoning)	Type of test	Test result	Significance value. A value is considered significant when it is lower than 0.05. (*) assumes significance when lower than 0.01
Frequent drivers may feel unfairly charged under a flat kilometer fee.	Interviews (A2)	Kruskal-Wallis	It was assumed that the flat kilometer fee refers to distance-based pricing. Here, it was examined how various groups felt about the statement, "It is fair to charge road users based on how much they use the road (distance-based pricing)." The groups were defined based on which mode of transport they use the most in an average week (in kilometers). The mean ranks are as follows (higher rank = agree more): Car: 48.97 Public transport: 58.62 Bicycle: 52.14 These results show that frequent drivers agree the least with the statement compared to other mode travelers.	0.309
Congestion pricing can disproportionately impact low-income groups.	Interviews (A2)	Kruskal-Wallis	The various income level groups ranked the following statement: "Road pricing would have unfair benefits for people who do not have feasible alternatives for driving." They scored it from 1 (strongly disagree) to 5 (strongly agree). The group agreeing the most (mean rank: 68.42) was in the yearly income range of €30,001 – €40,000. The lowest mean rank of 28.88 belongs to the group with an income between €100,001 and €200,000.	0.372

Hypothesis/ statement	Source (literature, interviews, own reasoning)	Type of test	Test result	Significance value. A value is considered significant when it is lower than 0.05. (*) assumes significance when lower than 0.01
Many resist change, as their lives are structured around current cost systems.	Interviews (A4)	Spearman correlation	The correlation between the statements "The current pricing system is fair" and "Road pricing would make me more aware of my travel behavior and make me consider travel alternatives" was analyzed. Spearman's rho = -0.161, indicating that people who find the current system fair are less likely to consider alternatives, which aligns with the statement from the interviewee.	0.097
People perceive a road pricing policy more fair when they believe they are not worse off.	Interviews (A1)	Spearman correlation	The correlation was analyzed between the statements "I would support road pricing, disregarding pricing type" and "I think road pricing would positively affect me." Spearman's rho = 0.215	0.026
Clear communication helps people perceive the policy as more fair.	Interviews (B2)	Spearman correlation	The correlation was analyzed between the statements "I would support road pricing, disregarding pricing type" and "Good communication about how road pricing works would make me more likely to support it." Spearman's rho = 0.267	0.006*
People who find road pricing policy fair, are more likely to accept it.	Literature (Huber et al., 2019; Van Wee & Mouter, 2021), interviews (B1, B3)	Spearman correlation	The correlation was analyzed between the statements "I would support road pricing, disregarding pricing type" and "I would support a road pricing policy in the Netherlands, disregarding pricing type." Spearman's rho = 0.398	<0.001*

Fairness in Road Pricing Policies

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Abstract

Road pricing is increasingly proposed as a policy tool to address urban challenges such as congestion, pollution, and infrastructure funding. However, public acceptance of such policies often hinges on perceptions of fairness, particularly regarding cost distribution and revenue allocation. This study investigates how Dutch citizens perceive the fairness and acceptability of road pricing schemes, with a focus on revenue redistribution strategies. The knowledge gap lies in the limited understanding of how the Dutch public perceives the fairness and acceptability of such policies, particularly concerning fairness dimensions, revenue allocation strategies, and socio-demographic influences. Using a three-stage methodology— literature review, expert interviews, and a public survey—this research explores key fairness dimensions, including procedural, distributive, horizontal, vertical, and geographical equity. Findings reveal that fairness perceptions are shaped by factors such as car ownership, residential context, and transparency in communication. Distance-based and emission-based pricing models are generally perceived as fairest, particularly by non-car owners. Preferences for revenue use, such as reinvestment in public transport or tax reductions, significantly influence acceptance. Car owners tend to perceive road pricing policies, including distance-based, emission-based, and congestion pricing, as less fair compared to non-car owners, who generally view these schemes more positively. Moreover, non-car owners show stronger support for allocating revenues to public transport and tax reductions, while car owners prefer investments in road infrastructure. The study highlights the importance of transparent communication, inclusive policy design, and visible societal benefits in fostering public support. By developing a conceptual model, this research provides theoretical insights and practical recommendations for equitable and publicly acceptable road pricing policies in the Netherlands and beyond.

Keywords: Fairness, road pricing, revenue allocation, public acceptance, equity

1. Introduction

Urban areas worldwide are increasingly challenged by congestion, pollution, traffic accidents, rising infrastructure costs, and insufficient public transit funding. Road pricing is often proposed as a policy tool to address these issues. It can regulate road use by influencing travel behavior, generate revenues for infrastructure and public transport, and serve as an economic signal for investment decisions (Lindsey, 2012). By reducing congestion, emissions, and accident rates, road pricing is intended to improve transport efficiency and societal well-being (De Palma et al., 2006).

However, the success of such policies hinges not only on their effectiveness but also on public acceptance, especially with perceived fairness. Fairness concerns, particularly the distribution of costs and benefits across societal groups, are central to debates on road pricing. Policymakers increasingly emphasize the need for research on fairness to inform socially acceptable transport policies (Van Wee & Mouter, 2021). Fairness is a multidimensional and contested concept, making it difficult to evaluate within the context of road pricing.

