

# Have you seen that I've paid to go green?

*A quantitative study on how product visibility impacts consumers' intention to pay a price  
premium for green steel and ammonia products*

## **Master Thesis**

## **Stockholm School of Economics**

Business and Management

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## **Submission**

May 16th, 2022

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# Abstract

Are consumers willing to pay a price premium for green product alternatives? This is a key question for companies evaluating whether to decarbonise their businesses. For so-called hard-to-abate industries, decarbonisation will require significant investment, and thus this question is of great importance. Many hard-to-abate industries stand for significant portions of global emissions, such as steel and ammonia, which represent approximately 7% and 2% of global emissions respectively. Understanding the consumer willingness to pay for products using these materials will be key in unlocking decarbonisation and thereby significantly reducing global greenhouse gas emissions.

The conceptual framework used in the study is an expanded version of the Theory of Planned Behaviour, where product visibility is added as a variable to the original model to see if it impacts the willingness to pay a premium (“WTPP”) Intention for a green alternative, due to a potential green signalling effect. According to green signalling theory, consumers buy green products to signal to their environment that they can afford to spend money on more costly green products and thereby gain social status. The purpose of this study is to test whether product visibility affects how much more a consumer indicates they are willing to pay for a green product alternative. Visibility is expected to positively impact willingness to pay intention.

An experiment was devised using an online survey with 1402 respondents, where visible or non-visible products containing steel or ammonia were randomly assigned to respondents and WTPP Intention for a green alternative was measured. The results of the study indicate that on average consumers show a WTPP Intention of 15.7% for green alternatives containing steel or ammonia. Further, the results show that consumers have a higher WTPP Intention for non-visible products compared to visible products. Although opposite to the predicted outcome, this result could be explained by prosocial signalling theory. In cases when individuals are intrinsically motivated to purchase green products, they might be more likely to engage in altruistic acts if their actions are less visible to their peers.

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# Definitions & abbreviations

*Below is a list of terms and abbreviations used throughout the thesis with their definitions and how they are meant to be understood by the reader.*

|   |  |
|---|--|
| <b>Green product or green alternative</b> | Despite many different definitions and usages in media and academia, in this study the use of “green” refers to products with a lower carbon footprint compared to traditional alternatives  |
| <b>Hard-to-abate industries</b>           | Industries that are difficult to decarbonise because the current technological solutions are more expensive than the abatement costs of continuing traditional methods of production. Industries that are often included in this category are cement, steel and ammonia (World Economic Forum, 2020) |
| <b>Willingness to Pay (“WTP”)</b>         | A concept capturing the maximum price a buyer is willing to pay for a given quantity of a good (Werthenbroch & Skiera, 2002)   |
| <b>WTP Intention</b>                      | Different from willingness to pay in an actual purchase situation, WTP Intention is the measure used in this study to capture what consumers indicate they are willing to pay in the hypothetical scenario of the experiment   |
| <b>WTPP</b>                               | Willingness to Pay a Price Premium   |
| <b>TOPB</b>                               | Theory of Planned Behaviour  |
| <b>Visible product</b>                    | A product or purchase that is likely to be seen or noticed by the owner’s peers  |
| <b>Non-visible product</b>                | A product or purchase that is not likely to be seen or notices by the owner’s peers  |

# Introduction

*This introductory chapter covers the background to why this thesis is relevant and introduces the topic of consumer willingness to pay a price premium for green products through a literature review of previous research within the field.*

## Background

The past decades of strong economic growth and unrestrained consumption enabled by the exploitation of natural resources has resulted in a global climate crisis (United Nations, 2022b). Climate change includes long-term shifts in global temperatures and weather patterns that are predicted to lead to rising sea levels, ozone depletion, as well as environmental degradation of air, soil, and water (United Nations, 2022). Yet, energy consumption is steadily increasing, and the continued rise in greenhouse emissions has resulted in the highest greenhouse gas concentration levels in 2 million years (United Nations, 2022). Such environmental changes pose new and challenging threats to both people and organisations on a global scale.

In order to decelerate climate change, drastic reductions of greenhouse gases are required. Various global initiatives, strategies, and policies, such as the Paris Agreement (UNFCCC, 2022) or the Sustainable Development Goals (United Nations, 2022a), aspire to limit the effects of climate change. Despite such international policies, emission rates have continued to rise (International Energy Agency, 2022). Results from previous international climate negotiations have displayed several challenges, such as difficulty in incentivising high-emitting actors to behave in a sustainable manner (Nordhaus, 2021).

Regulators, investors and consumers are now putting more pressure on companies to adhere to global policies and make products and services more sustainable (Lestari et al., 2021). Therefore, putting sustainability on the agenda has become a central question for both incumbents and new market entrants. While the shift to green production in some industries has been on the rise for decades, other sectors have faced significantly larger challenges to decarbonise. For these so-called “hard-to-abate” industries, existing technology has so far made it commercially not viable to decarbonise (Muslemani et al., 2021).

However, new technologies have enabled production innovations in high-emitting industries that allow greener production. For example, large investments are currently being made in Northern Sweden to lead the transition and scale up the green steel industry (H2 Green Steel, 2022b; Hybrit, 2022). Today, the steel industry makes up about 7-9% of global emissions (Gerres et al., 2021). New technology that enables hydrogen usage in the production is expected to reduce CO<sub>2</sub> emissions by 95%, from 2000kg of CO<sub>2</sub> to less than 100kg CO<sub>2</sub> per ton of steel produced (H2 Green Steel, 2022a). Another industry responsible for approximately 2% of global emissions is ammonia production, making it another one of the most high-emitting industries in the world (Ritchie et al., 2020). 85% of the global ammonia produced is used for fertilisers that enable food production for at least 48% of the global population (Erisman et al., 2012). Similarly to steel production ammonia production can be decarbonised by the use of green hydrogen in the production process, reducing the CO<sub>2</sub> emissions by at least 90% (The Royal Society, 2020).

As decarbonisation is on the horizon in these two hard-to-abate industries, investigating the consumer demand for green products produced in these industries rises in importance. Consumers are directly and indirectly responsible for approximately 60-70% of global emissions, since they have the option to choose whether they want to purchase green or non-green products (Kolaczowski, 2021). This makes green consumption one of the cornerstones to alleviate the pressure of resources and to promote a sustainable development of the overall economy. Therefore it is more relevant than ever to understand consumers' demand for different types of green products and in particular their potential demand for products that could be produced as heavy industry starts to decarbonise.

## Problem Discussion

Steel production and ammonia production represent a large part of the global emissions that consumer household purchases are responsible for since they are essential elements of many consumer products. For instance, a regular Volvo V60 car consists of 65% steel (Volvo Cars, 2022), for which it emits 1620 kg CO<sub>2</sub>, which is the same amount of CO<sub>2</sub> emitted when driving a car for 8262 km or landfilling 561 kg of waste instead of recycling it (United States Environmental Protection Agency, 2022). Other common consumer products that include high levels of steel are bicycles, which generally consist of 90% steel (Länna Sport, 2022), or dishwashers that contain 59% steel (Electrolux Home, 2022). The ammonia used in fertiliser

production for necessary products such as wheat bread, stands for 43% of the product's CO<sub>2</sub> emissions (Goucher et al., 2017). With new hydrogen technology, the emissions from steel and ammonia production can be reduced by 90-95% (Muslemani et al., 2021; The Royal Society, 2020). Therefore, by purchasing products with green steel or green ammonia, consumers can make a significant difference in future CO<sub>2</sub> emissions.

Despite the bright forecast of more industries being able to decarbonise, which is enabling the creation of green consumer products, the problem is that many green products will be costlier to produce than their non-green counterparts. Although there are no large-scale green steel or ammonia production sites in place today, initial estimates indicate an approximated production cost increase of 20-40% (Muslemani et al., 2021). Interviews with industry experts have indicated an unwillingness, or inability, of producers to absorb the added cost of the green product, meaning that the added cost either fully or partly trickles down to the end-consumer (Interview with Sustainability Project Manager, 2022). As a consequence, consumers who want to purchase green products will need to pay a price premium. However, producers have limited insight into what the effects would be of applying a green price premium, which creates market uncertainty amongst many producers (Interview with Sustainability Project Manager, 2022). Therefore, increased knowledge about consumers' willingness to pay for a green premium, and the factors affecting that willingness, are of paramount importance to these companies.

Willingness to pay ("WTP") is defined as "maximum price a buyer is willing to pay for a given quantity of a good" (Wertenbroch & Skiera, 2002). Measuring WTP is a common tool in pricing processes when evaluating the consumer demand (Mitchell & Carson, 1989). For the past decades, a significant amount of research has been conducted to understand consumer WTP for green products and services in various industries. Previous research includes WTP for green buildings and real estate (Ofek & Portnov, 2020), green food products (de-Magistris & Gracia, 2016), green everyday products (Berger, 2019), green furniture (Wan et al., 2018), as well as green automobiles (Delgado et al., 2015; de Medeiros et al., 2016; Sexton & Sexton, 2014).

Ofek and Portnov (2020) investigated whether the WTP for green buildings in Israel differed depending on whether stakeholders were familiar with the concept of green buildings or not. The authors found that consumers were willing to pay a premium ("WTPP") between 7.74%-



9.25%, where consumers with lower familiarity were willing to pay a lower premium. De-Magistris and Gracia (2016) analysed Spanish consumers' WTPP for almonds by analysing the impact of organic labels and if the almonds were locally grown. The results showed that consumers were WTPP of 5% for organically produced almonds, and 25% for locally produced almonds. Wan et al. (2018) assessed the WTPP for green furniture, more specifically eco-friendly children's furniture in China. The authors found that 98% of the 320 consumers sampled in the study showed a WTPP above zero, whereof 53% of the consumers tolerated a maximum premium of 10%, 45% stated a WTPP of more than 10%, and 6% stated a WTPP of more than 50%. Yang et al. (2021) also investigated Chinese consumers' WTP for green products, and concluded that only 30.1% of the 991 respondents in the study were willing to pay any premium at all. Furthermore, De Medeiros et al. (2015) also examined the WTP for green furniture, as well as the WTP for green automobiles. This Brazilian study found that 50% of the study respondents showed WTPP of at least 10% of the base price for a green version of the furniture piece or automobile.

Green automobiles have been particularly popular to analyse in WTP studies. Sexton and Sexton (2014) investigated the WTP for Toyota Prius, a hybrid car with a distinct design that is well recognised amongst consumers for being more environmentally friendly than regular cars. The authors hypothesised that consumers might be willing to pay a price premium for the "green signals" that the car sends out to their surroundings, which in turn could benefit the individual owners' social status. The results of the study showed that consumers were WTP for the green signalling effect of the Toyota Prius, with a vehicle purchase premium range between \$430 and \$4200. Further, Delgado et al. (2015) also examined the value of environmental signalling by analysing how much more consumers were willing to pay to signal their environmental consciousness also through the purchase of the hybrid car Toyota Prius. The authors found that the Prius had a signalling value of 4.5% of its value, corresponding to \$587 (Delgado et al., 2015).

Previous research has also indicated that green signalling can impact WTP for everyday products. A study made by Berger (2019) compared the willingness to pay for eight different products (chocolate, lemonade, toothpaste, cotton buds, soap, shower gel, washing up liquid, and socks) and their costlier, green counterparts. The study resulted in a WTPP ranging between 17% and 27% for the green products that were visible to people in their

environment, which was explained by the fact that the study participants were perceived as more prosocial by people around them (Berger, 2019).

The latter findings imply that consumers are willing to pay to be seen as green. The question is whether this behaviour holds for other types of products that are visible to a consumer's environment. The results of prior WTP research have varied to a great extent in terms of the share of consumers willing to pay any premium at all, as well as the size of the premium. So far no studies have specifically focused on consumer products produced by steel and ammonia. This calls for further research to understand whether consumers indicate a WTPP for products stemming from these two industries, how large that premium can be, and whether the consumer behaviour differs depending on whether the products are visible to others or not.

## Purpose

The purpose of the study is to answer the following research question:

*Does product visibility affect how much more consumers indicate they are willing to pay for green steel or ammonia product alternatives?*

## Contribution

The contribution of the study is two-fold. Firstly, it will contribute to academic theory by investigating the effect of product visibility and WTPP Intention by connecting two well-established theories, the Theory of Planned Behaviour and Signalling Theory, as to be explained in *Theory*. Secondly, this thesis will make an empirical contribution for practitioners within hard-to-abate industries. Our results will contribute to a richer understanding of consumers' WTPP Intention for a range of green products from different industries using steel and ammonia from consumers in four markets (Brazil, Canada, Germany and Sweden) across three continents. Such knowledge is of interest to marketers as well as managers in new product development, pricing, and strategic decision-making. It also contributes to the research on green consumption and marketing, which is of interest for academia.

## Delimitations

The first delimitation in the study is the choice of industries and product types. We have chosen two different and high-emitting industries that are essential materials used in many consumer products. Cement, another hard-to-abate industry responsible for 7% of global emissions (International Energy Agency, 2018), was not selected due to the fact that there are few end-consumer products containing cement in comparison to ammonia and steel. Thereby, the findings of this thesis could be considered limited to products within these industries. However, since the study includes a wide variety of products, and the focus of the study is on whether or not the products are visible, the results could be considered generalisable beyond steel and ammonia products.

The second delimitation is the geographical area covered. The diversity of the tested markets could be considered generally representative of Western cultures. However, the results might not be generalisable to non-Western cultures where there are other income levels and different shopping habits.

Lastly, although the study includes respondents from different markets, we do not do a cross-country analysis or focus on the differences between markets in the main model. Similarly, although both steel and ammonia products are included in the study, the results are compared in terms of visibility and not per product-type. The results are studied in their entirety to find generalisable findings, both country-wise and product-wise.

## Thesis outline

*This thesis consists of six chapters being 1) Introduction, 2) Theory, 3) Methodology, 4) Results and Analysis, 5) Discussion and 6) Conclusion.*

# Theory

*In this chapter, we discuss the two central theories that are used in the study; their central claims and how previous research has applied them. Further, the conceptual framework is introduced as well as the four hypotheses of this study.*

## Signalling theory

Signalling theory is based on the prevalence of asymmetric information between two parties, and was developed in both economics (Spence, 1973) and biology (Zahavi, 1975). The theory includes two parties, a sender and a receiver, where the former aims to convince the latter that they possess a desirable quality that the latter cannot observe directly. If the sender indeed possesses the purported quality and the two parties engage in any type of economic or social exchange, both of them will profit.

A common example to illustrate signalling theory is in the labour market. For instance, job applicants might want to persuade their potential employer of their productivity, which is not a directly observable trait. Therefore, different types of observable proxies for productivity need to be used. A common proxy for productivity in the labour market is university credentials and education certificates, which enables the potential employer to reliably differentiate different candidates' productivity levels at a certain probability (Spence, 1973).

### *Costly signalling theory*

Signalling theory is also common within marketing and consumer research. More than a century ago, sociologist and economist Thorsten Veblen established the term *conspicuous consumption* (1912). This term refers to the consumption and display of products that are easily recognisable as expensive by other consumers (Veblen, 1912). Products in this category include highly visible items such as expensive clothes, watches, and cars. But why do consumers want to pay for luxurious products, instead of being satisfied with more affordable counterparts? This phenomenon can be explained by costly signalling theory. According to costly signalling theory, an individual is able to signal that he or she has the ability to spend money on extravagant items, i.e. engaging in conspicuous consumption, instead of purchasing equivalent, cheaper products (Berger, 2017). This, in turn, results in an

unobservable quality for that individual, which could be desirable in certain social groups, and could consequently lead to higher social status. Since both social status and economic wealth are unobservable, individuals need to rely on signals to perceive and communicate such traits (Berger, 2017).

### *Prosocial signalling*

In contrast to costly signalling, prosocial signalling is when luxury handbags are replaced with good deeds. Prosocial behaviour is acting in a way that is generally beneficial to others (Penner et al., 2005). Accordingly, in prosocial signalling individuals benefit from prosocial behaviour as a signalling mechanism; when a person behaves in a prosocial way, such as donating to charity or participating in a fundraiser, they are judged or perceived in a more positive way by others and by themselves (Gneezy et al., 2012). Thus, the social benefits of behaving altruistically motivates people to engage in prosocial behaviours. This mechanism has been demonstrated in many studies, with findings such as that churches receive more donations when they pass an open basket compared to a closed bag (Soetevent, 2005). However, research has found that in certain contexts the opposite effect can be true; charity donations are sometimes higher when made anonymously, because public displays of altruism can undermine the intrinsic drivers of behaviour (Gneezy et al., 2012). An intrinsic driver of a prosocial action can be purely altruistic or impurely altruistic i.e. also driven by the positive feelings about oneself feeling that one gets after a prosocial action, sometimes referred to as a “warm glow” effect (Andreoni, 1990). If a prosocial action is observed, it may reduce the positive self-image and “warm glow” it creates (Gneezy et al., 2012).

### *Green signalling*

Social visibility of consumption is not only relevant when it comes to luxury goods or charity, but it has also gained attention in the context of environmentally friendly behaviour (Griskevicius et al., 2010). This theoretical construction is called “green signalling” and is used by researchers to evaluate conspicuous consumption of products through an environmental lens. Similarly to conspicuous consumption, the purchase of green products can signal an individual’s ability to prioritise and spend money on green products (Delgado et al., 2015; Sexton & Sexton, 2014). Thus, the purchase of green products can also result in perceptions of wealth and social status. Further, green signalling can make an individual seem more prosocial (Berger, 2019). Green purchase behaviour is often seen as an act of altruism, as it takes time, money, or other resources. Making such efforts signals that the

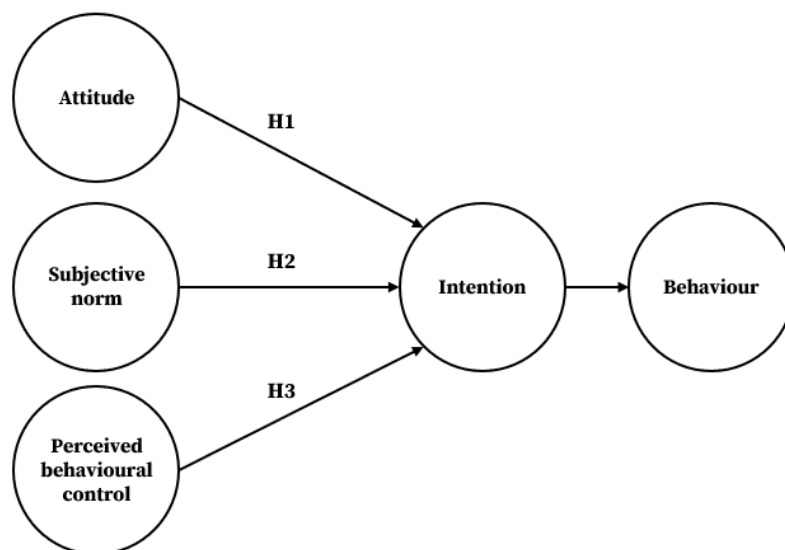
individual can sacrifice their personal interests for public welfare. Those who send green signals, can receive advantageous treatments in social groups and interactions (Berger, 2017).