A key factor that may shape fairness perceptions is the allocation of revenues generated from pricing schemes. How these revenues are redistributed—whether toward public transport, infrastructure, or social services—can significantly affect public attitudes toward road pricing.

This research explores how the Dutch public perceives the fairness of road pricing schemes, with a particular focus on the role of revenue allocation in shaping public support.

1.1 Problem Description and Objectives

Road pricing is increasingly viewed as a promising tool to address congestion, pollution, and infrastructure funding

challenges. While countries like Singapore, Sweden, and the UK have implemented it with varying degrees of success, public resistance remains a significant barrier elsewhere. In the Netherlands, national road pricing proposals have repeatedly stalled—largely due to concerns about fairness. Dutch citizens evaluate fairness not only in terms of personal cost but also in relation to broader societal considerations such as how revenues are used and regional equity.

Fairness is a complex, multidimensional concept encompassing procedural fairness (how decisions are made) and distributive fairness (how costs and benefits are shared). This study investigates how the Dutch public perceives the fairness and acceptability of road pricing, focusing particularly on the role of revenue allocation. It explores different equity dimensions, including opportunity equity (inclusive decision-making), horizontal equity (equal treatment of similar users), vertical equity (recognition of different needs), and geographical equity (variations in regional impact). Each of these dimensions poses distinct challenges for designing equitable policies.

A key focus of the research is understanding how various revenue redistribution strategies—such as investments in public transport or healthcare—affect public perceptions of fairness. By combining expert interviews with a public survey, the study aims to provide both theoretical insights and actionable recommendations for policymakers.

The scientific gap addressed by this research lies in the limited understanding of how the Dutch public perceives these fairness dimensions, revenue allocation strategies, and the influence of socio-demographic factors. Furthermore, the study considers underexplored elements such as the role of communication, public misconceptions, and psychological factors like status quo bias in shaping acceptance.

Ultimately, the findings aim to inform the development of road pricing policies that are not only effective and sustainable but also publicly acceptable, by enhancing perceived fairness, transparency, and trust in the decision-making process.

1.2 Research Scope

This study investigates how Dutch citizens perceive the fairness and acceptance of road pricing, focusing on the influence of revenue allocation strategies. Using a three-stage approach—literature review, expert interviews, and a public survey—it explores key fairness dimensions. While centered on the Netherlands, the research includes international insights. Rather than examining technical efficiency, the study emphasizes public attitudes, aiming to inform the design of equitable, publicly acceptable road pricing policies.

2. Methodology

This research adopts a multi-stage methodology to investigate public perceptions of fairness and acceptance of road pricing policies in the Netherlands. The approach comprises three interconnected stages: a literature review, semi-structured interviews, and a survey. This structure enables a comprehensive exploration of the topic by combining theoretical insights, expert perspectives, and empirical evidence from the general public. Each phase builds upon the findings of the previous one, allowing for a systematic development and refinement of the conceptual model (see Figure 1) that underpins the study.

By integrating qualitative and quantitative methods, the study ensures both depth and breadth of understanding. The literature review establishes a theoretical foundation and identifies key themes and gaps, while the interviews add practical perspectives and contextual nuance. Finally, the survey allows these insights to be tested and validated across a broader population, ensuring that the conclusions drawn reflect a diverse range of opinions and experiences.

2.1 Stage 1: Literature Review

The first stage of the research consists of an extensive literature review focused on concepts of fairness and acceptance in road pricing schemes. This review draws upon academic literature, policy reports, and empirical studies related to transport equity, behavioral responses to pricing, and evaluation methodologies in mobility and infrastructure policy.

The literature review aimed to establish a foundational understanding of how fairness is defined, measured, and applied in transport policy, particularly in road pricing schemes such as tolling, congestion charges, and emissions-based pricing. It also sought to identify knowledge gaps, inform hypotheses about the link between fairness and public acceptance, and develop an initial conceptual model to guide the subsequent research stages.

The literature review is organized thematically to address these objectives. Topics include dimensions of fairness (e.g., distributive, procedural, horizontal, vertical, and geographical), methods of policy evaluation, and international case studies. These insights laid the groundwork for interview question development and informed the design of the survey instrument.

2.2 Stage 2: Semi-Structured Interviews

The second phase of the research involved conducting semi-structured interviews with selected stakeholders, including transportation experts and policymakers. These interviews aimed to supplement the theoretical insights from the literature with real-world perspectives, allowing for a more nuanced understanding of fairness in Dutch road pricing policy discussions.

The interviews aimed to explore how fairness issues identified in the literature apply to the Dutch context and to gather expert insights on adapting existing evaluation

frameworks for more equitable policy assessments. They also provided stakeholder perspectives on revenue redistribution strategies and helped refine the conceptual model by validating or revising hypothesized relationships between fairness and public acceptance.

The semi-structured format allowed interviewees to provide detailed, personalized insights while ensuring consistency across participants. The interview guide focused on four key areas:

1. **General Experience**: Participants described their background with road pricing and shared expectations about its potential implementation in the Netherlands.
2. **Fairness in Policy Design**: Questions explored which social groups might be impacted unfairly by road pricing and how revenue redistribution might address or exacerbate equity concerns.
3. **Evaluation Frameworks**: Experts critiqued existing frameworks and discussed ways to improve the measurement of fairness in transport policy.
4. **Public Perceptions and Acceptance**: Interviewees shared their views on how the Dutch public perceives road pricing and the degree to which fairness influences support for these policies.

A total of eight interviews were conducted—four with academics and three with policymakers from the Ministry of Infrastructure and Water Management. Interviewees were anonymized and referred to by coded identifiers (1–4 for academics, 5–7 for policymakers). All participants signed consent forms, and interviews were recorded and transcribed for analysis. Themes were identified using a coding approach aligned with the research sub-questions, and the insights gained informed the design and content of the survey.

2.3 Stage 3: Survey

The third and final research phase involved administering a structured survey to a broad sample of Dutch residents. The survey was developed based on insights from the literature review and interviews and aimed to evaluate public attitudes toward fairness and acceptance of various road pricing strategies.

The survey aimed to evaluate how perceived fairness influences public acceptance of road pricing policies and to identify which revenue redistribution strategies are considered fair. It also tested and refined the conceptual model by examining links between socio-demographic factors, fairness perceptions, and the acceptability of different road pricing schemes.

The survey was open to all residents of the Netherlands, without restrictions based on demographic characteristics. Given the time and resource constraints, the sample was expected to be non-representative, with potential bias. To maximize reach, participants were recruited using multiple methods, including social media (LinkedIn, Instagram, WhatsApp), flyers with QR codes in public spaces, and the research-sharing platform SurveyCircle. No incentives were offered, in part to respect privacy and avoid collecting unnecessary personal information.

The survey consisted of a mixture of open-ended, Likert scale, ranking, and multiple-choice questions. These generated a range of data types, including nominal and ordinal data, suitable for non-parametric analysis. The survey was structured into thematic sections:

- **Introduction to Road Pricing**: Participants were briefed on five common pricing schemes—distance-based, emission-based, congestion pricing, toll roads, and cordon pricing.
- **Perceptions of Fairness**: Participants evaluated each scheme's fairness using Likert scales and ranking tasks.
- **General Acceptance**: Respondents indicated their acceptance of the schemes and rated proposed revenue allocation strategies based on perceived fairness.
- **Perceived Benefits and Drawbacks**: Participants assessed the societal and personal implications of implementing road pricing.
- **Open-Ended Feedback**: A section invited participants to provide additional qualitative insights.
- **Socio-Demographic Information**: Data were collected on age, gender, income, education, location, and car ownership to explore potential correlations with fairness and acceptance.

Survey data were analyzed using SPSS. Key statistical tests included the Mann-Whitney U test for comparing two independent groups (e.g., car owners vs. non-owners), the Kruskal-Wallis test for comparing three or more groups (e.g., urban vs. suburban vs. rural residents), and Spearman's rank correlation for exploring associations between ordinal variables (e.g., fairness perceptions and acceptance likelihood).

To ensure robust conclusions, significance thresholds were set at $p = 0.05$ for the Mann-Whitney and Kruskal-Wallis tests and at $p = 0.01$ for Spearman's correlations to reduce the likelihood of Type I errors. Where Kruskal-Wallis tests indicated significant group differences, Bonferroni-adjusted post hoc Mann-Whitney tests were applied to pinpoint specific differences.

The combination of methods ensures that the study is both empirically grounded and theoretically informed. The iterative design, where each stage refines and informs the next, contributes to a more holistic understanding of the fairness considerations shaping the public acceptance of road pricing in the Netherlands. The next chapter presents the findings from each of these research stages.

3. Results

In this section, two versions of the conceptual model will be shown. The first version is based on the results of the theoretical insights, the literature review. As there are some gaps in the model (dotted lines, assumptions), these will be further analyzed through the empirical methods (interviews and the survey). In both models, the links are referred to via A#, B#, and C#. The A represents links found in literature, B for interviews, and C for the survey results. The following subsections will explain the links that are shown in the conceptual model (Figure 1).

3.1 Theoretical Insights

This conceptual model synthesizes key determinants influencing public perceptions of fairness and acceptance in road pricing schemes, particularly within the Dutch context. It integrates theories of equity, socio-demographic influences, implementation strategies, and communication effectiveness to explain how individuals form their judgments and ultimately support or reject such policies.

At the heart of the model lies the construct of "someone's perceived fairness of road pricing", which significantly affects the acceptance of the policy (A1). As shown by Huber et al. (2019), public support is largely contingent on how fair individuals perceive a policy to be. Van Wee and Mouter (2021) further emphasize that fairness perception is a pivotal determinant in public acceptability, particularly for policies involving financial costs.

One primary driver of fairness perceptions is procedural justice (A2), which entails the fairness of the decision-making process. As Karner et al. (2020) note, participatory processes that include diverse and affected communities tend to yield policies that better address equity concerns. When the public is actively involved in the design and discussion of transport pricing mechanisms (Hsieh, 2022; Hårsman, 2001), perceived fairness is enhanced, thereby increasing public trust and acceptance.