Using costly signalling theory as a basis for green signalling has particularly been used for highly visible green products, for instance hybrid cars, where social status plays an important part in purchase decisions (Delgado et al., 2015; Sexton & Sexton, 2014). The authors in both studies concluded that there are two types of consumers who want to signal their wealth: those who have altruistic purposes and care about the quality of the environment for non-status reasons, and others who want to exhibit their status through environmental means (Delgado, Harriger et al. 2015; (Sexton & Sexton, 2014). As many studies use costly signalling theory as its theoretical basis for green signalling, this study also adopts this approach when referring to green signalling.

As explained, the focus of this study is to understand the effect of visibility on WTPP for green steel and ammonia products. Our definition of WTPP intention is the measured price premium that consumers indicate they are willing to pay in a hypothetical situation. However, in order to deepen the analysis and understand the potential effect of visibility in relation to other commonly attributed drivers of WTPP, additional theory is required. One of the most established ways to explain WTP or WTPP is the Theory of Planned Behaviour. However, the original Theory of Planned Behaviour framework does not use WTP or WTPP as the dependent variable, but intention. According to Ajzen and Fishbein (1980), willingness is not a separate construct from intention, but rather a more specific measure of intention describing an individual's willingness to behave in a specific way in a situation. Since the TOPB framework is proven to successfully predict intentions in various contexts, and more specifically WTP and WTPP in many studies, the aim is not to test if it works, but to expand the framework and include an additional factor, visibility, and thereby enrich the consumer WTPP analysis and explanatory ability of the model.

# Theory of planned behaviour

The theory of planned behaviour (“TOPB”) (Ajzen, 1991) is an extension of the theory of reasoned action (Ajzen & Fishbein, 1980), where the central element is the intention of individuals to perform specific behaviours. The theory posits that as the intention to perform a behaviour grows, the likelihood of the behaviour increases. The theory, illustrated in *Figure 1*, includes the three factors that impact the intention to perform a behaviour: attitudes, subjective norms, and perceived behavioural control. TOPB has been used extensively in prior studies to capture different factors impacting WTP Intention. In later years, it has often been used to capture the willingness to pay a premium for green products or environmental initiatives, for instance for green products in general in India (Yadav & Pathak, 2017), green food in Malaysia (Al Mamun et al., 2018; Rezai et al., 2013), urban park conservation in Spain (López-Mosquera et al., 2014; López-Mosquera, 2016), a city sponge city program in China (Wang et al., 2020) and abatement of forest regeneration in Finland (Rekola, 2001).



**Figure 1:** Theory of planned behaviour (Ajzen, 1991)

## Attitude

The first factor in the model is an individual’s attitude towards the intended behaviour. Attitude refers to how favourable or unfavourable the individual’s assessment of the specific behaviour is; the more positive or favourable the attitude, the higher the intention to perform the behaviour (Fishbein & Ajzen, 1972). For example, the more positive a person’s attitude towards the concept of recycling, the more likely it is that their intention to recycle their household waste will increase since intention is a predictor of behaviour. This study concerns

the attitude towards paying more for green alternatives. The first hypothesis of this study is therefore:

**H1: As attitudes towards paying a premium for green products becomes more positive, the green premium a person intends to pay increases**

*Subjective*

*norm*

The second predictor in the model is subjective norm, and reflects the social factors that impact intention and behaviour. More specifically, subjective norm is the social pressure that the individual perceives to perform the specific behaviour (Fishbein & Ajzen, 1972). The higher social pressure is perceived to be, the higher the intention to behave in that way. For example, in a country where recycling is a common part of every-day life, individuals would be more likely to recycle their household waste as they expect to be perceived in a negative way by their peers if they do not recycle. In this study the subjective norm concerns the social pressure individuals feel when it comes to paying more for green alternatives. The second hypothesis of this study is therefore:

**H2: As subjective norms regarding paying a premium for green products becomes more positive, the green premium a person intends to pay increases**

*Perceived*

*behavioural*

*control*

The third element in the model is perceived behavioural control, which refers to the individual's perceived ease or difficulty in performing the specific behaviour. This is the differentiating factor between the theory of planned behaviour and the theory of reasoned action (Ajzen, 1991). As the perceived behaviour control increases, so does the intention to perform a behaviour (Ajzen, 1991). In the context of green products, this factor can be applied to the perceived impact upon improving the environment. For example, if individuals think that recycling their plastic containers will be easy as they have the willpower to recycle on a regular basis, or they believe it is an actual contribution to fighting climate change, then the likelihood of him or her recycling the containers increases. In the study, the perceived behavioural control concerns if individuals feel that they are able to purchase green alternatives and impact climate change by doing so. The third hypothesis of this study is therefore:

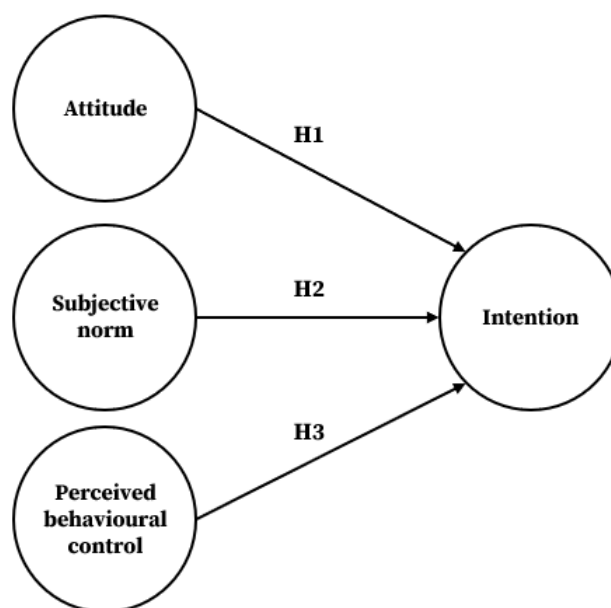
**H3: As perceived behavioural control of paying a premium for green products increases, the green premium a person intends to pay increases**



There is a distinct difference between *actual* control and *perceived* behavioural control, which is worth clarifying. Despite the intention to engage in a behaviour, there will be some non-motivational factors that can constrain the ability to perform a behaviour, such as time, financial resources, and skills to perform the behaviour. Depending on the individual the difference between actual and perceived behavioural control can vary. If individuals are limited in their ability to perform an action because they cannot afford to do so, that can limit the behaviour, even if the intention to perform the behaviour is high. For that reason, it is key to distinguish between what individuals intend to do because of their perceived behavioural control and those who simply do not have the means. In other words, the latter may be willing to pay more if their personal situation were to change.

Together, these three factors can predict an individual's intention to behave in a certain way. The relative importance of each factor will vary depending on different situations and different types of behaviours; whereas attitudes may dominate the effect on intention in some contexts, in others perceived behavioural control may alone be enough to account for intentions (Ajzen, 1991). However, attitude is often considered the poorest predictor in the TOPB model (Joshi & Rahman, 2015).

The first three independent variables and hypotheses to be tested in this study are demonstrated in *Figure 2*.



**Figure 2:** Theory of Planned Behaviour, first three hypotheses

The original TOPB has been challenged by some researchers, claiming that there often is an attitude-behaviour gap between what consumers self-report and what their actual behaviour results in, which is not adequately explained by the model (Joshi & Rahman, 2015). For instance, one study found that while 67% of consumers showed a positive attitude towards purchases of organic food products, only 4% actually purchased those products (Hughner, McDonagh et al. 2007). However, many studies that have used the theory of planned behaviour framework have also demonstrated the strength of the model. A meta-analysis by Armitage and Conner (2001) illustrates that the three original factors, attitude, subjective norms and perceived behavioural control, have generally explained 39% of the variance in behavioural intentions and 27% of the variance in behaviours. Therefore, the original theory of planned behaviour framework can be considered a relatively good explanatory and predictive model (Armitage & Conner, 2001).

To further strengthen the explanatory power of the model, Ajzen (1991) proposed that the theory of planned behaviour can be expanded upon by including additional variables that are suitable for a certain topic or context. This has been done in several previous studies. In a study about willingness to pay for urban park conservation in Spain, moral norms were included as a variable in the TOPB framework (López-Mosquera et al., 2014). A later study for park conservation also included gender as a socio-demographic predictor to WTP (López-Mosquera, 2016). A Chinese study that predicted WTP for municipal solid waste management in Beijing extended the framework by integrating environmental concern (He et al., 2021). A study that investigated determinants to green consumption and behavioural intention in developing nations (Yadav & Pathak, 2017), as well as a study analysing the WTP for a sponge city program in China (Wang et al., 2020), both included the additional construct perceived value. So far, no studies have expanded the TOPB to include product visibility.

## Conceptual framework

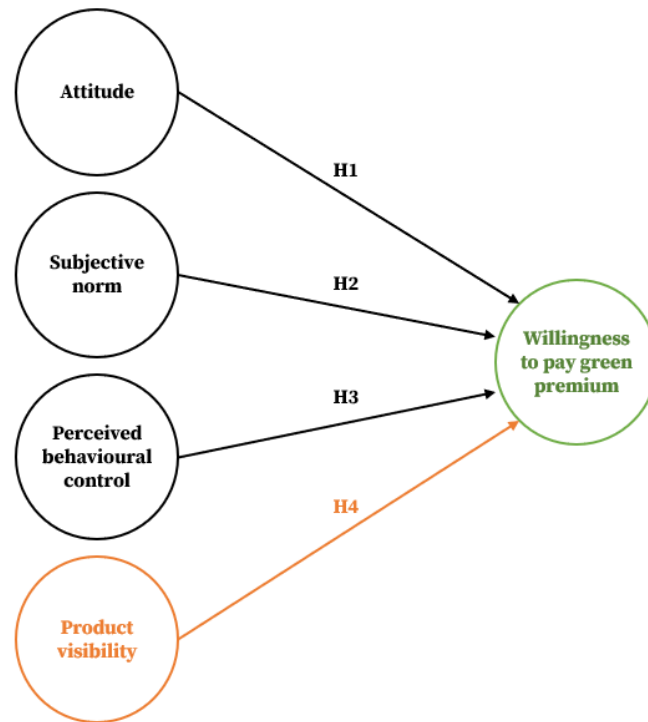
A consumer's environmental beliefs, attitudes, and behaviours are not always directly observable to one's peers. Thus, buying green products that are visible can be a way to signal to peers that one is making a positive environmental contribution. For instance, a person may be more willing to pay a price premium for a green car, which is typically seen as a status symbol and often viewed by others, as compared to a vacuum cleaner, which is not as visible, often hidden away in a cupboard only to be brought out when used in the privacy of a person's

home. The underlying reasoning is that consumers might be willing to pay more for a product used or displayed in public, thus being visible towards others, because the product can send out certain desirable signals to their social group and beyond. In contrast, buying green products that are used in private will not inform anyone outside the consumer's household, and is unlikely to confer any social benefit.

Given the application of signalling theory to explain consumer purchase behaviour across product types, and the widespread application of the theory of planned behaviour to explain green premium purchase intention, this study aims to combine the two theories in a novel way to test whether signalling theory can explain potential differences between purchase intentions. Thus, our conceptual framework will add visibility as an additional variable in the theory of planned behaviour, see *Figure 3*, and it is hypothesised that:

**H4: If a product is visible, the green premium a person intends to pay will increase, compared to a product that is not visible**

Furthermore, signalling theory has been proven to bridge the attitude-behaviour gap that the TOPB framework has been unable to explain (Berger, 2019). This is done via a green signalling mechanism, where the consumer might be willing to pay for a green product if she is expected to be treated beneficially in social exchanges. In other words, being treated advantageously in social groups might incentivise her to pay a price premium for green goods, thus having an effect on the gap between attitude, intention and behaviour (Berger 2019). Our academic contribution is thus the combination of these theories to explain consumer purchase behaviour.



**Figure 3:** Conceptual framework: Adapted Theory of Planned Behaviour, adding product visibility

# Method

*In this section we describe the methodological approach of the thesis, including why the chosen approach is appropriate for the topic we are studying, for preparatory work for the main study and for the study design. The quality of the data and research ethics are also discussed in this chapter. Lastly, it explains how the data was handled and provides descriptive analysis about the sample.*

## Scientific approach to the research

The study uses a deductive research methodology, meaning that it is grounded in existing theory with the development of new hypotheses that are tested through empirical analysis (Bell et al., 2019). As outlined in the *Theory* chapter, a significant amount of research has been completed to study the factors that impact consumers willingness to pay for certain green products using the theory of planned behaviour, which suggests that a deductive method is an appropriate choice to further test the theory. Due to the mature nature of the field and the research that supports the TOPB model, the approach of the study is not to build a new theoretical framework, but instead to expand upon and combine existing theory by introducing a new independent variable, in testing the theory empirically.

A key benefit in adopting a quantitative approach is that we are able to test a large sample, which strengthens the ability to make claims including generalisability. Another benefit of quantitative research in a mature field is the possibility to isolate a specific variable and randomly assign it to the sample, thereby potentially establish causality between the randomly assigned independent variable and the dependent variable. By adopting a quantitative approach, the relationships between variables can objectively be assessed.

Furthermore, a quantitative approach allows us to not only establish whether a causal relationship exists, but also the magnitude or strength of the relationship between the variables, measuring the exact differences rather than only establishing general relationships. Given the mature nature of the research field we are also able to use best-practise techniques and recommendations from research to improve the validity of our results. Thus, the overall methodological approach to the thesis is in line with mature theory research (Edmondson & McManus, 2007).

An online survey with respondents sourced by an external third-party firm was determined to be the best approach for this study, as it enabled access to a large sample across four geographic markets, therefore increasing the generalisability of any findings significantly. Given time and resource restraints, it would not have been possible to gather the same number of respondents across the markets without adopting this approach. Using a survey also enabled collection of data points that may otherwise be difficult to observe, such as attitudes, subjective norms, and perceived behavioural control of the respondents.

Despite the good fit between mature research field and quantitative research, there are also draw-backs to this approach. Quantitative research based on surveys is fundamentally limited in its ability to capture the complex human nature. Further, this study relies on the ability of respondents to accurately and truthfully respond to questions about themselves and their true intentions.

## Preparatory work for the main study

Prior to distributing the main study, two pre-studies in the form of interviews and surveys were completed in order to refine the development of the main study.

### Pre-study 1: Desktop research & interviews

As the study focuses on WTP for products where the carbon footprint is radically reduced by new technologies, we needed to gain an understanding on what types of products would be relevant, and what the carbon footprint and cost implications on end-consumer products could be. In order to do so, we engaged in desktop research, reviewing industry reports, as well as in interviewing industry experts working with production or sales of products containing steel or ammonia.

#### *Interviews*

15 potential interviewees were contacted within both the steel and ammonia industries. In total, six experts were interviewed from the following companies; NCC, Lantmännen, H2 Green Steel, Sweco and Peab. Three of the interviewees (from Sweco, NCC and Peab) work within construction and therefore their core competence was within the steel industry. Lantmännen produces agricultural products and is a large consumer of fertiliser, the most

common product from the ammonia industry. H2 Green Steel is a newly started company aiming to establish the world's first large-scale green steel production facility.

The interviews were open-ended but followed a series of questions, see *Appendix 2*, including topics such as how the industry is aiming to decarbonise, the current market appetite for green alternatives, potential costs of the decarbonisation and where the incurred costs can expect to land. Although the interviewees had different views on some of the topics there were also areas of general consensus. Firstly, they agreed that the production of green hydrogen and its ability to decarbonise the steel and hydrogen industries is confirmed. Secondly, they agreed that there is increased consumer appetite for green alternatives but that the willingness to pay a significant premium is questioned; a premium of 50% was considered the upper limit.

#### *Product selection*

In order to select the products in the study, we needed to identify relevant products containing steel and ammonia. As the main study focused on end-consumers (B2C) rather than business customers (B2B), the products selected for the study needed to be targeted on the end-consumer. Based on our interviews and market reports, common consumer products that contain steel or ammonia or use significant amounts of ammonia in their production were identified.

Steel is a material widely used in many different sectors. Consumer-facing products include automobiles, white goods, smaller kitchen appliances and construction goods. According to the European Committee of Domestic Equipment Manufacturers (2017), the EU steel production is dominated by construction (49%), followed by mechanical engineering (16.9%), metal products (11.3%), automotive (7.5%), other transport (3.7%), oil and gas (5.8%) and domestic appliances (3.2%). A list of end-consumer products were identified based on these different market segments; car (automotive), bicycle (transport), kitchen sink (metal product), refrigerator (domestic appliances), roof tiles (construction) and vacuum cleaners (home appliance).

Ammonia is a chemical used for many different applications and industries including as an explosive in the mining industry, as a stabiliser for rubber and latex, as an ingredient in cleaning products, and as a refrigerant gas in pharmaceuticals. However, by far the largest

application is ammonia fertilisers within the agricultural sector, which stands for approximately 80% of the ammonia market share (Mordor Intelligence, 2022).

Fertiliser is an essential product for modern society that enables food production for at least 48% of the global population (Erisman et al., 2012). Maize (16.2%), wheat (15.3%) and rice (13.7%), vegetables (8.6%), residual (7.8%) and fruits (7.2%) stand for the majority of fertiliser usage (International Fertilizer Association & International Plant Nutrition Institute, 2015). Furthermore, ammonia is also used in various cleaning products, where up to 5-10% of cleaning spray consists of pure ammonia (Ghavam et al., 2021). A list of end-consumer products was identified based on these different market segments; bread (wheat), rice (rice), coffee (residual), apples (fruits), and cleaning spray (cleaning product).

### *Carbon impact*

The interviews and several company announcements confirmed that there is commercially viable technology that can radically reduce the carbon footprint of steel production and ammonia production (H2 Green Steel, 2022; Hybrit, 2022; Yara, 2022). The interviewees also confirmed that the technology can enable a reduction in the carbon footprint of both steel and ammonia production by up to 90-95%. Central to the decarbonisation of both industries is the production of green hydrogen; using renewable energy to power electrolyzers that convert water to hydrogen and oxygen (Wieland et al., 2021).

For green steel production, the new technology replaces the carbon-intensive blast-furnace production process. Green hydrogen replaces coal to reduce the iron ore to iron, which is used to produce steel coils via an electrified downstream process and subsequently sold to producers, such as automobile manufacturers (Muslemani et al., 2021). The interviewees confirmed that while traditional steel production emits approximately 2000 kg CO<sub>2</sub> per 1000 kg of steel, the new production technique would reduce the carbon footprint by 95% to approximately 100 kg CO<sub>2</sub> per 1000 kg of steel.

For green ammonia production, green hydrogen is used to replace the traditional process where natural gas is reformed to hydrogen and combined with nitrogen, emitting CO<sub>2</sub>, to make ammonia via an electrified Haber-Bosch process (The Royal Society, 2020). The interviews confirmed that traditional ammonia production emits approximately 2000 kg CO<sub>2</sub>



per 1000 kg ammonia and the new production technique would reduce the carbon footprint to approximately 100 kg CO<sub>2</sub> per 1000 kg of ammonia.

### *Price impact*

As green steel or green ammonia are not currently produced on a commercial scale, there is limited knowledge on costs of production for these new technologies. However, the interviewees confirmed that the increased cost of production would partly or fully flow through the production chain; “Ultimately, the cost will need to trickle down and be paid for by the end consumer for it to be viable. The consumer decides.” (Interview with Lead Buyer - Steel, 2022). In other words, in order for there to be a financial case for buying green materials, the end-consumer must be willing to pay more for the green end-product.

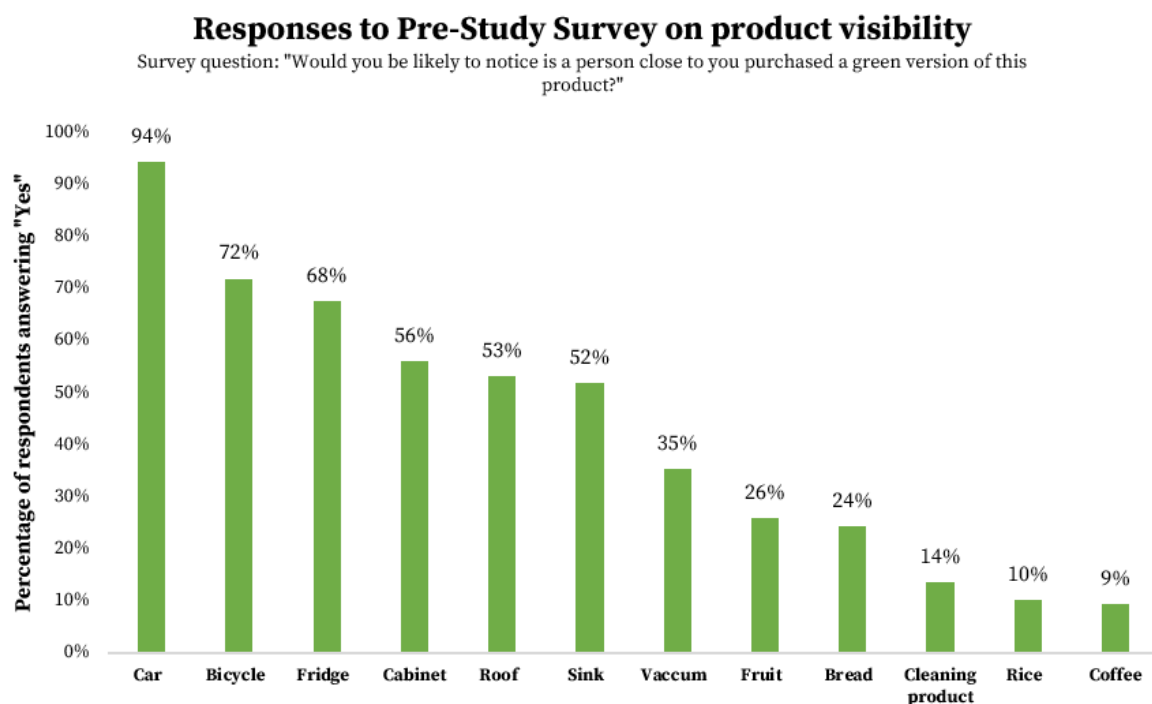
The price impact of using green steel or green ammonia will also vary significantly depending on the cost structure of end-product; for a product that is made 100% of steel the price impact of switching to green steel will naturally be higher than a product that contains only 20% steel and the same for ammonia. Although none of the interviewees were willing to estimate exact price implications, a 50% end-price increase was generally considered the highest that would be acceptable from a commercial point of view, which therefore became the benchmark for our main study as the highest premium a respondent could indicate.

## Pre-study 2: Manipulation check and product categorisation

To be able to examine the potential relationship between the visibility of products and the willingness to pay a green premium, the products needed to be divided into visible and non-visible categories. To avoid any biases influencing our categorisation, we took the same approach as Heffetz (2012) who categorised visibility based on a survey method. Heffetz (2012) looked at the relative expenditure visibility of different consumer purchases amongst US households, where respondents answered whether they would notice whether a similar household to themselves makes a new purchase. Based on the responses a long list of products was drawn up, in which the different products were coded and categorised into levels of visibility (Heffetz, 2012).

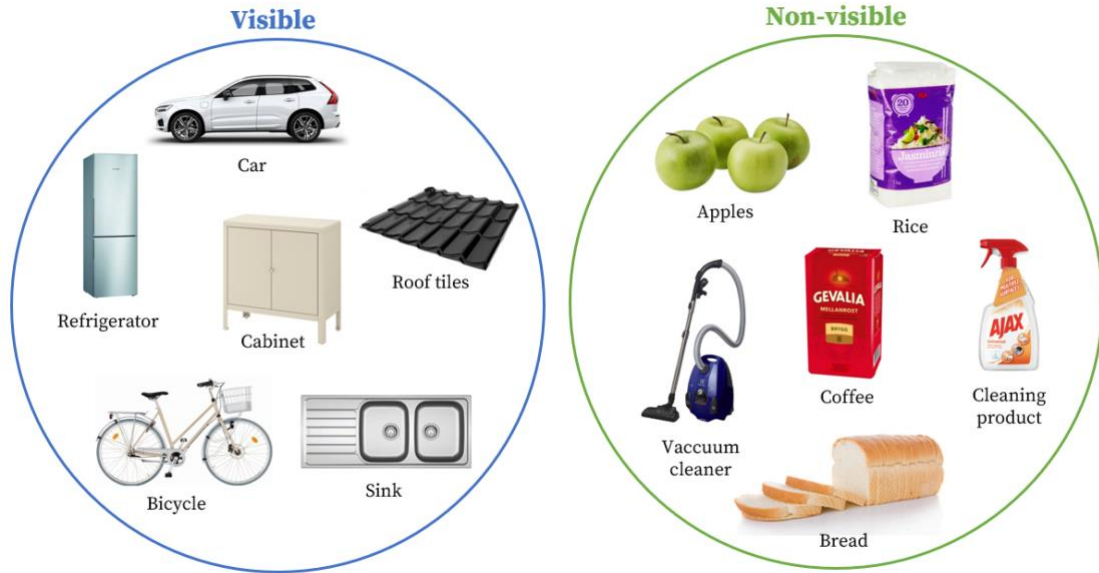
The list of products containing steel or ammonia was put together and a short survey was developed. Respondents were shown the list of products and asked whether they were likely

to notice if a person close to them purchased a green version of the product, to which they could respond either “Yes, I would likely notice” or “No, I would likely not notice.” When respondents answered yes, the answer was coded as 1, and the no-answers were coded as 0. The survey was shared via email and social media to our personal networks between 25<sup>th</sup> of February and the 16<sup>th</sup> of March 2022. After removing respondents under the age of 18 and incomplete answers, the number of responses totalled 139 and included respondents between 20 and 77 years old, and although predominantly from Sweden also some respondents from the United Kingdom and the United States. The results are shown in *Figure 4* below.



**Figure 4:** Results from pre-study survey categorising product visibility

The products that received a majority of answers stating that they would likely be noticed were classified as “visible” whilst those who received more than 50% of the answers stating they would likely not be noticed were classified as “non-visible”. The subsequent categorisations are shown in *Figure 5*, below:



**Figure 5:** Product division into visible and non-visible categories

## Main study

### Sampling and sample

The sample included respondents from four geographic markets (Sweden, Germany, Brazil, and Canada) between the ages of 18 and 77 years old. The markets were selected to include the wide range of cultural and societal differences present across Northern Europe, Central Europe, North America, and South America, in order to strengthen the generalisability of the study results.

The research instrument was an online survey hosted and distributed via Pollfish, an online survey platform with access to over 250 million real consumers as respondents across more than 160 countries and is used by many large multinational firms to complete market research (Pollfish, 2022). Pollfish was selected as the best option to target respondents in the selected target markets and host the type of survey that we wanted to distribute.

### Study design

#### **Randomly assigned independent variable – Visibility**

A posttest-only control group approach is when two groups receive a treatment, i.e. there is no control group, and the treatment of each group is measured (Söderlund, 2018). This approach was adopted in this study to test the effect of visible vs. non-visible products on

WTPP Intention. In other words, each respondent was exposed to one, and only one, treatment variable. Respondents were randomly assigned either a visible or non-visible product group before asked how much more they would be willing to pay for them.

Within this approach a mixed design was used, meaning that it included both between-subjects (visible vs. non-visible) and within-subjects (multiple products per respondent) design, as it increases the power of the study and minimises potential differences between individual products (Charness et al., 2012). There are three main disadvantages with within-subjects design: internal validity, time-related effects, and carryover effects. The first two are addressed under *Internal Validity* and *Stability*, respectively. Carryover effects means that the outcomes, i.e. the WTPP Intention, can be affected by the order in which the products were presented. This was not addressed due to technical limitations of the third-party survey distribution platform, thus being a limitation of the study.

### Non-randomised independent variables

The survey questions to measure the three independent variables in the TOPB framework were based on the previous TOPB studies, tailored slightly where needed in order to match the specifics of the present study. A summary of the questions and their previous occurrence is shown in *Figure 6*. In order to be concise, and thus maximise respondent attention, each independent variable was limited to only three questions, which is also in line with previous studies (e.g., Al Mamun et al., 2018; López-Mosquera, 2016). The respondent was given options on a 7-point Likert scale, which is a well-established scale considered optimal for attitude scales (Krosnick & Fabrigar, 1997).

| Question in main study  | Reference study                      |
|---|--------------------------------------|
| <b>Attitude</b>   |                                      |
| "Purchasing products with lower CO2 footprint is necessary to mitigate global warming"                              | (Al Mamun, Fazal et al. 2018)        |
| "Between products with higher CO2 footprint and lower CO2 footprint, I prefer the product with lower CO2 footprint" | (Al Mamun, Fazal et al. 2018)        |
| "I think purchasing products with lower CO2 footprint is very responsible"  | (Wang, Liu et al. 2020)              |
| <b>Subjective Norms</b>   |                                      |
| "People around me think that others should pay for sustainable product alternatives"                                | (López-Mosquera, García et al. 2014) |
| "People that are close to me think that I should make environmentally friendly purchase choices"                    | (Al Mamun, Fazal et al. 2018)        |
| "Many of my friends and family are willing to pay more for products that are lower in CO2"                          | (López-Mosquera, García et al. 2014) |
| <b>Perceived behavioural control</b>  |                                      |
| "I feel capable of purchasing sustainable product alternatives"   | (Al Mamun, Fazal et al. 2018)        |
| "What I purchase as a consumer has an effect on environmental impact"   | (López-Mosquera, García et al. 2014) |
| "I feel I can help impact environmental problems by buying products with a low CO2 footprint"                       | (Wang, Liu et al. 2020)              |

**Figure 6:** Survey questions and reference studies used to measure Attitude, Subjective Norm and Perceived Behavioural Control

## **Dependent variable – WTPP Intention**

### *Purchase scenario*

The dependent variable for this study is how much more the respondent indicates they are willing to pay; WTPP Intention. In conjunction with each product, the survey framed the purchase scenario in a way that the respondent should imagine that they need to purchase the given product, as illustrated in *Figure 7*. Although some of the products, such as coffee, were likely to be a purchase that most respondents could relate to, some of the products were potentially harder for some respondents to relate to, due to the high price or specific scenario of the purchase, such as the roof tiles. Therefore, before asking what the respondent was willing to pay the respondent was told that they needed to buy the product and that the option presented was one that met their needs, in order to reduce the risk that a respondent would answer from the perspective that they simply did not want or need the product.

A price was also stated, which was based upon the real prices of specific products available in the market today, accompanied with an image of the product to which the price was sourced from. For example, in the case below, the cabinet is presented as follows and the accompanying image and price is taken from IKEA;

*You need to buy a new cabinet.  
The cabinet that meets your requirements costs 800 kr.*



**Figure 7:** Illustration of how product, price and purchase situation was presented

### *Green alternative*

After the purchase scenario was stated, the green option was presented, including the estimated reduction in carbon emissions. Using the cabinet example, the respondent was told “You have the option to buy an identical product where the only difference is that the steel in the cabinet is fossil free, which would reduce your CO<sub>2</sub> footprint by 27 kg CO<sub>2</sub>.” The approximate impact on the carbon footprint was based on pre-study research and computed via carbon footprint calculators (Poore & Nemecek, 2018), shown in *Figure 8*.

Although sustainability is a topic of increasing interest for many consumers, we identified a risk that respondents would have difficulty grasping the relative size of the carbon footprint in terms of kilos of carbon dioxide (kg of CO<sub>2</sub>). Therefore, a point of reference for the carbon footprint in the form of driving distance was included, where 1.97kg CO<sub>2</sub> is the equivalent of driving 10 km in a Toyota Corolla 2022 (Poore & Nemecek, 2018). Car driving was chosen as a point of reference since it is assumed to be a well-known emitting factor amongst a majority of consumers in our chosen markets. Thus, the saved carbon footprint could be translated into terms of kilometres driving a car, shown in *Figure 8*.

| Product type     | CO2 abatement of using green steel/ammonia (kg CO2) | CO2 abatement in terms of driving (km) |
|------------------|---|--|
| Cleaning product | 0.21  | 1.1                                    |
| Car              | 1140  | 7344                                   |
| Bicycle          | 24  | 123                                    |
| Coffee           | 10.9  | 55.8                                   |
| Roof tiles       | 65  | 331                                    |
| Apple            | 0.18  | 0.9                                    |
| Refrigerator     | 52  | 263                                    |
| Rice             | 20  | 102                                    |
| Cabinet          | 27  | 139                                    |
| Vacuum           | 1.7   | 9                                      |
| Sink             | 8   | 41                                     |
| Bread            | 4.9   | 25                                     |

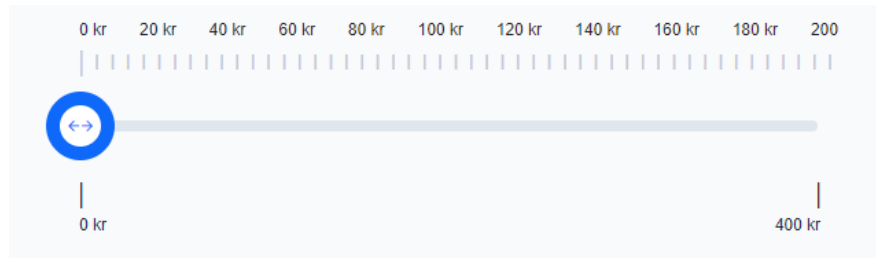
**Figure 8:** CO<sub>2</sub> abatement estimations per product and equivalent emissions in terms of driving

#### *Dependent variable measurement*

As the green versions of the products included in the survey do not exist in the market as of today, the respondent could not be presented with a real purchase scenario. Instead, we sought to capture the potential price that the respondent could consider paying the green alternative. The method used to capture the willingness to pay for the green alternative was *contingent valuation method*, which is a method that is often used to capture what an individual is willing to pay for a product that does not yet exist in the market (Mitchell & Carson, 1989).

Respondents were presented with a scale following the question “How much more would you be willing to pay for the product?”. The price scale was made relative to each product’s base price as the price points varied, starting at zero and up to a maximum of a 50% price increase. However, the price was not presented in terms of percent but instead as the actual price

increase for each product. For example, in the case of the cabinet that cost 800 SEK, the respondent was shown a scale ranging from 0 kr to 400 kr, rather than 0% to 50%. Along the scale there were 20 reference points to help the respondent understand the relative size of the scale. Example shown in *Figure 9*.



**Figure 9:** Screenshot from survey showing scale where respondents could indicate WTPP Intention

### *Zero selection*

If respondents selected zero on the scale, they were directed to a question asking them why they chose zero. Four options were provided, based on previous TOPB studies (Wang et al., 2020). The first option “*I cannot afford it*” was important to include as it reflects an economic inability rather than lack of willingness. As the TOPB model in general, and the factor perceived behavioural control in particular, seeks to measure willingness to pay rather than actual ability to pay, this is a key distinction to pick up and render the zero response not relevant for the subsequent analysis. In line with Ajzen’s original recommendation (1991), these answers were thus excluded.

Three further options were included, based on prior studies, to capture common reasons for why a respondent may not be willing to pay a premium; “*I do not think it will help solve the climate crisis*”, “*It is the government’s responsibility to solve climate issues*” and “*I will not enjoy the benefits of the lower CO2 footprint*”. A final fifth option, “*Other reason*”, was included where respondents could input an additional reason not provided in the aforementioned options.

### *Control question*

As discussed in the *Scientific Approach* section, there are some drawbacks with using online survey platforms, and these can be heightened when sourcing respondents from third party services (Chmielewski & Kucker, 2020). One key risk is that the respondents do not pay attention to the survey and answer the questions without reading the questions or considering their response, leading to low-quality results (Söderlund, 2018). In order to

mitigate this risk, a control question was included in the survey, stating “*To make sure you are reading carefully, please write the numerical form of eight.*”

The intention was to capture any respondents that were blatantly not paying attention to the survey. Any respondents that incorrectly answered this question would be removed from the sample. In addition to the control question, the survey was also developed in a way to increase engagement and reduce responder fatigue. Questions were kept concise, only essential questions were included and images were added to the product sections in order to evoke a stronger and more accurate response.

## Background information

### *Product information*

In order to ensure that all respondents understood the different options they were presented with, some background information was provided at the start of each survey. The information outlined the new technologies that are currently available, their potential impact on the carbon footprint of certain products and that the reduction in carbon emissions will lead to higher production costs, as shown below:

**Steel** is used in a wide range of products used by consumers. Traditional steel production is very carbon intensive, with 1000kg of steel emitting 2000kg of CO<sub>2</sub>. Approximately **7% of global CO<sub>2</sub> emissions come from steel production.**

**New technology** enables green steel production, **reducing emissions by 95%** to 100kg CO<sub>2</sub> per 1000kg of steel.

**Ammonia** is used in a wide range of products used by consumers, including fertilisers and cleaning products. Traditional ammonia production is very carbon intensive, with 1000kg of ammonia emitting 2000kg of CO<sub>2</sub>. **Approximately 2% of global CO<sub>2</sub> emissions come from ammonia production.**

**New technology** enables green ammonia production, **reducing emissions by 95%** to 100kg CO<sub>2</sub> per 1000kg ammonia.

## Differences in surveys for geographic markets

### *Language*

The survey was developed and shared in all markets in English, despite not all the markets having English as their native language. Pollfish includes pre-questions about language



proficiency, and therefore only respondents that selected that they were proficient in English were invited to do the survey. Furthermore, the control question to check for attentiveness would also be a way to catch if a respondent was not proficient enough in the language to understand the question. Lastly, translation into different languages can lead to mis-translations and can increase the risk of respondents understanding information differently. Therefore, no translations into native languages were made for the surveys.