Socio-demographic factors (A3)—such as income, age, and car ownership—mediate how road pricing impacts individuals. These characteristics influence both the individual economic and accessibility impacts and the degree to which someone views the policy as fair. For instance,
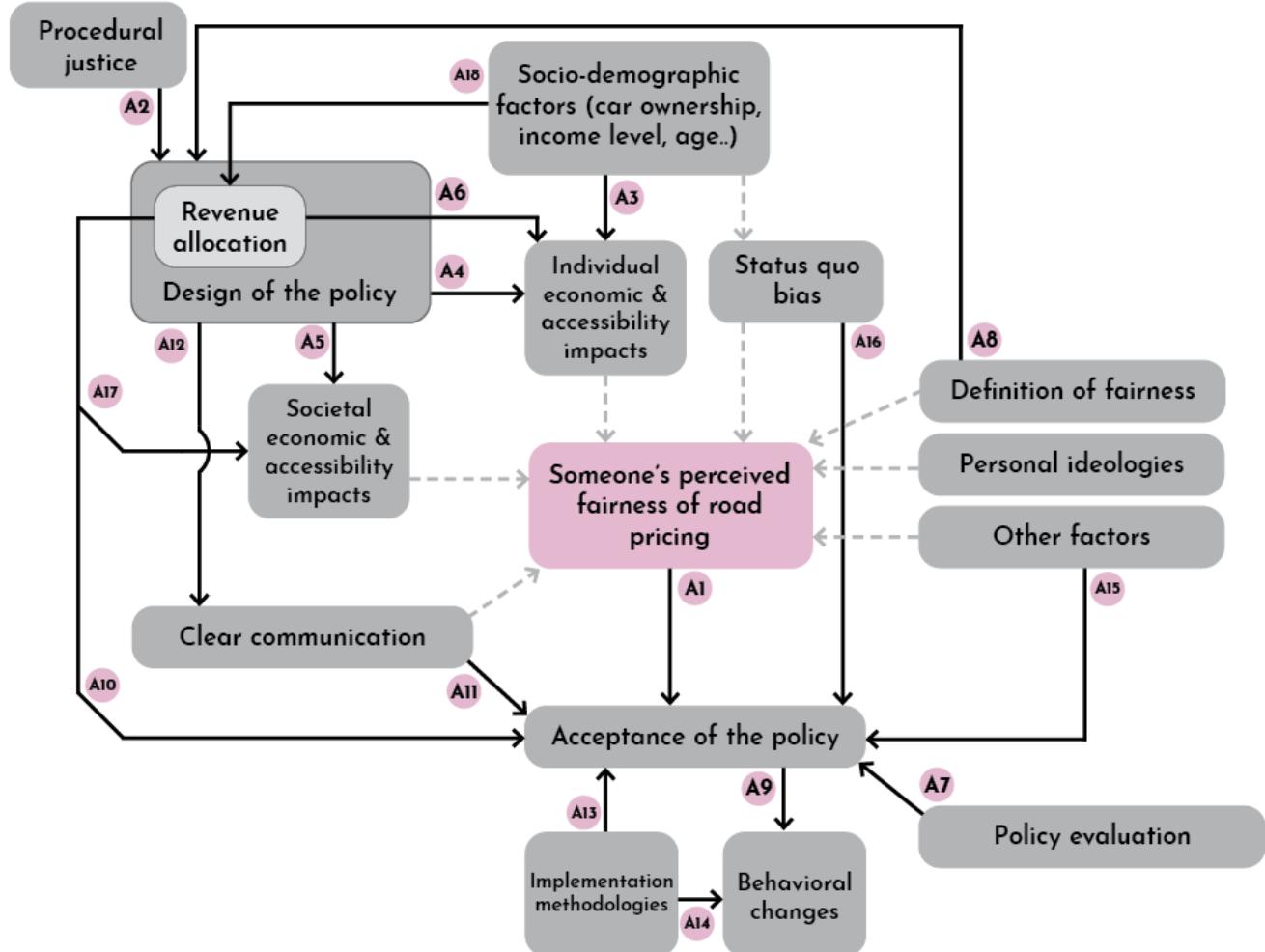

Figure 1: Conceptual model based on literature review. Dotted lines are gaps, based on assumptions.

lower-income individuals often bear a disproportionate burden from flat pricing schemes (Eliasson, 2016; Sen et al., 2022) and are less flexible in adjusting travel behavior due to fewer modal alternatives or higher dependency on car travel (Craik & Balakrishnan, 2022). Additionally, spatial factors like the location of charging zones relative to residence and work locations further complicate the equity implications (Parkhurst et al., 2006; Ecola & Light, 2009).

These socio-demographic and economic impacts feed into how people perceive the design of the policy (A4). A transport policy can be considered fair if it improves the capabilities of the most disadvantaged, aligning with principles of vertical equity (Randal et al., 2020). Such design considerations influence societal-level impacts (A5), which also affect perceptions of fairness. For example, revenue reinvestment in public transport has been shown to redistribute benefits more equitably, especially when directed toward underserved areas (Gu et al., 2018; Eliasson, 2014).

Revenue allocation (A6) plays a crucial role in determining both individual and collective perceptions of fairness. Redistribution mechanisms that benefit traditionally underserved groups, such as rural residents or low-income populations, are key to enhancing fairness (Cain & Jones, 2008; Vrtic et al., 2007; Farrell & Saleh, 2005). Without such mechanisms, road pricing risks reinforcing existing social inequalities (Ecola & Light, 2009).

The evaluation of policies (A7) also depends on how well they incorporate and balance various dimensions of equity. The framework developed by Raux and Souche (2004) underscores the importance of embedding fairness criteria early in the design phase. However, differing definitions of fairness, personal ideologies, and other contextual factors (A8) can influence individual interpretations, sometimes making it difficult to reach consensus (Pereira et al., 2016).

Once a policy is implemented, behavioral changes (A9) serve as both an outcome and a feedback loop to policy acceptance. For implementation to be successful, public commitment through meaningful dialogue and co-creation is essential (Banister, 2008). Clear communication (A10) about policy objectives, revenue usage, and expected outcomes is critical for shaping perceptions. Neutral, transparent, and problem-focused messaging helps foster legitimacy and trust (Sørensen et al., 2013; Higgins et al., 2010; Hazan et al., 2020). Misconceptions, such as seeing road pricing as just another tax, can be mitigated through effective communication (Tillema et al., 2012).

The transparency of implementation and the clarity of how equity is addressed (A12) are also essential. Demonstrating benefits across income groups and geographical areas builds trust and strengthens fairness perceptions (Higgins et al., 2010). Implementation methodologies (A13), such as trial periods or phased rollouts, allow policymakers to test assumptions, adapt to

feedback, and build legitimacy (Sørensen et al., 2013; De Palma et al., 2006).

Gradual behavioral adjustments (A14) are more likely to occur when implementation is incremental and well-communicated, ultimately leading to increased acceptance (Börjesson et al., 2016). Nevertheless, persistent concerns about privacy, cost, and system performance (A15) can undermine acceptance if not adequately addressed (Grush, 2010).

Furthermore, the model includes status quo bias (A16), which reflects resistance to change simply because people are accustomed to "free" roads. As Manville (2019) explains, this bias often overlooks the hidden inequities of current transport systems that disproportionately harm disadvantaged groups. Road pricing reforms, if properly communicated and implemented, can correct these injustices.

Finally, geographical fairness in revenue reinvestment (A17) and public preferences for specific forms of compensation (A18) further determine the perceived legitimacy of the policy. Dutch studies indicate that lower-income individuals favor tax reductions (e.g., on fuel), while a broader segment supports road infrastructure investments (Verhoef et al., 1997; Ubbels & Verhoef, 2006). These preferences underline the importance of aligning revenue use with public priorities.

3.2 Empirical Insights

The emprical insights are based on the results from the interviews and the survey. The following sections will show the links in the updated conceptual model (Figure 2). The dotted lines refer to the assumptions made in the original model (Figure 1). The pink lines show new links based on the empirical insights, where dotted pink lines show the confirmation of the assumptions in Figure 1, and other pink lines are new, previously unassumed, links.

3.2.1 Interview analysis

The updated model (Figure 2) integrates qualitative insights through new B-coded connections (B1–B12), refining how fairness perceptions in road pricing are shaped and influence public acceptance. These additions highlight the interplay between personal circumstances, system design, and communication in determining whether individuals view pricing policies as fair.

A central contribution is B1, which underscores that fairness is not a universal concept but can be understood through different lenses—utilitarian, egalitarian, or sufficiency-based (interview 3). These normative frameworks shape how individuals evaluate road pricing outcomes and can amplify or mitigate perceived injustices depending on the policy's distributional impacts.

B2, B3, and B10 stress the importance of individual and socio-demographic factors, such as income, location, and car

dependence. Participants noted that policies that ignore these differences are perceived as unfair (B2, interview 1). Pricing schemes that favor wealthier groups deepen equity concerns (B3, interview 1), while fairness perceptions are particularly sensitive to personal circumstances such as income and necessity to drive (B10, interview 6).

Rural residents and car-dependent populations were seen as especially vulnerable to road pricing due to higher travel costs and fewer alternatives (B4, interviews 4, 5, 7; B3, interview 1; B1, interview 3). These spatial and modal limitations intensify perceived unfairness in the absence of compensatory measures.

The design and communication of road pricing also emerged as key determinants. Complex pricing systems are viewed as less fair when people do not understand them (B5, interview 6). Transparent and simple communication about fee structures helps to foster public trust and perceptions of fairness (B6, interviews 4, 6; B5, interview 6). These findings indicate that fairness is shaped not only by distributional outcomes but by the clarity and transparency of the policy itself.

Procedural justice was also highlighted (B7, interviews 1, 4). When policy design and implementation involve inclusive, transparent processes, public perceptions of legitimacy and fairness are enhanced.

Gradual implementation strategies (B8, interview 4) allow individuals to adjust behaviors and expectations over time, softening initial resistance. Likewise, fairness perceptions improve when individuals feel they are not personally worse off, particularly when they see direct societal benefits such as improved infrastructure or lower taxes (B9, interviews 1, 2).