### Products

Although the product types were the same across the surveys, there were certain products that were less generic due to the visible branding or language on the packaging. Thus, some tailoring was made to ensure that respondents in each market would recognise the product type. Local product images were included for coffee, cleaning product and rice, as with rice exemplified in *Figure 10*, shown in full in *Appendix 6*.



**Figure 10:** Different rice product images shown depending on market

### Currency

The product pricing was kept the same between each survey but adjusted for local currency rates to make it easier for the consumer to relate to, based on the exchange rates from 2<sup>nd</sup> of March 2022, shown in *Figure 11* below:

| Euros | Swedish krona | Canadian Dollar | Brazilian Real |
|-------|---------------|-----------------|----------------|
| 1 EUR | 10.76 SEK     | 1.41 CAD        | 5.72 BRL       |

**Figure 11:** Exchange rates used to calculate pricing across markets from 2nd March 2022. Source: (Xe, 2022)

### Review & revisions

Prior to distributing the survey via Pollfish it was shared within our network in order to catch errors or misunderstandings. One issue was raised, which was the phrasing concerning the green alternative. Initially the question to the respondent was phrased “How much more would you be willing to pay for the green steel/ammonia alternative?” However, two respondents had misunderstood the question and thought that the question meant that the steel was in fact

green in colour, rather than in terms of carbon footprint. Therefore, the phrasing was edited to state simply: “*How much more would you be willing to pay for this alternative?*” Aside from this edit, only minor type errors were changed following the circulation of the survey draft.

### **Demographics**

Prior research has indicated that there is key demographic information that can impact WTPP Intention. Olli et al. (2001) show that approximately 10% of environmental actions are explained by socio-demographics. Thus the following factors were included in the survey; age, income, gender, educational level, marital status, number of children, geographic area (rural vs. urban) and living situation (alone vs. with others).

## **Data Quality**

### **Reliability**

Reliability determines if a method measures something consistently. If the same method is re-applied and gives significantly different results, the method can be considered unreliable (Bell et al., 2019). Reliability can be considered both in terms of *stability*, how well the result of a study holds over time, *internal reliability*, whether items within a multi-item scale are consistent in measuring the same intended variable, and *interobserver reliability*, the degree of consistency when more than one person evaluate the same thing (Bell et al., 2019).

### *Stability*

In the case of TOPB, signalling theory and WTPP Intention one could expect results to be relatively stable over time. This is further emphasised by a literature review of the topic, where 53 studies on the topic of green purchase intention in different markets between 2000 and 2014 are reviewed, but reach similar conclusions (Joshi & Rahman, 2015). However, one could imagine that drastic events could impact the WTPP Intention over time, for example news about environmental issues and catastrophes, such as the climate crisis even more rapidly worsening. Such news might increase the WTPP Intention over time, if the perceived threat of the crisis becomes more tangible. On the other hand, negative shocks in the global economy, such as a recession leading to subsequent financial hardship, could decrease the WTPP Intention as consumers adjust their economic priorities.

### *Internal reliability*

In this study internal reliability concerns the factors affecting WTPP Intention by the TOPB model; that there is consistency between the answers on the questions concerning attitudes, subjective norms, and perceived behaviour control. A common method to control and establish internal reliability, Cronbach's Alpha, can be applied, which is measured on a scale between 0 and 1. A Cronbach's Alpha above 0.7 is considered acceptable for reliability purposes (Bell et al., 2019), which is the case for our three constructs, see *Figure 12* below.

| <b>Total model</b> | Attitudes | Subjective Norms | PBC   |
|--------------------|-----------|------------------|-------|
| <b>0.843</b>       | 0.826     | 0.773            | 0.769 |

**Figure 12:** Cronbach's alpha of measures. Notes: PBC = Perceived behavioural control.

### *Interobserver reliability*

The interobserver reliability was strengthened by performing a pre-study to categorise the products into visible and non-visible categories. Although the pre-study included a relatively high number of respondents (N = 139), which increases interobserver reliability, the sample of respondents that completed the pre-study and the main survey are not the same, meaning that there remains some risk that the main survey respondents did not consider the visibility of the products in the same way as those in the pre-study.

Another way to strengthen interobserver reliability was to limit the number of open-ended questions, where responders had no guidance on common or expected answers. Thus, in the main study, most of the answers were limited to scales or multiple choice. The question asking respondents to explain why they selected zero on the willingness to pay scale included three options as well as one open-ended question, which was the only question to provide this option.

## Validity

### *Internal validity*

Internal validity refers to the causality between variables and the degree to which the independent variables can explain the variation in the dependent variable (Bell et al., 2019). To improve internal validity in this study, several actions were taken. Firstly, participants were randomly assigned to whether they were asked about visible or non-visible products, which means that they were randomly assigned one of two treatment groups. This mitigated

the risk of selection effects, in other words, that the participants in the two treatment groups differ significantly from each other in any way. Secondly, the surveys were released at the same time, which mitigated risks to internal validation related to timing. We could not control for the time of the day when the participants answered the survey but do not expect this to have any significant effect on results.

Moreover, the causal relationships within the TOPB model concerning the relationship of attitudes, subjective norms, and perceived behavioural control on WTPP Intention have been tested and proven in previous studies, as discussed in the hypothesis generation (see *Figure 3*), which strengthens the validity of these variable relationships.

One risk related to internal validity in this study concerns the product selection and groupings. As the study compares the effect of different types of products rather than different versions of the same product, the products are different in many ways, more than simply being visible or non-visible, which is further discussed under *Limitations and Suggestions for Future Research*. Lastly, the internal validity could have been improved by conducting a real-life experiment, such as in a lab setting (Berger, 2019). However, there is an inherent trade-off between internal and external validity; the more specific and controlled research setting, the less generalisable it becomes. In this study, the aim was to increase the generalisability of the results.

#### *External validity*

External validity concerns how well a study can be applied in other contexts outside the scope of the particular study, thus how generalisable the study is (Bell et al., 2019). Several actions were taken to improve the generalisability of the study. The study includes data from four different markets, with over 300 respondents per market, in three different continents spanning a wide range of ages, incomes, educational levels and fairly even gender balance. This large and diverse sample size significantly increases the study's generalisability compared to if it was limited to only one market, region, or demographic skew. However, the validity could be further improved with even more respondents. The external validity could also have been improved by including more markets to cover a larger geographical area, for instance by including countries in Africa or Asia.

#### *Measurement validity*

Measurement validity implies how well a measure, in our case variables, describes what is intended to be measured (Bell et al., 2019). Overall, the variables used in the study are well established and have been used in previous research, as described in theory. Although these variables require self-reporting, which by nature make them more subjective and thus less reliable than objective measures, the use of scales has been accepted and proven to be good indications of attitudes and value perceptions (Söderlund, 2018). Although the validity could have been further improved by including additional questions for each factor, there is a trade-off between being exhaustive in capturing the essence of the factor and keeping the attention of the respondent, which is why the number of questions was limited.

Further, contingent valuation was used to measure WTPP Intention. This method is used by a majority of the recent TOPB research, as it fits the theoretical model well due to the hypothetical nature of the scenarios that the theory usually is testing. One limitation of the contingent valuation approach is linked to the drawbacks of using surveys as a way to test consumer behaviour; that asking a question does not accurately reflect actual intention or behaviour. However, Harris et al (Harris et al., 1989) concluded that it is a method that “fits nicely” with theories appraising reasoned action, such as Ajzen’s theory of planned behaviour, further confirmed by Rekola (Rekola, 2001), as it provides an adequate decision structure for a choice that does not exist in real life and therefore is difficult to measure in other ways. Hence, contingent valuation’s widespread use in existing theory of planned behaviour and WTP research (López-Mosquera et al., 2014; López-Mosquera, 2016) e.g., López-Mosquera et al., 2014; López-Mosquera, 2016).

## Replicability

Reliability implies how trustworthy a study is and if the results would be the same if the study was replicated (Bell et al., 2019). In order to ensure that it is replicable this study has well-documented steps theoretically, methodically, and empirically. Further, the measures and methods are adapted from previous studies in the same field of research, which increases the possibilities for replication. However, since the study is based on a unique sample acquired through the online distribution service Pollfish, it is impossible to complete a fully identical study with the same sample of respondents. Thus, identical results cannot be expected if replicating the study on another sample.

Further, the experiment of the present study was pre-registered on OSF. Pre-registration was done to reduce the risk of publication bias, where only positive results are published, and developing hypotheses after the results are known (OSF, 2022).

## Research ethics

Research ethics concerns the ethical relationship between the researchers and the participants in a study (Bell et al., 2019). Four dimensions that are commonly discussed are harm to participants, lack of informed consent, invasion of privacy and deception (Diener & Crandall, 1978).

Upon assessment, this study is not believed to have caused any physical or emotional harm to participants; neither in the industry expert interviews nor either of the surveys. Participants could at any point terminate the survey and no questions were considered to be harmful. The survey sample is large and anonymised with unique respondent identification numbers so individual respondents cannot be identified in the results. As for informed consent, each respondent was provided with information that their personal data would be handled in accordance with GDPR regulations, see all surveys in *Appendices 4,5 and 6*. In the case of the main study, respondents were also informed that Pollfish is a third-party survey distributor and of their terms and conditions. The respondents were also notified all data would be deleted after the completion of the study and that all data provided was anonymous. Lastly, our judgement is that there is little risk for deception. The purpose of the research project and our own interests were clearly stated at the beginning of the interviews. Lastly, if the participants chose zero premium in the main survey, they were presented with four potential reasons as to why they did so, as well as an open-ended field so that they were not forced to choose a reason that they did not identify themselves with.

## Data review and quality

### *Data cleaning*

All respondents that answered the attention check question incorrectly were excluded from the data set. Upon further review, some additional respondents were eliminated due to answers that clearly demonstrated that the respondent did not read or did not understand the question. Respondents that answered zero with the reason that they could not afford any premium, were also excluded. The reason for this was to isolate the willingness to pay rather

than the actual ability to pay, as discussed in the *Theory* chapter. In total, 79 respondents were excluded, leaving a total respondent population of 1402, shown in *Figure 13*. Given that 6 products were used in each group, the total number of observations amounted to 8412.

|                                       |             |
|---------------------------------------|-------------|
| <b>Original sample population</b>     | <b>1502</b> |
| Answers failing attention check       | -23         |
| Respondents answering “Cannot afford” | -79         |
| <b>Final data set</b>                 | <b>1402</b> |

**Figure 13:** Final data set after data cleaning

After excluding the responses of those who answered that they cannot afford to pay for a green premium, there remained a group of respondents who declared they would not be willing to pay a green premium. In total, 63 respondents, which is 4.5% of the total sample population, answered that they were not willing to pay a green premium for at least one product, see *Figure 14*. However, as shown in and *Figure 15*, across each of the six product questions the number of observations with this answer was 173. In other words, many of those who answered that they were not willing to pay did so for several products. The most common answer given for not wanting to pay a premium was that the respondent did not think that the action would help solve the climate crisis (61.3%), followed by the respondent thinking that it was the government’s responsibility to solve the climate issues (22.0%) and lastly that the respondent would not enjoy the benefits of the lower carbon footprint (16.8%).

| <b>Response</b>   | <b>N of respondents</b> | <b>%</b>    |
|---|-------------------------|-------------|
| Answered they were not willing to pay a premium at least once | 63                      | 4.5%        |
| Never answered they were not willing to pay                   | 1339                    | 95.5%       |
| <b>Total</b>  | <b>1402</b>             | <b>100%</b> |

**Figure 14:** Frequency of respondents who answered at least once they were not willing to pay a green premium

| <b>Reason for not willing to pay green premium</b>              | <b>N of observations</b> | <b>%</b>    |
|---|--------------------------|-------------|
| “I do not think it will help solve the climate crisis”          | 106                      | 61.3%       |
| “It is the government’s responsibility to solve climate issues” | 38                       | 22.0%       |
| “I will not enjoy the benefits of the lower CO2 footprint”      | 29                       | 16.8%       |
| <b>Total</b>  | <b>173</b>               | <b>100%</b> |

**Figure 15:** Frequency of observations for the question of why a respondent selected they did not want to pay a green premium across the six products

### *Recoding of variables*

Before analysing the data, several variables were recoded. Firstly, WTPP Intention was collected as a percentage where respondents indicated on a scale from 0% to 50% of the original product price. However, Pollfish imported the data on a 0 to 100 scale. Therefore we transformed the variable by dividing it by two, to make the variable more intuitively reflect what was measured in the survey. Secondly, the three TOPB variables were collected on a 7-point Likert scale, with three questions for each variable. In order to have the answers on a continuous scale and summarised into three single variables, the mean of the three answers was taken, creating three new variables: average attitude, average subjective norms, and average perceived behavioural control.

Thirdly, some of the demographic data was also recoded in order to make them easier to analyse. Age was collected automatically by Pollfish as year of birth and was thus recoded firstly into actual age by subtracting each response from the current year, 2022, and then the lowest age, 18, was subtracted from all results, leaving us with a so-called minimum-centred age. Using minimum-centred age instead of actual age or age groups makes the results easier to interpret from the regression model. Income was collected automatically by Pollfish in seven categories and coded in a non-linear way between 1-7. To simplify the data, income was categorised into three groups - Low, Medium and High - as well as the “Prefer not to say” option. Using Sweden as a reference country, where the average national wage is 433 000 SEK per year (Statistikmyndigheten, 2022), the “Medium” category was defined as including wages between 225 000 and 675 000 SEK per year. Subsequently, wages below 225 000 SEK per year were considered “Low” and those above 675 000 SEK per year “High”. Education was collected by Pollfish in seven categories ranging from “elementary school” to “post-graduate” and coded in a non-linear way. To simplify this analysis, Education was recoded into a dummy variable; either university and above or below university. Lastly, Visibility was coded as a dummy variable.

## Sample

### *Sample demographics*

As shown in *Figure 16*, more than 55.4% of the respondents are men, while 46.6% are women. The age groups are relatively evenly distributed across the respondents, with the age groups 25-34 and 35-44 being most common, representing almost half of the sample. A majority of



the respondents are highly educated, meaning that they have at least a university degree. Further, almost exactly half of the respondents are parents and have at least one child. The living situation of the respondents is 74.3% of the cases together with friends or family, while 25.7% live alone. 75.7% live in city or urban areas, whereas 24.3% live in the countryside. Lastly, Brazil constitutes the highest proportion of respondents with 27% of the sample, whereas Sweden has the lowest proportion with 22.8% of the respondents.

| Demographic variable | Category                            | Frequency | Percentage |
|----------------------|-------------------------------------|-----------|------------|
| Gender               | Male                                | 820       | 55.4%      |
|                      | Female                              | 661       | 44.6%      |
| Age Group            | 18 – 24                             | 190       | 12.8%      |
|                      | 25 – 43                             | 351       | 23.7%      |
|                      | 35 – 44                             | 362       | 24.4%      |
|                      | 45 – 54                             | 262       | 17.7%      |
|                      | 55 – 64                             | 264       | 17.8%      |
|                      | 65+                                 | 52        | 3.5%       |
| Education            | Below university                    | 684       | 46.2%      |
|                      | University and above                | 797       | 53.8%      |
| Income               | Low                                 | 333       | 22.5%      |
|                      | Medium                              | 516       | 34.8%      |
|                      | High                                | 531       | 22.5%      |
|                      | Prefer not to say                   | 101       | 6.8%       |
| Parent               | No children                         | 749       | 50.6%      |
|                      | Children                            | 739       | 49.4%      |
| Living situation     | Living with friends or family       | 1101      | 74.3%      |
|                      | Living alone                        | 380       | 25.7%      |
| Urban or countryside | Living in small town or countryside | 360       | 24.3%      |
|                      | Living in city or urban area        | 1121      | 75.7%      |
| Country              | Sweden                              | 337       | 22.8%      |
|                      | Brazil                              | 400       | 27.0%      |
|                      | Canada                              | 395       | 26.7%      |
|                      | Germany                             | 349       | 23.6%      |

**Figure 16:** Demographic profile of final data sample

### *Multicollinearity*

Multicollinearity is present when one or several variables are highly correlated with each other, which can lead to issues with identifying the true effects of the individual variables. In the case of multicollinearity, the regression model generates a high  $R^2$  value, but the regression coefficients often also show high standard errors. To investigate whether multicollinearity was present, a correlation matrix between the variables was made, see *Figure 17*. We can establish that there were no multicollinearity issues, as the correlation between variables was not +/-0.8 as highest or lowest (Brooks, 2019).

| V# | Correlation       | 1        | 2      | 3        | 4       | 5        | 6       | 7        | 8       | 9        | 10       | 11    | Min | Max | Mean | SD   |
|----|-------------------|----------|--------|----------|---------|----------|---------|----------|---------|----------|----------|-------|-----|-----|------|------|
| 1  | <b>WTP</b>        |          |        |          |         |          |         |          |         |          |          |       | 0   | 50  | 15.7 | 11.1 |
| 2  | <b>Visibility</b> | 0.090**  |        |          |         |          |         |          |         |          |          |       | 0   | 1   | 0.52 | 0.50 |
| 3  | <b>Attitude</b>   | -0.009   | -0.009 |          |         |          |         |          |         |          |          |       | 1   | 7   | 5.52 | 1.23 |
| 4  | <b>Norm</b>       | 0.169**  | -0.014 | 0.338**  |         |          |         |          |         |          |          |       | 1   | 7   | 4.43 | 1.25 |
| 5  | <b>PBC</b>        | 0.192**  | -0.028 | 0.603**  | 0.454** |          |         |          |         |          |          |       | 1   | 7   | 5.25 | 1.18 |
| 6  | <b>Age</b>        | -0.106** | -0.007 | 0.083**  | 0.054*  | 0.068**  |         |          |         |          |          |       | 0   | 59  | 23.1 | 14.2 |
| 7  | <b>Gender</b>     | 0.091**  | 0.010  | 0.012    | 0.014   | 0.030    | 0.059*  |          |         |          |          |       | 0   | 1   | 0.45 | 0.50 |
| 8  | <b>Income</b>     | -0.088** | 0.021  | 0.030    | 0.125** | 0.007    | 0.016   | -0.169** |         |          |          |       | 0   | 3   | 2.00 | 0.93 |
| 9  | <b>Education</b>  | 0.006    | -0.008 | 0.124**  | 0.110** | 0.142**  | 0.089** | 0.009    | 0.233** |          |          |       | 0   | 1   | 0.54 | 0.50 |
| 10 | <b>Parent</b>     | 0.137**  | -0.006 | 0.029    | 0.141** | 0.173**  | 0.066*  | 0.012    | 0.134** | 0.0114** |          |       | 0   | 1   | 0.49 | 0.50 |
| 11 | <b>Living</b>     | 0.083**  | -0.010 | -0.110** | -0.009  | -0.130** | 0.052*  | 0.058*   | -0.025  | -0.057*  | -0.250** |       | 0   | 1   | 0.26 | 0.44 |
| 12 | <b>Urban</b>      | 0.054*   | 0.000  | 0.053*   | 0.043   | 0.104**  | 0.011   | 0.012    | -0.014  | 0.122**  | 0.031    | 0.012 | 0   | 1   | 0.76 | 0.43 |

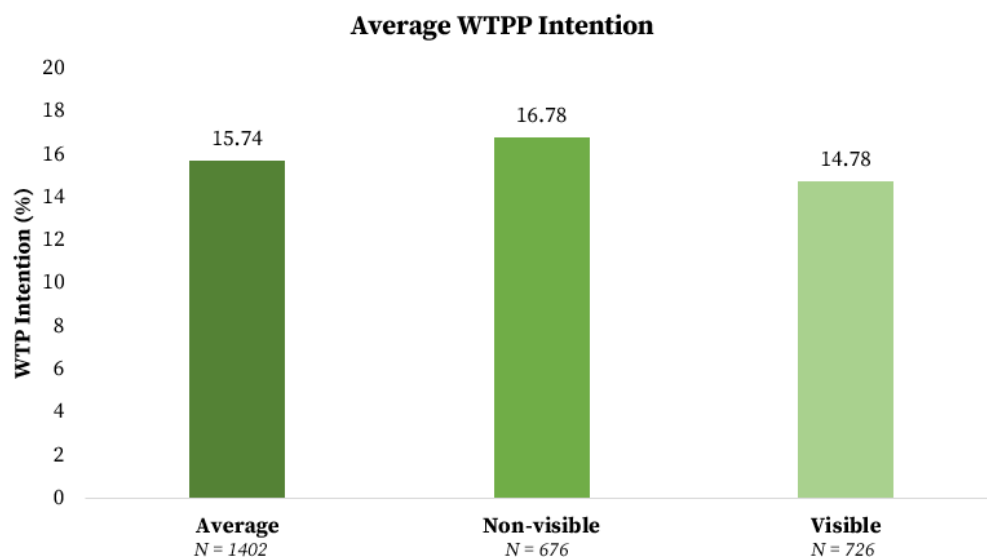
**Figure 17:** Correlation table for each measured variable, fixed effects of country included. Notes: V# = variable number, WTP = WTPP Intention, PBC = Perceived behavioural control, Age = minimum-centred age starting at 18, Gender where 1 = female, Parent = whether parent or not where 1 = respondent is parent, Living = living situation where 1 = living alone, Education where 1 = university level or above, Urban = living in countryside or city where 1 = city.