Compensating affected groups, such as through reduced vehicle taxes or public transport investments, enhances both fairness and acceptance (B11, interview 2). Finally, B12 captures the cumulative effect: acceptance rises when a policy is perceived as fair and beneficial to society (interview 5), while perceived unfairness fuels resistance and undermines implementation (interview 7).
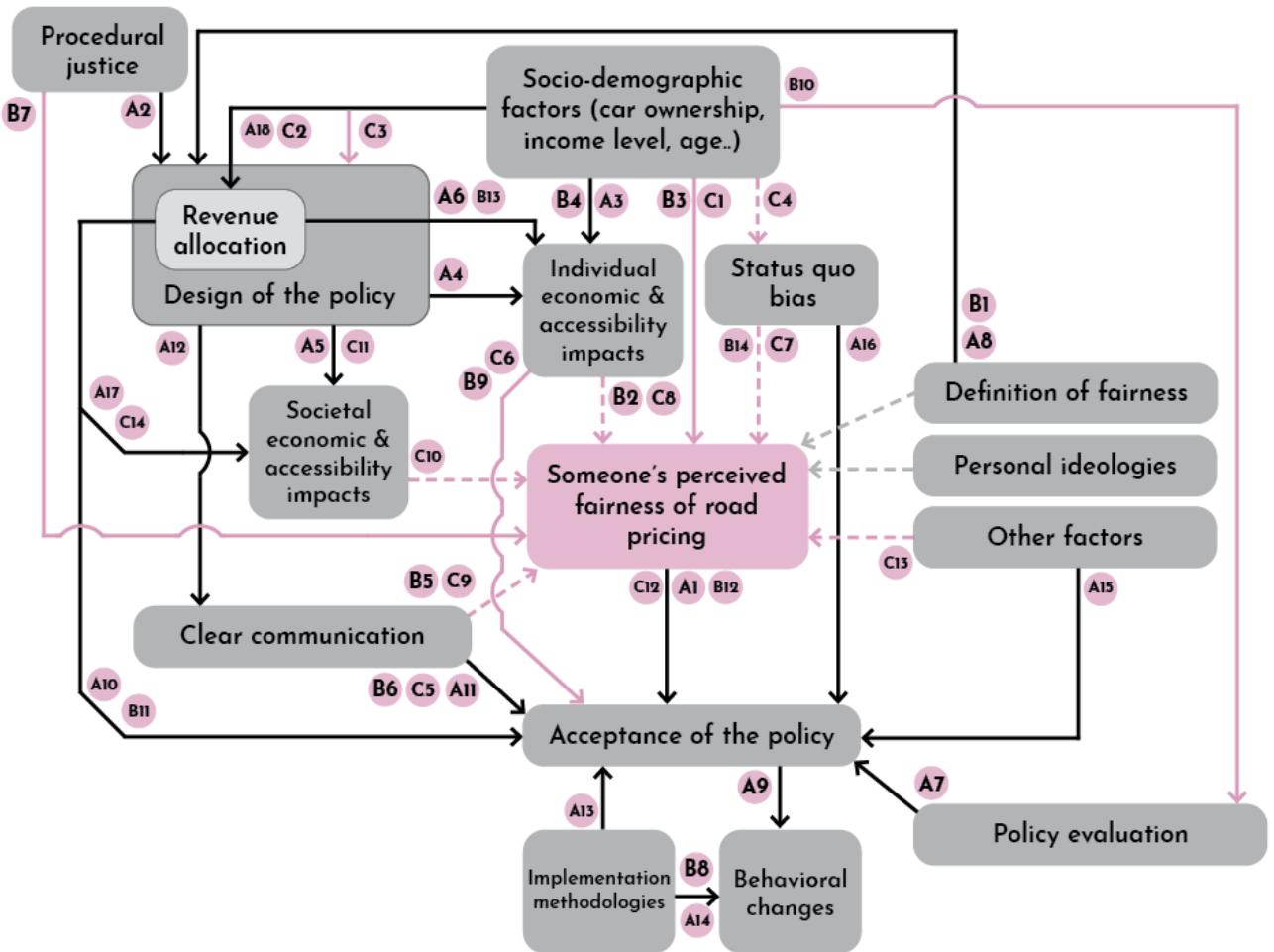

Figure 2: Conceptual model with input from empirical methods. Pink lines show the proven links based on the interviews (B#) and/or the survey (C#). Dotted lines are the same assumptions as in Figure 1.

3.2.2 Survey analysis

The C-connections in the conceptual model (Figure 2) show the results of the survey. These results reveal a nuanced picture of how the Dutch public perceives the fairness and acceptability of various road pricing mechanisms. These findings enrich the conceptual model by linking key personal and contextual characteristics to perceived fairness, acceptance, and support for road pricing. Both statistically significant and theoretically relevant—but non-significant—relationships are incorporated and justified to ensure the model reflects not just quantitative trends but also deeper societal insights.

Car ownership emerged as a strong determinant of fairness perceptions. Respondents without a car found distance-based, emission-based, and congestion pricing significantly fairer than car owners. This suggests that individuals not financially or logistically impacted by these systems perceive them as more equitable. These differences underline the importance of including car ownership in the model (C1). While the overall fairness perception across all mechanisms did not differ significantly by ownership, the specific differences for individual pricing types justify its inclusion. Furthermore, car owners showed significantly less support for emission-based pricing, reinforcing the link between ownership and acceptance (C2).

The residential context also influenced perceptions. While no broad significant difference was found between urban and rural residents in general fairness scores, urban respondents showed greater support for emission-based pricing and cordon pricing, and less support for maintaining the current system. Urban residents also preferred revenue to be used for tax reductions, a finding not observed among rural participants. These insights justify including both fairness perception (C4) and revenue preference (C5) links from residential environment in the model. This distinction likely reflects the greater availability of transport alternatives in urban settings and higher exposure to congestion and emissions.

Communication plays a critical role in shaping public acceptance. Survey respondents who agreed that good communication can increase public acceptance of road pricing were also more likely to support it themselves. More notably, those who believed that transparent communication about how revenues are spent was significantly more supportive. These relationships confirm the importance of communication both in general (C6) and specifically regarding transparency of revenue use (C11). This aligns with qualitative interview findings, where both experts and citizens emphasized the need for proactive, clear, and continuous communication to build trust and legitimacy.

A strong correlation was observed between perceived fairness and acceptance of road pricing (C9), reinforcing the theoretical claim that people are more likely to support

measures they view as just. Similarly, individuals who believed they would benefit from road pricing were more likely to support it (C10), indicating that perceived self-interest plays a role alongside broader evaluations of fairness.

Public opinion on revenue allocation offers further insights. Respondents indicated that their support for road pricing would increase if revenues were used to improve public transport, maintain road infrastructure, or reduce taxes. Notably, non-car owners were more likely to prefer investment in public transport, while car owners preferred tax reductions. These differences support the inclusion of links between car ownership and revenue preference (C12, C13). Moreover, open responses highlighted a belief that investing in sustainable transport modes enhances both the effectiveness and fairness of road pricing. This qualitative evidence supports the inclusion of a broader link between revenue strategy and perceived fairness (C14).

Although income was not a significant predictor of fairness or support in the survey, its inclusion remains justified. Qualitative responses raised concerns that low-income individuals may lack the resources to switch to cleaner vehicles or to avoid peak-hour travel, which could make some pricing mechanisms regressive. These reflections support retaining income as a factor influencing perceived fairness (C7) and point to the need to consider distributional impacts, even in the absence of significant quantitative findings (C8).

4. Discussion

This research aimed to explore how the Dutch public perceives a potential national road pricing policy, with a particular focus on fairness and acceptance. The combination of a literature review, expert interviews, and survey results allowed for a comparative analysis that sheds light on both shared patterns and unexpected differences across these sources.

One of the most striking findings lies in the divergence between empirical results and prior literature regarding preferences for road pricing types. While earlier studies and expert opinions often suggest a relatively balanced or even skeptical view on road pricing, the survey revealed more favorable attitudes, particularly toward distance-based and emission-based models. These schemes were perceived as fairer, likely because they are more closely aligned with principles of personal responsibility and environmental impact. Individuals may feel a stronger sense of control when pricing depends on how much they drive or their vehicle's emissions, as opposed to congestion charges or tolls, which may feel more arbitrary or punitive. However, such preferences could also reflect survey design, respondent familiarity, or underlying biases, rather than a clear-cut public endorsement.

Another unexpected result relates to regional fairness perceptions. Existing literature tends to emphasize the concerns of rural populations, who are often believed to perceive road pricing as less fair due to limited alternatives and longer travel distances. Contrary to this, the survey showed minimal variation in fairness perceptions across urban, suburban, and rural respondents. This could suggest a shift in how people across regions evaluate transport policies, or it might reflect broader acceptance of compensation mechanisms, such as reinvestment of revenues into regional infrastructure. Alternatively, the lack of strong regional differences may stem from limitations in the sample composition or the framing of survey questions.

Despite these insights, it is important to understand the limitations of the survey. The sample was not fully representative of the Dutch population. Students and urban residents were overrepresented, while older adults, rural residents, and frequent car users were underrepresented. This imbalance likely influenced the findings, as younger, urban respondents may have different mobility habits, values, and prior exposure to sustainability concepts than the general population. These demographic skews may have also contributed to the higher acceptance levels observed compared to expectations set by previous research.

Additionally, while the open-ended survey responses enriched the dataset with personal concerns and suggestions, not all theoretical links could be verified through the available data. Some aspects highlighted in the literature and interviews, such as long-term behavioral changes or detailed revenue allocation trade-offs, may require deeper qualitative exploration or a more robust, representative survey to validate. Certain questions might have benefited from clearer wording or additional context, particularly for more technical topics like procedural fairness or implementation complexity. There is always a balance to strike between survey depth and respondent fatigue, which inevitably limits the breadth of issues that can be covered in a single questionnaire.

Nonetheless, the open-ended responses did help bridge some gaps. Many respondents echoed fairness-related concerns, such as the treatment of low-income drivers or people in areas with limited transport alternatives. These remarks often overlapped with expert concerns about systemic disadvantages and reinforced the need for inclusive, adaptive policy design. Transparency and communication were also frequently mentioned as enablers of public trust. Respondents wanted to understand how pricing schemes would work in practice, how much they might pay, and how the revenues would be used. This underscores the importance of public education and ongoing dialogue in shaping acceptance.

On the topic of revenue use, there was broad agreement that allocating funds to public transport and reducing existing car-related taxes would make road pricing more acceptable.

However, preferences varied based on personal circumstances, such as income level, travel behavior, and car ownership, highlighting the need for flexible, context-sensitive strategies. A uniform approach is unlikely to satisfy everyone, and perceived fairness is often tied to how well a policy accounts for different lifestyles and needs.