# Results & Analysis

*This section explains how the data, via a lined mixed effects regression model, was analysed and whether the results support the hypotheses.*

## Results

On average, respondents stated that they intend to pay 15.74% more for green alternatives for the selected products. Further, when comparing the intended WTP between product visibility, the results show that the mean WTPP Intention is in fact higher for non-visible products (M = 16.78%) compared to visible (M = 14.78%), shown in *Figure 18*.

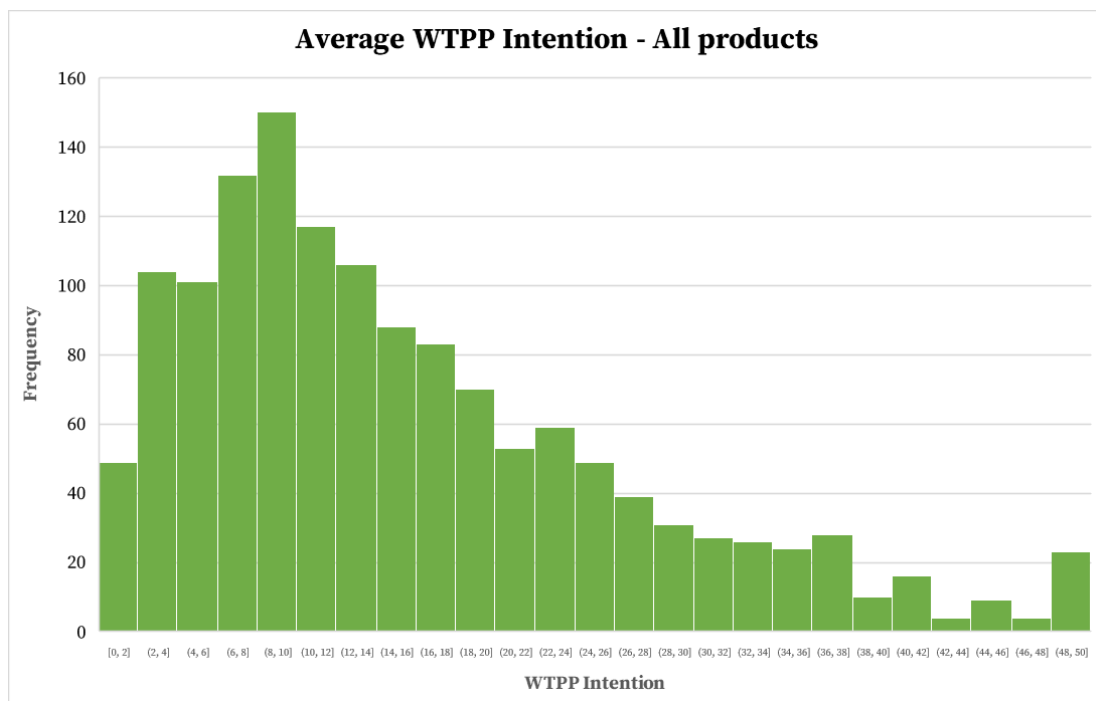


**Figure 18:** Average WTP intention by visibility

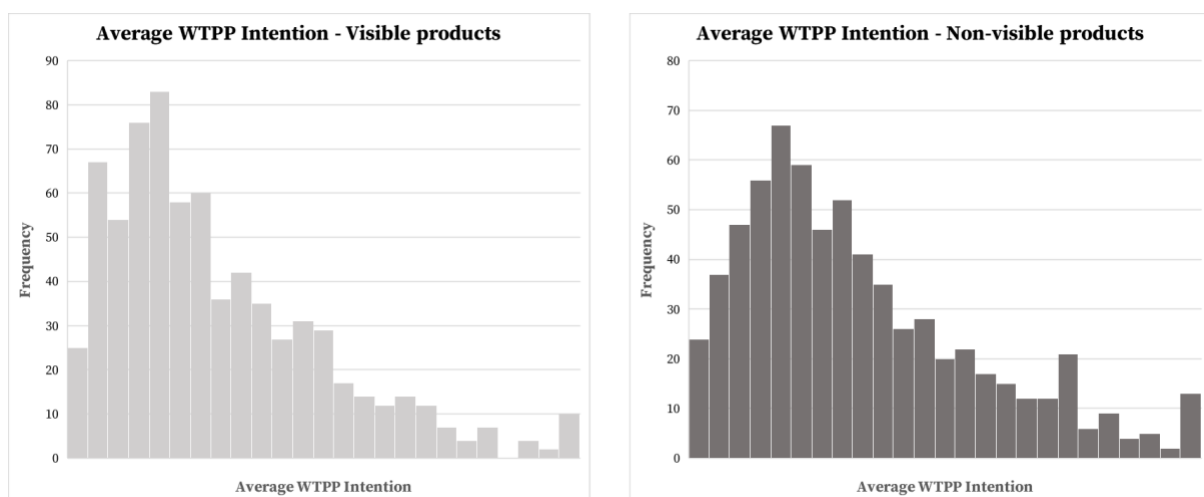
By doing a mean comparison between groups through an ANOVA test, it could be concluded that there was a statistically significant difference between the visible and non-visible product groups, as can be seen in *Appendix 9*. In order to understand the reasons behind this effect and how visibility impacts WTPP Intention within the context of the additional established factors impacting purchase intention, such as the TOPB variables and identified covariates, a linear mixed-effects regression analysis was also performed in addition to the mean comparison, presented in section *Model Construction*.

*Figures 19, 20 and 21 show the frequency distribution of WTPP Intention and for each visibility the data follows a normal distribution. On average and for both visibilities, the distribution is skewed to the right in a positive skew, with a higher mean (visible M = 16.78,*

non-visible  $M = 14.78$ ) than median (visible  $Mdn = 12.04$ , non-visible  $Mdn = 14.13$ ) indicating potential presence of anomalies. As can be seen in the graphs, there are some respondents that have selected close to or the highest value (50% price premium). In total, 30 respondents out of 1402 selected between 45% and 50%. When presented with the choice to treat the answers as outliers and remove them from the sample, or to keep them in the analysis, the decision was made to proceed with the latter. The reasoning for this decision is that showing the highest WTPP Intention should not be penalised in itself. Including premiums up to 50% is also suggested by previous research (Wan et al., 2018) (Berger, 2019).



**Figure 19:** Frequency distributions of average WTPP Intention for all products

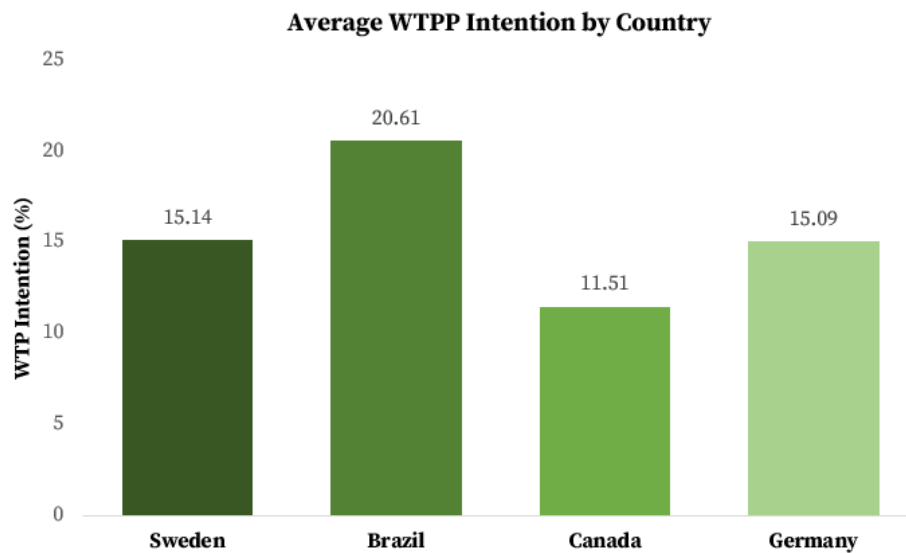


**Figure 20:** (left): Frequency distributions of average WTPP Intention for visible products

**Figure 21:** (right): Frequency distributions of average WTPP intention for non-visible products

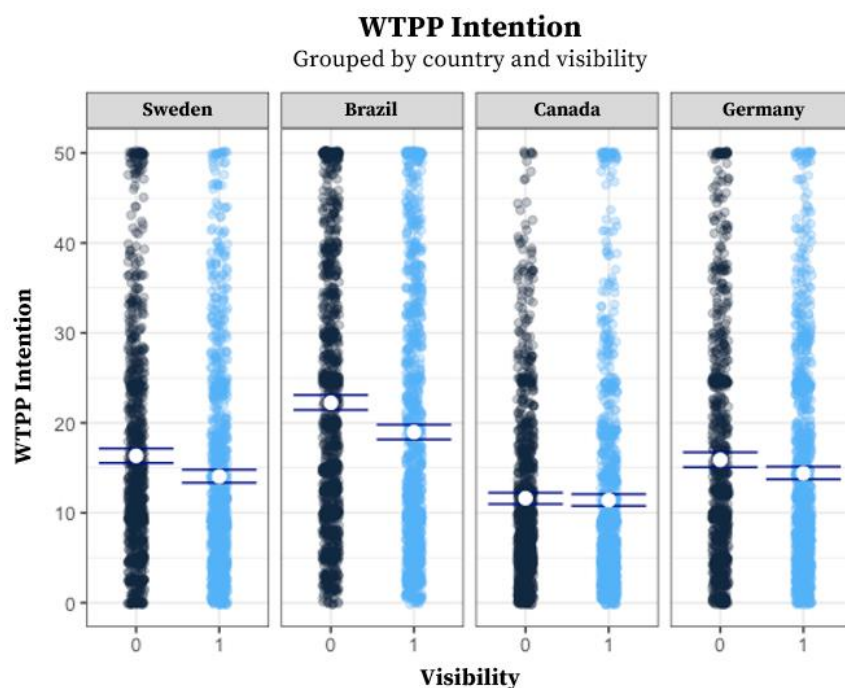
On a country-by-country comparison, shown in Figure 22, there are some noteworthy differences in WTPP Intention. Brazil has the highest mean for green premium ( $M = 20.61\%$ )

compared to Canada that had the lowest ( $M = 11.51\%$ ). The WTPP Intention is similar in Sweden and Germany, with a mean premium of 15.14% and 15.09% respectively.



*Figure 22: Mean WTPP Intention by country*

Figure 23 shows the distributions of WTPP Intention of visible and non-visible in each market. The mean WTPP Intention is higher for non-visible products for all markets except Canada. Further, one can see that the distributions are similar in each market with slightly fewer responses in the higher WTPP Intentions for visible products compared to visible.



*Figure 23: Distribution and mean WTPP Intention for visible vs. non-visible products by country.*

Notes: Visibility, 1 = visible, 0 = non-visible.

### *Descriptive statistics of the non-randomly assigned independent variables*

Average attitude reported the highest average mean (5.56) and the mean for each of the three individual questions was higher than for any other question, shown in *Figure 24*. The answers to the subjective norm questions were the lowest in terms of mean; the average answer was 4.49 and each of the individual questions had a lower mean than the other two factors. In comparison, perceived behavioural control had an average mean of 5.31. Attitude responses also had the highest first and third quartile responses; 75% of respondents answered between 5 and 7 and the top 25% responded 7 for each attitude question. In comparison, only one of the perceived behavioural control questions and none of the subjective norm questions had a third quartile response as high as attitude. The first quartile ranged between 3 and 4 for subjective norms and between 4 and 5 for the perceived behavioural control questions.

| Question  | Mean (SD)          | 1 <sup>st</sup> Quartile | 3 <sup>rd</sup> Quartile |
|---|--------------------|--------------------------|--------------------------|
| <b>Attitude (Average)</b>   | <b>5.56 (1.21)</b> | <b>5.00</b>              | <b>6.33</b>              |
| "Purchasing products with lower CO2 footprint is necessary to mitigate global warming"                              | 5.46 (1.51)        | 5.00                     | 7.00                     |
| "Between products with higher CO2 footprint and lower CO2 footprint, I prefer the product with lower CO2 footprint" | 5.58 (1.37)        | 5.00                     | 7.00                     |
| "I think purchasing products with lower CO2 footprint is very responsible"  | 5.64 (1.35)        | 5.00                     | 7.00                     |
| <b>Subjective Norms (Average)</b>   | <b>4.49 (1.22)</b> | <b>3.67</b>              | <b>5.33</b>              |
| "People around me think that others should pay for sustainable product alternatives"                                | 4.49 (1.44)        | 4.00                     | 6.00                     |
| "People that are close to me think that I should make environmentally friendly purchase choices"                    | 4.63 (1.45)        | 4.00                     | 6.00                     |
| "Many of my friends and family are willing to pay more for products that are lower in CO2"                          | 4.36 (1.55)        | 3.00                     | 5.00                     |
| <b>Perceived behavioural control (Average)</b>  | <b>5.31 (1.14)</b> | <b>4.67</b>              | <b>6.00</b>              |
| "I feel capable of purchasing sustainable product alternatives"   | 4.99 (1.43)        | 4.00                     | 6.00                     |
| "What I purchase as a consumer has an effect on environmental impact"   | 5.56 (1.33)        | 5.00                     | 7.00                     |
| "I feel I can help impact environmental problems by buying products with a low CO2 footprint"                       | 5.37 (1.38)        | 5.00                     | 6.00                     |

**Figure 24:** Descriptive statistics for Attitudes, Subjective Norms and Perceived behavioural control responses  
Notes: SD = Standard deviation.

## **Model construction**

### *Linear mixed-effects model*

A linear mixed-effects model was used to calculate the effects of visibility and TOPB on WTPP Intention. The model is appropriate since the WTPP Intention was collected for six products for each respondent, either visible or non-visible, and thus each respondent had repeated measures, increasing the power of the model. Compared to a linear model where each observation is independent, a mixed-effects model assumes that there is a dependence structure across repeated observations (Oberg & Mahoney, 2007). As each respondent in this

study answers several questions within either the category “visible” or “non-visible”, rather than treating these as a single variable in a linear regression, the mixed-effects model takes into consideration that the same respondent answers multiple questions within its randomly assigned group. The model was computed using the statistical software *R*.

#### *Model construction*

In order to test the established hypotheses, several models were developed by adding each of the recorded variables and assessing the statistical significance of the variables (*p-value*), regression coefficient ( $\beta$ ), and the variance explained in the dependent variable ( $R^2$ ).

To find the optimal model, forward stepwise selection was used, shown in *Figure 23*. Starting with an empty model, each independent variable was added step-by-step for each hypothesis. After that, the collected covariates were added to see whether they adjusted the main effect. If a covariate did not contribute to the model, meaning that it did not have a statistically significant relationship with the dependent variable, it was removed. Following this process, the covariates Income, Education, Living Situation, and Urban/Rural, were all tested and removed since they did not have a *p-value* below 0.10, see *Appendix 7*. Country variables were kept as fixed effects, i.e. not broken out separately, as the aim of the study was not to do a comparative analysis between markets. The final and preferred model is Model 7, see *Figure 25*.

|                               |                      |                      |                      |                      |                      |                      |                      |
|-------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Observations N = 8412         | 1                    | 2                    | 3                    | 4                    | 5                    | 6                    | 7                    |
| Visibility                    | -1.856***<br>(0.563) | -1.870***<br>(0.563) | -1.839***<br>(0.549) | -1.785***<br>(0.543) | -1.788***<br>(0.540) | -1.790***<br>(0.539) | -1.817***<br>(0.536) |
| Attitude                      |                      | -0.368<br>(0.232)    | -1.040***<br>(0.240) | -1.832***<br>(0.279) | -1.762***<br>(0.277) | -1.701***<br>(0.278) | -1.711***<br>(0.277) |
| Subjective Norm               |                      |                      | 2.040***<br>(0.238)  | 1.560***<br>(0.252)  | 1.602***<br>(0.250)  | 1.541***<br>(0.251)  | 1.544***<br>(0.250)  |
| Perceived Behavioural Control |                      |                      |                      | 1.741***<br>(0.321)  | 1.749***<br>(0.319)  | 1.662***<br>(0.321)  | 1.649***<br>(0.319)  |
| Age                           |                      |                      |                      |                      | -0.025***<br>(0.019) | -0.088***<br>(0.019) | -0.092***<br>(0.019) |
| Parent                        |                      |                      |                      |                      |                      | 1.305*<br>(0.556)    | 1.324*<br>(0.553)    |
| Gender                        |                      |                      |                      |                      |                      |                      | 2.099***<br>(0.550)  |
| Country Level Fixed Effects   | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Constant                      | 16.105<br>***        | 18.176<br>***        | 12.355<br>***        | 10.046<br>***        | 11.487<br>***        | 11.365<br>***        | 10.867<br>***        |
| r <sup>2</sup>                | 0.070                | 0.071                | 0.102                | 0.115                | 0.123                | 0.125                | 0.131                |

Robust standard errors in parentheses.

Not significant =  $p > 0.05$

\* =  $p \leq 0.05$  (5%)

\*\* =  $p \leq 0.01$  (1%)

\*\*\* =  $p \leq 0.001$  (0.1%)

**Figure 25:** Linear mixed effects models 1 - 7. Notes: Age = minimum-centred age starting at 18, Gender where 1 = female, Parent = whether parent or not where 1 = respondent is parent.

## Hypothesis testing

The results of the final linear mixed effects regression model (Model 7) show statistically significant relationships between WTPP Intention and Visibility, Attitude, Subjective Norm, PBC, Age, Parent, Gender, and Country. All of the independent variables are statistically significant on the highest level, 0.1%, except for Parent, which has a significance level of 5%. The independent variables in the model contribute to explain a variance in the dependent variable, WTPP Intention, of 13.1%. Using the results from the preferred model, Model 7, the hypotheses derived from our theoretical framework were tested.

The results indicate that the relationship for H1 is reversed, since the coefficient is negative ( $\beta = -1.711$ ,  $p < .001$ ). This can be interpreted as that the more positive attitude individuals have towards paying a premium for a sustainable product, the less likely they are to indicate a higher WTPP Intention. Thus, H1 is not supported.



**H1:** As attitudes towards paying a premium for green products becomes more positive, the green premium a person intends to pay increases

**NOT SUPPORTED**

H2 is statistically significant on the highest level, resulting in a positive coefficient of 1.544 ( $p < .001$ ). Thereby, H2 is supported.

**H2:** As subjective norms regarding paying a premium for green products becomes more positive, the green premium a person intends to pay increases

**SUPPORTED**

The final model supports H3, resulting in a positive coefficient of 1.649 ( $p < .001$ ).

**H3:** As perceived behavioural control of paying a premium for green products increases, the green premium a person intends to pay increases

**SUPPORTED**

The preferred model illustrates a statistically significant relation in the opposite direction than hypothesised, with a regression coefficient of -1.8167 ( $p < .001$ ). This indicates that if a product is less visible, a person intends to pay a higher percentual green price premium compared to more visible products. As a consequence, H4 is not supported.

**H4:** If a product is visible, the green premium a person intends to pay will increase, compared to a product that is not visible

|                      |
|----------------------|
| <b>NOT SUPPORTED</b> |
|----------------------|

#### *Covariate results*

Three covariates contribute significantly to the WTPP Intention, as well as improve the  $R^2$ , and are therefore included in the final model. Age has a slightly negative coefficient of -0,092, indicating that older people have a lower WTPP Intention ( $p < .001$ ). Being a parent impacts the WTPP Intention positively ( $\beta = 1.324$ ,  $p < .05$ ). Lastly, gender also has a significant impact on WTPP Intention ( $\beta = 2.099$ ,  $p < .001$ ), proving that an average female survey respondent tends to have a higher WTPP Intention than a male respondent.

# Discussion

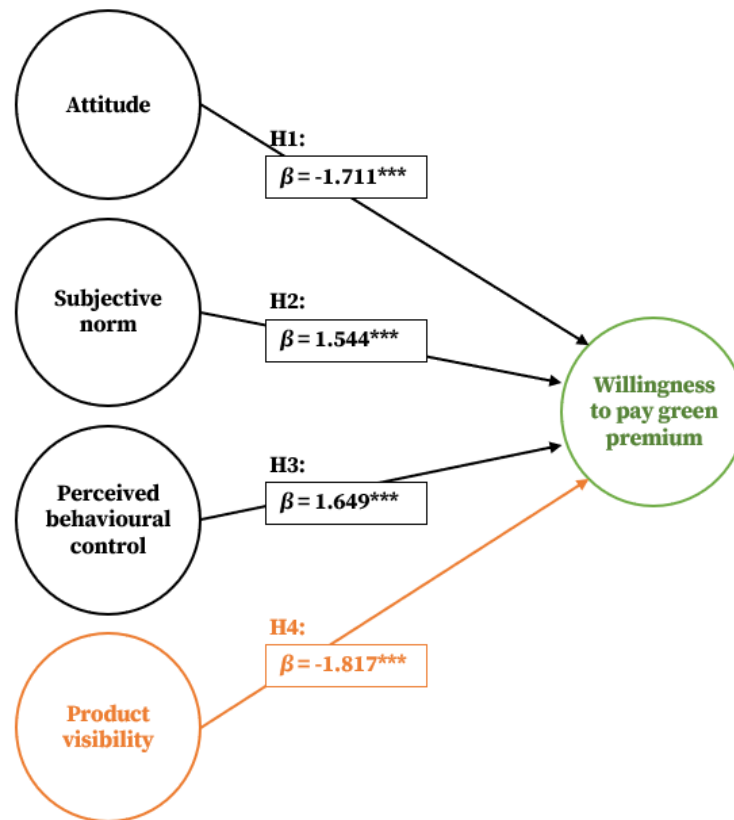
## Study results & existing literature

### Willingness to pay a green premium

Under pressure from new regulations and consumer demand, companies and entrepreneurs are looking at ways to reduce the carbon footprint of their products and investing in new technologies in order to do so (Lestari et al., 2021). However, the most fundamental requirement in order to rationalise such investments and reshape industries is to understand whether the consumer is willing to pay a premium for such products and whether that premium will cover increased production costs. For hard-to-abate industries such as steel and ammonia production, these investments will be significant (Musleman et al., 2021; Yara, 2022). Therefore, the finding in our study that 95.5% of all respondents indicated some level of WTPP Intention for a green alternative is aligned with Wan et al. (2018) and is of great interest to industries who find themselves considering such investments. Our findings are in stark contrast to a study on Chinese consumers, where only 30.1% stated that they were willing to pay any price premium for green products (Yang, Chen et al. 2021). Further, the median price premium in our study, i.e. the premium that 50% of the respondents were willing to pay, was 12%, which is slightly higher than previous studies that returned a median result of 10% (Wan, Zhang et al. 2018, de Medeiros, Ribeiro et al. 2016). In our study the mean WTPP Intention was 15.7%, and 2% of respondents claimed they are willing to pay a 50% premium or higher. This is a higher price premium than for Israeli consumers (Ofek & Portnov, 2020) and in a similar range as findings from Spanish consumers' WTPP Intention (de-Magistris & Gracia, 2016).

### Theory of planned behaviour model

In terms of the TOPB model, the results of this study, see *Figure 26*, are mixed in how they align with expectations and previous literature.



**Figure 26:** Conceptual framework showing coefficients from preferred regression model for each hypothesis

The results indicate the opposite relationship than what H1 predicted, as well as what empirical findings from previous theory of planned behaviour studies have shown. While existing literature has considered attitude as the poorest predictor to intention or behaviour in the TOPB model, most studies have generally found a weak but positive relationship between the two (Al Mamun et al., 2018; He et al., 2021; López-Mosquera et al., 2014), in contrast to the results of this study. The negative sign of the regression coefficient is therefore a surprising and interesting result. The results suggest a disconnect between attitude and WTPP Intention; although a person ranks their own attitudes to be very strong, their reported purchase intention does not match the attitude level.

Ajzen has raised the concern that attitudes alone are a poor predictor of purchase intention (2001). This is illustrated in this study by the fact that the variance in WTPP Intention is increased by only 0.1% when attitude is added to our regression model (see *Figure 23*). Therefore, we can conclude that even though it has a significant contribution to the model, the impact is very small.

Looking at the average values of the survey answers on attitude, subjective norms, and perceived behavioural control, attitude has the highest average mean value out of the three: 5.56 out of 7, compared to 4.49 and 5.31, respectively. Further, the quartile breakdown illustrates that 75% of the respondents have self-reported 5 or higher on the attitude statements, which could be considered high. This is in contrast to López-Mosquera et al. (2014) who found a higher mean value of perceived behavioural control than for attitudes. The high scores could be explained by the fact that sustainability and CO<sub>2</sub> emissions have become increasingly important societal topics, which could inflate the average consumer's reported attitude. So why does the high attitude scores not translate to a higher WTPP Intention? To explain this discrepancy one can revisit the green attitude-behaviour gap, which in this case instead is an attitude-intention gap, which is prevalent in several similar studies (Joshi & Rahman, 2015). Our results indicate that it is not sufficient or reliable to rely only on what people say is important to them in order to understand what they are actually willing to sacrifice to act in alignment with their opinions.

The support of H2 is in line with the findings of Yadav (2017) who analysed the purchase intention for green products in India, as well as Al Mamun et al. (2018) and Rezai et al. (2013) who investigated the WTP for green products in Malaysia. Al Mamun et al. (2018) explained that their results are strengthened by the fact that Malaysia is a collectivist society, like many other Asian countries, where subjective norms can have a stronger contributory effect on an individual's behaviour. Therefore, it is interesting that our study reached the same results as these three studies that were conducted in two culturally different markets compared to the four markets of this study. Wang et al. (2020), López-Mosquera et al. (2014), López-Mosquera (2016) and Rekola (2001), did not find any support for the impact of subjective norms on WTP. Nevertheless, the confirmation of H2 is supported by the original TOPB framework and implies that if the respondents' social groups are environmentally conscious, the respondent is likely to be affected by it and thus WTPP Intention for green products.

Lastly, H3 is a statistically significant positive predictor of WTPP Intention for green products in this study. These findings are in agreement with Yadav (2017), Rezai et al. (2013), Al Mamun et al. (2018), López-Mosquera (2016), Wang et al (2020), and Rekola (2001). This contradicts López-Mosquera et al. (2014) who did not find any support for the same variable. This outcome suggests that respondents felt that their green purchase behaviour does have an actual impact towards a better environment, and that such a feeling of perceived control

leads to a WTPP. Further, it implies that consumers feel that they can mitigate environmental issues by purchasing green products instead of their non-green counterparts, which they on average are willing to pay for.

## Visibility and green signalling

The results of the study show that although product visibility does significantly impact WTPP Intention, the hypothesised relationship goes in the opposite direction; respondents are likely to pay a higher premium for non-visible products than for the visible products. The result of H4 is surprising given the theoretical framework and the foundation in green signalling theory. As a consequence, the result is at odds with Berger (2019), Sexton and Sexton (2014) as well as Delgado et al. (2015), who found the opposite effect of visibility on WTP. However, the two latter investigated the Toyota Prius, which is a hybrid car with a distinct design that for many people is known to be green. In comparison, our study has analysed the WTPP Intention for green products that look exactly the same as their non-green counterparts. Thus, this suggests that consumers might be more willing to pay for highly visible products with a distinct design that are clearly recognisable as green, rather than visible to others but without any labelling or characteristics that make them distinguishable as green. Thereby, green products that are not distinguishable from their non-green counterparts, does not seem to be explained by green signalling theory that has costly signalling theory as a basis.

However, it is worth noting that although the premium for visible products was lower than for non-visible products, both product groups resulted in a majority of study participants stating a WTPP. Looking at some of the products included within each of the product baskets, the differences in premiums are in some cases similar to previous research. For example, a previous study on the green signalling effect of a Toyota Prius resulted in an indicated premium of 4.5% (Delgado et al., 2015), which is significantly lower than another study looking at household items such as washing up liquid, where the price premiums ranged between 17% to 27% (Berger, 2019). The way in which our product groups were created would categorise Berger's products as non-visible and the Toyota Prius (Delgado et al., 2015) as visible. Comparing their premiums therefore leads to a similar conclusion as our study; that visible products lead to a lower price premium (4.5% in Delgado et al., 2015) compared to non-visible products (17% - 27% in Berger, 2019). Thus, the different ways in which product

visibility has been categorised can also explain the difference in how we interpret the relationship between visibility and WTPP Intention.

The result contributes to enriching the literature stream on green signalling theory. Instead of analysing the results solely through the lens of costly signalling theory, other types of signalling theory could explain the negative relationship between high product visibility and WTPP Intention. As this study used product baskets including several different types of products, the motivation of different purchases might vary, leading to different types of signals being elicited. For instance, prosocial signalling could be a more appropriate theoretical ground for green signalling for certain products. Some studies have shown that the relationship between prosocial behaviour and signalling is rather complex and not always positive (Gneezy et al., 2012). The results of this study are in line with Gneezy et al. (2012) who proved that prosocial behaviour, such as charitable donations, are higher when being done anonymously, thus also non-visible to others. When the motivation to complete the prosocial action is impurely altruistic (Andreoni, 1990), driven by the “warm glow” one feels after doing a good thing and improving one's self image, that positive feeling may be tarnished when it is observed or publicly signalled to others. It seems as though the intrinsic motivations of purchasing green are stronger than the need to publicly display it towards others. This mechanism could explain the negative relationship between visibility and WTPP Intention in this study.

## Covariates

Of the three significant covariates in the final model, gender is the strongest predictor, suggesting that women are more likely to have a higher WTPP Intention for green products. This finding is in line with prior research that finds that women are in general more likely to have pro-environmental intentions than men (López-Mosquera, 2016). Having children is shown to positively influence your WTPP Intention. One explanation for this result is that being a parent may act as a proxy for being more invested in the future. If a parent cares for their child, they want them to live in a world that is not radically worsened by climate change. Therefore, parents might feel willing to pay more for products that you expect are reducing the chances of that happening. Lastly, the results show that age negatively impacts WTPP Intention. One explanation for such a relationship is that younger people expect to live

longer, and therefore have a higher likelihood to experience more of the negative effects of climate change as they potentially worsen.

## Managerial implications

One of the tasks of a marketer, strategic decision-maker, or pricing manager in a product producing organisation is to make sure that a product's pricing is in alignment with what consumers are willing to pay. The result of this study finds that consumers indicate that they are willing to pay a 15.7% green premium on average across product groups, 14.8% on average for visible and 16.8% on average for non-visible, and that 2% are willing to pay a premium of 45% or higher. This indicates that companies that are engaging in less carbon-intensive production processes, which lowers the CO<sub>2</sub> impact of the final product, can likely charge a price premium. The results can therefore motivate companies to transition towards sustainable practices.

The results of the covariate analysis also provide interesting implications for practitioners. Women indicate a higher WTPP Intention than men, which could make women a more suitable segment group to target compared to men. Further, younger people indicate a higher WTP than older people. Organisations thinking about transitioning to produce lower carbon-emitting products could therefore begin by developing products that cater to a younger audience. Lastly, consumers that are parents also indicate a higher WTP than non-parents, which is not surprising since it acts as a proxy for caring about the future environment. Therefore, targeting parents could be a potentially fruitful idea.

One factor that may have contributed to the consumer WTPP Intention is that the “greenness” of the products was clearly explained for the respondents. This was done not only in terms of stated decreased CO<sub>2</sub> emissions compared to their traditional counterpart, but also through a comparison of how much CO<sub>2</sub> emission decrease the new product corresponded to. In this case, kilometres of car driving was used to make such a comparison, an activity that was assumed to be a well-known high-emitting activity. Thus, stating the actual CO<sub>2</sub> emission decrease in kilograms and comparing it to something else that was easier for consumers to grasp might have concretised the otherwise abstract concept of emissions. However, this cannot be concluded based on this study, but could be adopted and explored further by marketers of low-carbon products and experimental researchers.



However, it is of great importance that the results are used by practitioners in an ethical manner. The overall finding that consumers have an average WTPP Intention of 15.7% for green products could be used by companies to deceive consumers, claiming to have a lower carbon footprint in order to gain a price premium, even if such claims are not genuine in order to be able to increase prices and profits. The repercussions of such deceptions would likely have a negative effect on consumers' trust to such claims in general and also negatively impact WTPP Intention for green products more broadly. For hard-to-abate industries, where decarbonisation will be so costly, a lack of trust in climate footprint claims and lower WTPP could jeopardise their ability to decarbonise. Thus, any such actions should be avoided. There are no clear risks identified concerning the finding that visibility negatively impacts WTPP Intention.

## Limitations and suggestions for future research

One limitation of this study is the way in which visibility was manipulated. Rather than just compare two different products, one visible and one non-visible, this study opted to create product baskets with several different types of products in each category to mitigate the effect of other differences between the products or preferences that the respondent may have to a specific product. For example, if only comparing the willingness to pay for a green bicycle to a vacuum cleaner, there may be many more reasons than *only* the visibility of the product that could contribute to the willingness to pay a larger green premium for one over the other. Other factors, such as brand familiarity or habits, could play a role in why the consumer prefers the vacuum over the bike. In other words, it is difficult to isolate the effect of visibility as the products are inherently different. Thus, product groups were created to mitigate this effect.

As the focus of this study is the WTPP Intention for end-consumer products that originate from two hard-to-abate industries there were limitations in the range of end-consumer products that could be used. For example, the price level of the visible products is higher than the non-visible products and the frequency of purchase likely also differs between them, as can be seen in the main survey in *Appendices 5 and 6*. Also, many products in the non-visible product group are ingestible, which means that other factors such as perceived healthiness or naturalness could potentially impact consumers' WTPP Intentions. Future

research could tackle these issues by replicating this experiment but forming different product groups that are more homogenous on factors such as price and purchase frequency, for instance by replacing the car purchase with car leasing, which makes it more comparable to purchases frequencies of the chosen non-visible products, but still differ the level of visibility.

Further, future research could treat visibility as a non-binary variable and instead record visibility on a scale. In the case when the randomly assigned variable is not binary by nature, there is a trade-off between making clear manipulations, and potential study results. In this case it meant making visibility binary and thus losing some of the nuances of that variable. In order to capture more of the nuances and the potential effect on the results, one could divide the level of visibility into several levels and then randomly assign them in a similarly designed, but more complex, experiment.

Lastly, a large amount of research raise the aforementioned attitude-behaviour gap, i.e. the gap between favourable attitudes and actual practices, which suggests that although consumers indicate their intention to pay more for green products, their actual behaviour shows a significantly lower willingness (Hughner et al., 2007; Joshi & Rahman, 2015). Therefore, it would be of interest to engage in further studies that analyse the influence of visibility on actual purchase behaviour, and whether that can bridge the gap between attitude and behaviour in any way. One way to do so would be to devise an experiment where behaviour is tested in real-life environments. For example, in partnership with an existing e-commerce business one could test how consumers actually behave when presented with the option to buy a lower-carbon product. However, this would require the product to actually be available in the marketplace, which was not the case in this study.

# Conclusion

As sustainability has grown in importance as a societal issue, it has impacted consumer preferences, and thus also markets. Therefore, understanding factors affecting such preferences, and the strength of the preferences, is of interest to both researchers and practitioners. Despite the rapid rise in sustainable alternatives for many consumer products, certain industries have been limited in their ability to offer such options, due to technical limitations or prohibitively high investment costs. These obstacles can lead to certain industries being deemed as unable to decarbonise as it would not be commercially feasible; so-called hard-to-abate industries. However, as technical breakthroughs enable the ability to offer green alternatives, such as steel and ammonia production through the utilisation of hydrogen, the question remains whether the end-consumer is willing to pay enough in order to justify the high cost of such capital-intensive investments.