Finally, the updated conceptual model developed from this research illustrates a more nuanced understanding of what shapes fairness perceptions. Beyond economic and accessibility impacts, psychological dimensions such as status quo bias and procedural justice play a significant role. People are more open to road pricing when they feel their situation is understood, their voice is heard, and the process is transparent. While not every theoretical assumption was supported by the empirical data, the model shows that fairness is multi-dimensional, context-dependent, and dynamic. It is not just about the policy's outcome, but also how it is designed, communicated, and implemented.

In sum, while the research has limitations—most notably related to sample representativeness and survey scope—it contributes valuable insights to the growing body of knowledge on public acceptance of road pricing. It also reinforces the importance of fairness as a central pillar in both public discourse and policy design. Future work could build on this foundation by involving a broader, more diverse population sample, testing different communication strategies, or modeling the impact of revenue allocation scenarios in greater detail. Such efforts would help policymakers craft more equitable, effective, and publicly supported road pricing solutions.

5. Conclusion

This research explored how people in the Netherlands perceive the fairness of road pricing and which factors influence their willingness to accept it. Fairness is a subjective concept, often tied to ideas of equal opportunity, equitable outcomes, and moral intuitions. The findings demonstrate that fairness perceptions are strongly shaped by practical realities such as car ownership, residential location, and the degree of transparency in policy communication. Among various pricing models, distance-based and emission-based systems were generally perceived as the fairest—particularly by non-car owners—while congestion charges and toll roads were viewed less favorably. These preferences varied depending on socio-demographic characteristics, with car owners tending to view pricing schemes as less fair and expressing greater support for revenue use in road infrastructure. In contrast, non-car owners were generally more supportive of pricing schemes and favored revenue allocation toward public transport investment and tax reductions. Preferences for how revenues are used thus significantly influenced policy acceptability, underlining the

importance of aligning pricing strategies with public values and expectations.

A key contribution of this study is the development of a conceptual model that illustrates the complexity behind public acceptance. Fairness is not only determined by the structure of a pricing scheme but also by how it is communicated and experienced. Elements such as procedural justice, revenue use, and broader societal impacts all contribute to whether people regard a policy as fair. People tend to value policies more when they are involved in the process, can see where the money goes, and feel they are not personally disadvantaged.

Transparency emerged as a particularly important factor. Around 80% of survey respondents indicated that clear communication about how road pricing works and where the money goes would make them more accepting of the policy. Communicating benefits and giving people time to adapt can make the system feel more predictable and just. Preferences for revenue use were also clear: respondents strongly supported reinvesting in public transport or reducing existing car-related taxes, signaling the importance of visible societal benefits.

The study also revealed a gap between academic debates and public concerns. While much of the literature emphasizes regional inequality or policy complexity, respondents focused more on trust, affordability, and perceived fairness. This suggests that policymakers may benefit from shifting their focus toward these more tangible themes when engaging the public.

Although this study focused on the Dutch context, its findings have broader relevance. Fairness, transparency, and trust are key ingredients for public support in many Western democracies. Case studies like Stockholm show that even unpopular measures can gain acceptance if they are introduced gradually, communicated well, and tied to noticeable improvements in transport infrastructure. The findings on revenue allocation, procedural justice, and socio-demographic differences, such as income or car dependency, may also apply to other contexts, including non-Western countries, if appropriately adapted to local conditions.

Academically, the research contributes to the literature on fairness and policy acceptance by empirically validating key equity concepts and showing how they relate to individual characteristics, communication strategies, and psychological factors like status quo bias. It bridges theory and public perception, offering a more nuanced understanding of how to design road pricing policies that are both effective and publicly supported.

Ultimately, this research demonstrates that when road pricing is perceived as fair, clearly explained, and tied to visible improvements, it is more likely to be accepted by the public.

6. Recommendations

This research offers key recommendations for both future research and policy development. While the study primarily explored public perceptions of fairness in road pricing, several areas remain underexplored. The conceptual model includes relationships that were not fully tested, and important factors such as technical and economic feasibility were beyond the scope of this research, but may strongly influence public acceptance. Future studies could investigate how combining different pricing types and revenue allocation methods affects fairness perceptions. Open survey responses revealed that fairness concerns are highly context-dependent—rural and low-income respondents often feel disproportionately burdened due to longer travel distances or limited alternatives. These findings suggest the need for more nuanced, inclusive analyses that reflect the diverse realities of road users.

Additionally, many respondents expressed stronger support for road pricing if revenues were visibly reinvested into transport-related improvements such as public transport or road maintenance. However, opinions differed on whether funds should support broader public services. Exploring mixed allocation strategies may enhance perceived fairness and boost acceptability. Given the influence of communication on public support, future research should also consider how framing and transparency affect perceptions. Combining insights from communication studies with transport policy research may provide valuable strategies for improving policy design and public engagement.

For policymakers, fairness must be at the core of road pricing policy. A one-size-fits-all approach risks disproportionately impacting vulnerable groups. Measures to address income disparities and limited mobility options, such as complementary investments in public transport, can improve equity. Transparency about the goals of road pricing and clear communication about revenue use are essential for building trust. Involving citizens in the policymaking process, particularly those most affected, can improve legitimacy and acceptance. Pilot programs, public consultations, and gradual implementation—starting in well-connected areas like the Randstad—were recommended. Finally, simplicity in design and messaging is crucial. A clear and understandable pricing system, coupled with visible benefits, will be key to securing long-term public support.

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