The purpose of this study was to answer the research question of whether product visibility impacts WTPP Intention for green steel or ammonia products. A theoretical framework was constructed where the variable product visibility, anchored in green signalling theory, was combined with Ajzen's theory of planned behaviour. In order to test this framework, an experiment through an online survey platform was distributed to respondents, who were randomly assigned visible or non-visible products and asked how much more they would be willing to pay for a green alternative.

The findings of this study are two-fold. Firstly, we are able to establish that there is an average WTPP Intention of paying a 15.7% price premium for products containing green steel or using green ammonia in their production. This contributes to the existing literature on green purchase behaviour and to practitioners working within these fields to reveal the potential in investing in decarbonising their production processes. Secondly, we establish that visibility does influence purchase intention; less visible products received higher WTPP Intentions than visible products. This finding makes the literature on green signalling richer through proving that costly signalling theory might not be appropriate to use as a basis to predict purchase intention for green products. Further, it follows the findings relating to some prosocial signalling theory, where individuals who are driven to act prosocially due to intrinsic motivations prefer to do so without observation from others.

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[linde-engineering-agree-to-build-a-24-mw-green-hydrogen-demonstration-plant-in-](https://www.yara.com/corporate-releases/yara-and-linde-engineering-agree-to-build-a-24-mw-green-hydrogen-demonstration-plant-in-norway.-both-companies-aim-to-achieve-a-significant-carbon-dioxide-reduction-in-the-production-of-fertilizers-in-norway/)

[norway.-both-companies-aim-to-achieve-a-significant-carbon-dioxide-reduction-in-the-production-of-fertilizers-in-norway/](https://www.yara.com/corporate-releases/yara-and-linde-engineering-agree-to-build-a-24-mw-green-hydrogen-demonstration-plant-in-norway.-both-companies-aim-to-achieve-a-significant-carbon-dioxide-reduction-in-the-production-of-fertilizers-in-norway/)

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# Appendix

## Appendix 1: Interviews with industry experts

| Role                           | Company        | Length of interview | Date       |
|--------------------------------|----------------|---------------------|------------|
| Head of Business Unit          | H2 Green Steel | 45 min              | 14-01-2022 |
| Commercial Director            | H2 Green Steel | 45 min              | 14-01-2022 |
| Lead Buyer - Steel             | NCC            | 60 min              | 08-03-2022 |
| Sustainability Project Manager | Lantmännen     | 45 min              | 17-03-2022 |
| Purchasing Manager - Steel     | Peab           | 60 min              | 18-03-2022 |
| Steel Constructor              | Sweco          | 30 min              | 28-04-2022 |

## Appendix 2: General questionnaire to interviewees

1. Tell us about yourself and your role.
2. How do you (your company) work with sustainability?
3. How do you (your company) view sustainable materials? What steps, if any, have you taken so far to use such materials?
4. Who do you think is driving the change to create more sustainable products? Is it primarily the public sector that has higher demand or is it the end consumer that is driving the change?
5. How do you work with your customers in discussing and evaluating green alternatives/material/products?
6. Green materials often imply a greater cost. How do you/your company view this - are you willing to make such an investment and give up your margins, or does the added cost land 100% on the end customer?
7. What do you think it takes for customers to pay more for green? That the green material is in products that are highly visible to others, that there is 100% traceability in the supply chain, that it is a certain material that is green, other reasons?
8. What do you think is the maximum a customer would be willing to pay for a green alternative and why?

## Appendix 3: Pre-study survey

As an integral part of the educational program at the Stockholm School of Economics, enrolled students complete an individual thesis. This work is sometimes based upon surveys connected to the subject.

You can at any time withdraw your consent and your data will thereafter be permanently erased. Anything you say or state in the survey will be held strictly confidential and will only be made available to supervisors, tutors and the course management team.

All data will be stored and processed safely by the SSE and will be permanently deleted when the project is completed. No personal data will be published.

The thesis written by the students will not contain any information that may identify you as participant to the survey.

You are welcome to visit <https://www.hhs.se/en/about-us/data-protection/> in order to read more and obtain information on your rights related to personal data.

**Imagine that you meet a person that you know. Imagine that their household is similar to yours.**

**They have recently purchased a new, green product. The product is identical to a non-green version, but just has a lower CO<sub>2</sub> footprint. Would you notice that they have made this new purchase?**

You will now see a range of images of different types of products. Please select whether you think it is likely you would notice this purchase.

Cabinet



---

Would you notice if someone you know purchased the product above?

- ☐ Yes, I would likely notice
- ☐ No, I would likely not notice

Bicycle



---

Would you notice if someone you know purchased the new product above?

- ☐ Yes, I would likely notice
- ☐ No, I would likely not notice

---

Rice



---

Would you notice if someone you know purchased the product above?

- ☐ Yes, I would likely notice
- ☐ No, I would likely not notice

Roof tiling



---

Would you notice if someone you know purchased the product above?

- ☐ Yes, I would likely notice
- ☐ No, I would likely not notice

Cleaning product



---

Would you notice if someone you know purchased the new product above?

- ☐ Yes, I would likely notice
- ☐ No, I would likely not notice

---

Fridge



---

Would you notice if someone you know purchased the product above?

- ☐ Yes, I would likely notice
- ☐ No, I would likely not notice



## Bread



---

Would you notice if someone you know purchased the product above?

- ☐ Yes, I would likely notice
- ☐ No, I would likely not notice

## Vaccum



---

Would you notice if someone you know purchased the product above?

- ☐ Yes, I would likely notice
- ☐ No, I would likely not notice

Coffee



---

Would you notice if someone you know purchased the product above?

- ☐ Yes, I would likely notice
- ☐ No, I would likely not notice

Car



---

Would you notice if someone you know purchased the new product above?

- ☐ Yes, I would likely notice
- ☐ No, I would likely not notice

### Sink



---

Would you notice if someone you know purchased the new product above?

- ☐ Yes, I would likely notice
- ☐ No, I would likely not notice

---

### Apples



---

Would you notice if someone you know purchased the product above?

- ☐ Yes, I would likely notice
- ☐ No, I would likely not notice

**What is your nationality?**

**What country do you live in?**

**How old are you? (in numerical form)**

**Gender**

- ☐ Male
- ☐ Female
- ☐ Non-binary / third gender
- ☐ Prefer not to say

**What is your nationality?**

**What country do you live in?**

**How old are you? (in numerical form)**

**Gender**

- ☐ Male
- ☐ Female
- ☐ Non-binary / third gender
- ☐ Prefer not to say

**What is your nationality?**

---

**What country do you live in?**

---

**How old are you? (in numerical form)**

---

**Gender**

- ☐ Male
- ☐ Female
- ☐ Non-binary / third gender
- ☐ Prefer not to say

**What is your nationality?**

---

**What country do you live in?**

---

**How old are you? (in numerical form)**

---

**Gender**

- ☐ Male
- ☐ Female
- ☐ Non-binary / third gender
- ☐ Prefer not to say

---

**Annual income (EUR). All answers are anonymous but please insert " - " if you prefer not to answer**

---

**What is the highest educational level you have achieved?**

- ☐ Below high school
- ☐ High school
- ☐ Bachelor degree
- ☐ Master degree or higher

---

**Living situation: I currently live;**

- ☐ Alone
- ☐ With friends or family

---

**Do you have children?**

- ☐ Yes
- ☐ No

---

**Annual income (EUR). All answers are anonymous but please insert " - " if you prefer not to answer**

---

**What is the highest educational level you have achieved?**

- ☐ Below high school
- ☐ High school
- ☐ Bachelor degree
- ☐ Master degree or higher

---

**Living situation: I currently live;**

- ☐ Alone
- ☐ With friends or family

---

**Do you have children?**

- ☐ Yes
- ☐ No

---

**Annual income (EUR). All answers are anonymous but please insert " - " if you prefer not to answer**

---

**What is the highest educational level you have achieved?**

- ☐ Below high school
- ☐ High school
- ☐ Bachelor degree
- ☐ Master degree or higher

---

**Living situation: I currently live;**

- ☐ Alone
- ☐ With friends or family

---

**Do you have children?**

- ☐ Yes
- ☐ No

---

**Annual income (EUR). All answers are anonymous but please insert " - " if you prefer not to answer**

---

**What is the highest educational level you have achieved?**

- ☐ Below high school
- ☐ High school
- ☐ Bachelor degree
- ☐ Master degree or higher

---

**Living situation: I currently live;**

- ☐ Alone
- ☐ With friends or family

---

**Do you have children?**

- ☐ Yes
- ☐ No

---

**Where do you live?**

- ☐ In a city or urban area
- ☐ In a small town or countryside

---

**Just to make sure you're not a robot - please insert the numerical form of the number eight below**



## Appendix 4: Main Survey - Visible products



Share your opinion on things that matter!



⌚ 8'

Start the survey

### YOUR RESPONSES ARE COMPLETELY ANONYMOUS

By accepting to take this survey, a specific set of user's device data, is automatically sent to Pollfish servers and associated with answers to the questionnaires, in order for Pollfish to discern whether the user is eligible for a survey and improve targeting of future surveys.

By taking this survey you accept our [Terms & Conditions](#)



Q3

### GDPR & personal data

Anything you say or state in the survey will be held strictly confidential. All data will be stored and processed safely and will be permanently deleted when the research projected is completed. No personal data will be published.

DESCRIPTION



Q1

What is your gender?

SELECT ONE

☐ Male

☐ Female

☐ Other



Q2

What is your year of birth? (e.g. 1984)

PLEASE ENTER YOUR YEAR OF BIRTH



Select the answer that best reflects your opinion on the following prompts:

SELECT ONE ANSWER PER STATEMENT

Purchasing products with lower CO2 footprint is necessary to mitigate global warming ▼

☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

Between products with higher CO2 footprint and lower CO2 footprint, I prefer the product with lower CO2 footprint ▼

☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

I think purchasing products with lower CO2 footprint is responsible ▼

☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

People around me think that others should pay for sustainable product alternatives ▼

☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

People that are close to me think that I should make environmentally friendly purchase choices ▾

☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

Many of my friends and family are willing to pay more for products that are lower in CO2 ▾

☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

I feel capable of purchasing sustainable product alternatives



☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

What I purchase as a consumer has an effect on environmental impact



☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

Q5

**Steel** is used in a wide range of products used by consumers. Traditional steel production is very carbon intensive, with 1000kg of steel emitting 2000kg of CO2. **Approximately 7% of global CO2 emissions come from steel production.**

**New technology** enables **fossil free steel** production, **reducing emissions by 95%** to 100kg CO2 per 1000kg steel.

DESCRIPTION



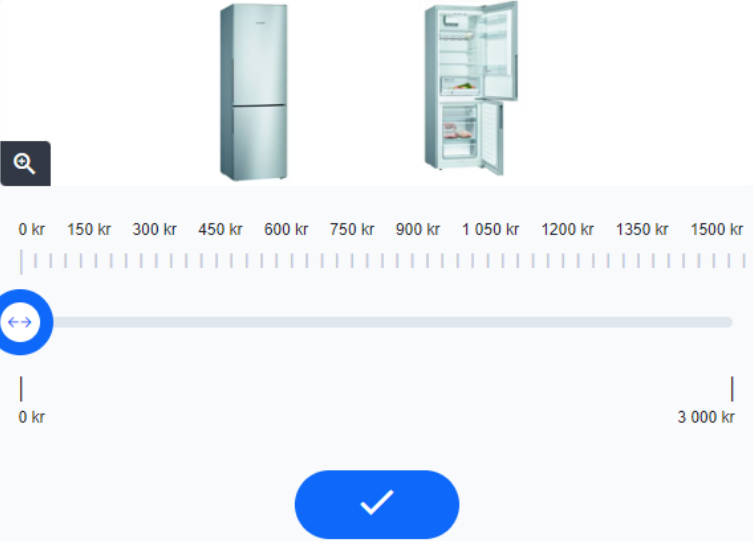
Q6

You need to buy a new refrigerator. The refrigerator that meets your requirements costs 6000kr.

You have the option to purchase an identical product where the only difference is that the **steel in the refrigerator is fossil free**, which would **reduce the CO2 footprint by 52kg CO2** - equivalent of driving approximately 260 km.

How much more would you be willing to pay for this alternative?

DRAG BUTTON TO RATE



0 kr 150 kr 300 kr 450 kr 600 kr 750 kr 900 kr 1 050 kr 1200 kr 1350 kr 1500 kr

0 kr 3 000 kr

*If respondent selected zero:*



Why did you select 0?

SELECT ONE

- ☐ I cannot afford it
- ☐ I do not think it will help solve the climate crisis
- ☐ It is the government's responsibility to solve climate issues
- ☐ I will not enjoy the benefits of the lower CO2 footprint
- ☐ Other reason




Q7

**You need to buy a new bicycle.** The bicycle that meets your requirements costs **8000kr**.

You have the option to purchase an identical product where the only difference is that the **steel in the bicycle is fossil free**, which would **reduce the CO2 footprint by 24 kg CO2** - equivalent of driving approximately 120 km.

How much more would you be willing to pay for this alternative?

DRAG BUTTON TO RATE



0 kr 200 kr 400 kr 600 kr 800 kr 1 000 kr 1 200 kr 1 400 kr 1 600 kr 1 800 kr 2 000 k

0 kr 4 000 kr

✓

*If respondent selected zero:*

Why did you select 0?

SELECT ONE

☐ I cannot afford it

☐ I do not think it will help solve the climate crisis

☐ It is the government's responsibility to solve climate issues

☐ I will not enjoy the benefits of the lower CO2 footprint

☐ Other reason




Q9

**You need to buy roof tiles for your house.** The tiles that meets your requirements cost **2000kr**.

You have the option to purchase an identical product where the only difference is that the **steel in the tiles is fossil free**, which would **reduce the CO2 footprint by 65kg** - equivalent of driving approximately 330 km.

How much more would you be willing to pay for this alternative?

DRAG BUTTON TO RATE



0 kr 50 kr 100 kr 150 kr 200 kr 250 kr 300 kr 350 kr 400 kr 450 kr 500 kr

0 kr 1 000 kr

✓

*If respondent selected zero:*

Why did you select 0?

SELECT ONE

- ☐ I cannot afford it
- ☐ I do not think it will help solve the climate crisis
- ☐ It is the government's responsibility to solve climate issues
- ☐ I will not enjoy the benefits of the lower CO2 footprint
- ☐ Other reason




Q10

You need to buy a new car. The car that meets your requirements costs **500 000kr.**

You have the option to purchase an identical product where the only difference is that the **steel in the car is fossil free**, which would **reduce the CO2 footprint by 1440 kg** - equivalent of driving approximately 7400 km.

How much **more** would you be willing to pay for this alternative?

DRAG BUTTON TO RATE



0kr 12 500 kr 25 000 kr 37 500 kr 50 000 kr 62 500 kr 75 000 kr 87 500 kr 100 000 kr 112 500 kr 125 000 kr

0kr 250 000 kr

✓

*If respondent selected zero:*

Why did you select 0?

SELECT ONE

- ☐ I cannot afford it
- ☐ I do not think it will help solve the climate crisis
- ☐ It is the government's responsibility to solve climate issues
- ☐ I will not enjoy the benefits of the lower CO2 footprint
- ☐ Other reason




Q11

You need to buy a new kitchen sink. The sink that meets your requirements costs **3000kr**.

You have the option to purchase an identical product where the only difference is that the **steel in the sink is fossil free**, which would **reduce the CO2 footprint by 8kg** - equivalent of driving approximately 41km.

How much **more** would you be willing to pay for this alternative?

DRAG BUTTON TO RATE



0 kr 75 kr 150 kr 225 kr 300 kr 375 kr 450 kr 525 kr 600 kr 675 kr 750 kr

0 kr 1 500 kr

✓

*If respondent selected zero:*



Why did you select 0?

SELECT ONE

- ☐ I cannot afford it
- ☐ I do not think it will help solve the climate crisis
- ☐ It is the government's responsibility to solve climate issues
- ☐ I will not enjoy the benefits of the lower CO2 footprint
- ☐ Other reason




Q12

**You need to buy a new cabinet.** The cabinet that meets your requirements costs **800kr**.

You have the option to purchase an identical product where the only difference is that the **steel in the cabinet is fossil free**. This would **reduce the CO2 footprint by 27kg** - equivalent of driving approximately 140km.

How much **more** would you be willing to pay for this alternative?

DRAG BUTTON TO RATE



0 kr 20 kr 40 kr 60 kr 80 kr 100 kr 120 kr 140 kr 160 kr 180 kr 200

0 kr 400 kr

✓

*If respondent selected zero:*

Why did you select 0?

SELECT ONE

- ☐ I cannot afford it
- ☐ I do not think it will help solve the climate crisis
- ☐ It is the government's responsibility to solve climate issues
- ☐ I will not enjoy the benefits of the lower CO2 footprint
- ☐ Other reason



Q13

What is your level of education?

SELECT ONE

☐ Middle school

☐ High school

☐ Vocational training / technical college

☐ University

☐ Post graduate



Q14

What is your level of income? (Pre-tax)

SELECT ONE

- ☐ Under 225 000 SEK
- ☐ Between 225 000 - 450 000 SEK
- ☐ Between 400 000 - 675 000 SEK
- ☐ Between 675 000 - 900 000 SEK
- ☐ Between 900 000 - 1 125 000 SEK
- ☐ Between 1 125 000 SEK - 1 350 000 SEK
- ☐ Prefer not to say



Q15

Number of children, if any?

PLEASE WRITE IN THE BOX





Q16

What country do you live in?

PLEASE WRITE IN THE BOX

Write your answer here



Q17

What is your current living situation?

SELECT ONE

☐ I live alone

☐ I live with friends or family



Q18

Just to make sure you are reading carefully, please write the numerical form of eight:

PLEASE WRITE IN THE BOX



## Appendix 5: Main Survey - Non-Visible products



Share your opinion on things that matter!



⌚ 8'

Start the survey

### YOUR RESPONSES ARE COMPLETELY ANONYMOUS

By accepting to take this survey, a specific set of user's device data, is automatically sent to Pollfish servers and associated with answers to the questionnaires, in order for Pollfish to discern whether the user is eligible for a survey and improve targeting of future surveys.

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Q3

### GDPR & personal data

Anything you say or state in the survey will be held strictly confidential. All data will be stored and processed safely and will be permanently deleted when the research projected is completed. No personal data will be published.

DESCRIPTION





Q1

What is your gender?

SELECT ONE

☐ Male

☐ Female

☐ Other



Q2

What is your year of birth? (e.g. 1984)

PLEASE ENTER YOUR YEAR OF BIRTH



Select the answer that best reflects your opinion on the following prompts:

SELECT ONE ANSWER PER STATEMENT

Purchasing products with lower CO2 footprint is necessary to mitigate global warming ▼

☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

Between products with higher CO2 footprint and lower CO2 footprint, I prefer the product with lower CO2 footprint ▼

☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

I think purchasing products with lower CO2 footprint is responsible ▼

☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

People around me think that others should pay for sustainable product alternatives ▼

☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

People that are close to me think that I should make environmentally friendly purchase choices ▾

☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

Many of my friends and family are willing to pay more for products that are lower in CO2 ▾

☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

I feel capable of purchasing sustainable product alternatives



☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

What I purchase as a consumer has an effect on environmental impact



☐ Strongly disagree

☐ Disagree

☐ Somewhat disagree

☐ Neutral

☐ Somewhat agree

☐ Agree

☐ Strongly agree

Q5

**Steel** is used in a wide range of products used by consumers. Traditional steel production is very carbon intensive, with 1000kg of steel emitting 2000kg of CO<sub>2</sub>. **Approximately 7% of global CO<sub>2</sub> emissions come from steel production.**

**New technology** enables **fossil free steel** production, **reducing emissions by 95%** to 100kg CO<sub>2</sub> per 1000kg steel.

DESCRIPTION



Q6

**Ammonia** is used in a wide range of products used by consumers, including fertilizers and cleaning products. Traditional ammonia production is very carbon intensive, with 1000kg of ammonia emitting 2000kg of CO<sub>2</sub>. **Approximately 2% of global CO<sub>2</sub> emissions come from ammonia production.**

**New technology** enables **fossil free ammonia** production, **reducing emissions by 95%** to 100kg CO<sub>2</sub> per 1000kg ammonia.


DESCRIPTION

**You need to buy bread.** One loaf of the bread **costs 30kr.**

You can buy an identical product where the only difference is that the **ammonia used in the fertilizer to grow the bread is fossil free**. If you buy 2 loaves of this bread per month it would **reduce your annual CO2 footprint by 5kg CO2** - same as driving approx 25km.

How much more would you be willing to pay for this alternative?

DRAG BUTTON TO RATE



0 kr 0,75 kr 1,50 kr 2,25 kr 3,00 kr 3,75 kr 4,50 kr 5,25 kr 6,00 kr 6,75 kr 7,50 kr

0 kr 15,00 kr

*If respondent selected zero:*

Why did you select 0?

SELECT ONE

- ☐ I cannot afford it
- ☐ I do not think it will help solve the climate crisis
- ☐ It is the government's responsibility to solve climate issues
- ☐ I will not enjoy the benefits of the lower CO2 footprint
- ☐ Other reason


✓

You need to buy a vacuum. One that meets your requirements costs 2000kr.

You can buy an identical product where the only difference is that the **steel in the vacuum is fossil free**, which would **reduce your CO2 footprint by 2kg CO2** - same as driving approx 10km.

How much more would you be willing to pay for this alternative?

DRAG BUTTON TO RATE



0 kr 50 kr 100 kr 150 kr 200 kr 250 kr 300 kr 350 kr 400 kr 450 kr 500 kr

0 kr 1000 kr

*If respondent selected zero:*

Why did you select 0?

SELECT ONE

☐ I cannot afford it

☐ I do not think it will help solve the climate crisis

☐ It is the government's responsibility to solve climate issues

☐ I will not enjoy the benefits of the lower CO2 footprint

☐ Other reason

✓

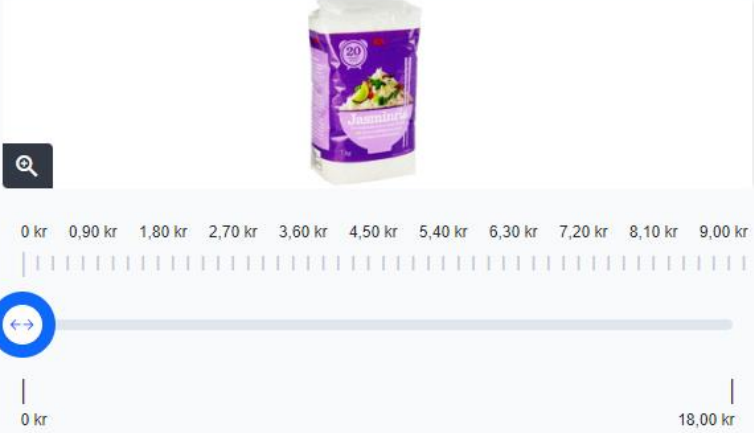


**You need to buy rice.** The rice below costs **36 kr.**

You can buy an identical product where the only difference is that the **ammonia used in the fertilizer to grow the rice is fossil free**, which if you buy 1 package of this rice per month would **reduce your annual CO2 footprint by 20kg CO2** - same as driving approx 100km.

How much **more** would you be willing to pay for this alternative?

DRAG BUTTON TO RATE



*If respondent selected zero:*

Why did you select 0?

SELECT ONE

- ☐ I cannot afford it
- ☐ I do not think it will help solve the climate crisis
- ☐ It is the government's responsibility to solve climate issues
- ☐ I will not enjoy the benefits of the lower CO2 footprint
- ☐ Other reason


✓

You need to buy cleaning spray. The spray below costs **44kr**.

You can buy an identical product where the only difference is that the **ammonia used in the spray is fossil free**, which if you buy 4 bottles of this cleaning spray per year would **reduce your annual CO2 footprint by 0.21g CO2** - same as driving approx 1.1km.

How much **more** would you be willing to pay for this alternative?

DRAG BUTTON TO RATE



0 kr 1,10 kr 2,20 kr 3,30 kr 4,40 kr 5,50 kr 6,60 kr 7,70 kr 8,80 kr 9,90 kr 11,00 kr

0 kr 22,00 kr

*If respondent selected zero:*

Why did you select 0?

SELECT ONE

☐ I cannot afford it

☐ I do not think it will help solve the climate crisis

☐ It is the government's responsibility to solve climate issues

☐ I will not enjoy the benefits of the lower CO2 footprint

☐ Other reason


✓

**You need to buy apples.** The 4 apples below cost **20kr**.

You can buy an identical product where the only difference is that the **ammonia used in the fertilizer to grow the apples is fossil free**. If you buy 12 apples of these apples per month it would **reduce your annual CO2 footprint by 0.18kg CO2** - same as driving approx 1km.

How much **more** would you be willing to pay for this alternative?

DRAG BUTTON TO RATE



0 kr 0,50 kr 1,00 kr 1,50 kr 2,00 kr 2,50 kr 3,00 kr 3,50 kr 4,00 kr 4,50 kr 5,00 kr

0 kr 10,00 kr

*If respondent selected zero:*

Why did you select 0?

SELECT ONE

☐ I cannot afford it

☐ I do not think it will help solve the climate crisis

☐ It is the government's responsibility to solve climate issues

☐ I will not enjoy the benefits of the lower CO2 footprint

☐ Other reason

✓

**You need to buy coffee.** The coffee below costs **44kr.**

You can buy an identical product where the only difference is that the **ammonia used in the fertilizer to grow the coffee is fossil free**, which if you buy 1 package of this coffee per month would **reduce your annual CO2 footprint by 11kg CO2** - same as driving approx 56km.

How much **more** would you be willing to pay for this alternative?

DRAG BUTTON TO RATE



0 kr 1,10 kr 2,20 kr 3,30 kr 4,40 kr 5,50 kr 6,60 kr 7,70 kr 8,80 kr 9,90 kr 11,00 kr

0 kr 22,00 kr

*If respondent selected zero:*

Why did you select 0?

SELECT ONE

- ☐ I cannot afford it
- ☐ I do not think it will help solve the climate crisis
- ☐ It is the government's responsibility to solve climate issues
- ☐ I will not enjoy the benefits of the lower CO2 footprint
- ☐ Other reason

✓

Q13

What is your level of education?

SELECT ONE

☐ Middle school

☐ High school

☐ Vocational training / technical college

☐ University

☐ Post graduate



Q14

What is your level of income? (Pre-tax)

SELECT ONE

- ☐ Under 225 000 SEK
- ☐ Between 225 000 - 450 000 SEK
- ☐ Between 400 000 - 675 000 SEK
- ☐ Between 675 000 - 900 000 SEK
- ☐ Between 900 000 - 1 125 000 SEK
- ☐ Between 1 125 000 SEK - 1 350 000 SEK
- ☐ Prefer not to say



Q15

Number of children, if any?

PLEASE WRITE IN THE BOX





Q16

What country do you live in?

PLEASE WRITE IN THE BOX

Write your answer here



Q17

What is your current living situation?

SELECT ONE

☐ I live alone

☐ I live with friends or family



Q18

Just to make sure you are reading carefully, please write the numerical form of eight:

PLEASE WRITE IN THE BOX





## Appendix 6: Main Survey - Adjustments in other market surveys

|                        | Sweden  | Brazil  | Canada   | Germany   |
|------------------------|---|---|--|---|
| Cleaning product image |    |    |    |    |
| Coffee image           |   |   |   |   |
| Rice image             |  |  |  |  |
| Bread price            | 30 kr   | 16 R\$  | 3.93 C\$   | 2.97 €  |
| Vacuum price           | 2 000 kr  | 1064 R\$  | 262 C\$  | 186 €   |
| Bicycle price          | 8 000 kr  | 4257 R\$  | 1049 C\$   | 744 €   |
| Sink price             | 3 000 kr  | 1596 R\$  | 393 C\$  | 279 €   |
| Car price              | 500 000 kr  | 226 050 R\$   | 65 581 C\$   | 46 511 €  |
| Apples price           | 20 kr   | 10.60 R\$   | 2.62 C\$   | 1.86 €  |

|  |   |  |   |   |
|--|---|--|---|---|
| <b>Cabinet price</b>                         | 800 kr  | 426 R\$  | 105 C\$   | 74.42 €   |
| <b>Cleaning products price</b>               | 44 kr   | 23.40 R\$  | 5.77 C\$  | 4.09 €  |
| <b>Rice price</b>                            | 36 kr   | 19.20 R\$  | 4.72 C\$  | 3.35 €  |
| <b>Fridge price</b>                          | 6 000 kr  | 3193 R\$   | 787 C\$   | 558 €   |
| <b>Coffee price</b>                          | 44 kr   | 23.40 R\$  | 5.77 C\$  | 4.09 €  |
| <b>Roof tiles price</b>                      | 2 000 kr  | 1064 R\$   | 262 C\$   | 186 €   |
| <b>Annual income groupings (by Pollfish)</b> | Below 250 000kr<br>225 000 - 450 000kr<br>450 000 - 675 000kr<br>675 000 - 900 400kr<br>900 400 - 1 125 000kr<br>1 125 000 - 1 350 000kr<br>1 350 000kr or higher | Below R\$ 5000<br>R\$ 5 001 - 10 000<br>R\$ 10 001 - 20 000<br>R\$ 20 001 - 40 000<br>R\$ 40 001 - 50 000<br>R\$ 50 001 - 60 000<br>R\$ 60 001 or higher | Below C\$ 25 000<br>C\$ 25 000 - 49 999<br>C\$ 50 000 - 74 999<br>C\$ 75 000 - 99 999<br>C\$ 100 000 - 159 999<br>C\$ 160 000 - 199 999<br>C\$200 000 or higher | Below €22 000<br>€22 000 - 44 000<br>€ 44 000 - 65 999<br>€ 66 000 - 87 999<br>€ 88 000 - 109 999<br>€ 110 000 - 131 999<br>€ 132 000 or higher |

## Appendix 7: Regression model results including non-significant variables

```
> #####
> #####ALL VARIABLES#####
> #####
> #Model 101
> m111 <- lme(WTP_Excl ~ Visibility+Attitude_Avg+Norm_Avg+PBC_Avg+Age_Mean_Centered
+ +Parent+Gender+Education_Dummy2+factor(Income_3_Groups)+Urban_Countryside+factor(Country), random = ~1|ID, data = lfviz)
> summary(m111)
```

Linear mixed-effects model fit by REML

Data: lfviz

|  | AIC      | BIC      | logLik    |
|--|----------|----------|-----------|
|  | 61754.42 | 61881.06 | -30859.21 |

Random effects:

Formula: ~1 | ID

(Intercept) Residual

StdDev: 9.494847 7.850366

Fixed effects: WTP\_Excl ~ Visibility + Attitude\_Avg + Norm\_Avg + PBC\_Avg + Age\_Mean\_Centered + Parent + Gender + Education\_Dummy2 + factor(Income\_3\_Groups) + Urban\_Countryside + factor(Country)

|                          | Value     | Std.Error | DF   | t-value   | p-value |
|--------------------------|-----------|-----------|------|-----------|---------|
| (Intercept)              | 11.558465 | 1.9616207 | 7010 | 5.892304  | 0.0000  |
| Visibility               | -1.793064 | 0.5363559 | 1386 | -3.343050 | 0.0009  |
| Attitude_Avg             | -1.670708 | 0.2772643 | 1386 | -6.025688 | 0.0000  |
| Norm_Avg                 | 1.587614  | 0.2508912 | 1386 | 6.327899  | 0.0000  |
| PBC_Avg                  | 1.654456  | 0.3199408 | 1386 | 5.171131  | 0.0000  |
| Age_Mean_Centered        | -0.090225 | 0.0193955 | 1386 | -4.651871 | 0.0000  |
| Parent                   | 1.530525  | 0.5629244 | 1386 | 2.718881  | 0.0066  |
| Gender                   | 1.946409  | 0.5569487 | 1386 | 3.494773  | 0.0005  |
| Education_Dummy2         | -0.718212 | 0.5760122 | 1386 | -1.246870 | 0.2127  |
| factor(Income_3_Groups)1 | 0.295652  | 1.1980627 | 1386 | 0.246775  | 0.8051  |
| factor(Income_3_Groups)2 | -1.086078 | 1.1397439 | 1386 | -0.952914 | 0.3408  |
| factor(Income_3_Groups)3 | -0.985038 | 1.1537531 | 1386 | -0.853769 | 0.3934  |
| Urban_Countryside        | -0.118402 | 0.6624935 | 1386 | -0.178721 | 0.8582  |
| factor(Country)2         | 4.510294  | 0.8273531 | 1386 | 5.451475  | 0.0000  |
| factor(Country)3         | -3.811308 | 0.7881690 | 1386 | -4.835649 | 0.0000  |
| factor(Country)4         | -0.875540 | 0.8037447 | 1386 | -1.089326 | 0.2762  |

## Appendix 8: Preferred model

```

> #####
> ##### PREFERRED MODEL #####
> #####
> #Model 100
> m100 <- lme(WTP_Excl ~ Visibility+Attitude_Avg+Norm_Avg+PBC_Avg+Age_Mean_Centered
+ +Parent+Gender+factor(Country), random = ~1|ID, data = lfviz)
> summary(m100)
Linear mixed-effects model fit by REML
Data: lfviz
      AIC      BIC    logLik
61757.21 61848.68 -30865.6

Random effects:
Formula: ~1 | ID
      (Intercept) Residual
StdDev:    9.502343 7.850366

Fixed effects: WTP_Excl ~ Visibility + Attitude_Avg + Norm_Avg + PBC_Avg + Age_Mean_Centered +
              Value Std.Error   DF   t-value p-value
(Intercept)  10.866700 1.6365990 7010   6.639806  0.0000
Visibility   -1.816661 0.5364389 1391  -3.386519  0.0007
Attitude_Avg -1.711326 0.2766516 1391  -6.185853  0.0000
Norm_Avg      1.544388 0.2499097 1391   6.179787  0.0000
PBC_Avg       1.648749 0.3191361 1391   5.166287  0.0000
Age_Mean_Centered -0.091772 0.0193340 1391  -4.746678  0.0000
Parent        1.324378 0.5532303 1391   2.393899  0.0168
Gender        2.098887 0.5497726 1391   3.817737  0.0001
factor(Country)2  4.725734 0.7909814 1391   5.974520  0.0000
factor(Country)3 -3.867141 0.7815823 1391  -4.947836  0.0000
factor(Country)4 -0.756207 0.7909584 1391  -0.956064  0.3392

```

## Appendix 8: Code for regression model

```
rm(list=ls()) # Clear workspace
cat("\014") # Clear console

#Loading required libraries
library(Hmisc)
library(tidyverse)
library(MuMIn)
library(nlme)

#Downloading data
setwd("~/Downloads")
green <- read.csv("All_data.csv", header = T)

#Splitting visible and non-visible into two different sets
nviz <- subset(green, green$Visibility==0)
yviz <- subset(green, green$Visibility==1)

#Reshaping the data
#Setting up 6 product observations
nviz$prod1 <- nviz$Bread_WTP
nviz$prod2 <- nviz$Vacuum_WTP
nviz$prod3 <- nviz$Coffee_WTP
nviz$prod4 <- nviz$Rice_WTP
nviz$prod5 <- nviz$Cleaning_WTP
nviz$prod6 <- nviz$Apples_WTP

yviz$prod1 <- yviz$Fridge_WTP
yviz$prod2 <- yviz$Bike_WTP
yviz$prod3 <- yviz$Roof_WTP
yviz$prod4 <- yviz$Car_WTP
yviz$prod5 <- yviz$Sink_WTP
yviz$prod6 <- yviz$Cabinet_WTP

fviz <- rbind(nviz, yviz)

# Exclude Cannot Afford
fviz$exclude <- is.na(fviz$WTP_Actual_Avg_ExclCannotAfford)
summary(fviz$exclude)
fviz$exclude2 <- ifelse(fviz$exclude=="TRUE", 0, 1)
fvizEX <- subset(fviz, fviz$exclude2==1)

#Wide to long data
lfviz <- gather(fvizEX, product, WTP_Actual_RemoveCannotAfford, prod1:prod6)

lfviz$WTP_Excl <- lfviz$WTP_Actual_RemoveCannotAfford / 2

summary(lfviz)
```

```
#####
##### PREFERRED MODEL #####
#####
#Model 100
m100 <- lme(WTP_Excl ~
Visibility+Attitude_Avg+Norm_Avg+PBC_Avg+Age_Mean_Centered
+Parent+Gender+factor(Country), random = ~1|ID, data = lfviz)
summary(m100)
r.squaredGLMM(m100)

#####
#####ALL VARIABLES#####
#####
#Model 101
m111 <- lme(WTP_Excl ~
Visibility+Attitude_Avg+Norm_Avg+PBC_Avg+Age_Mean_Centered
+Parent+Gender+Education_Dummy2+factor(Income_3_Groups)+Urban_Countryside+fact
or(Country), random = ~1|ID, data = lfviz)
summary(m111)
r.squaredGLMM(m111)

#Making country plot
wtp <-
ggplot(lfviz, aes(as.factor(Visibility), WTP_Excl, color = Visibility))+
geom_point(alpha=.3, position = position_jitter(w=.1))+
stat_summary(fun.data = mean_cl_boot, geom="errorbar", color = 'darkblue', width=.9)+
stat_summary(fun.y = "mean", color = 'white', geom="point", size = 2.5)+
facet_grid(~factor(Country))+
theme_bw()+
labs(title = "WTPP Intention for Green Products",
      subtitle = "Unadjusted Data from Sweden, Brazil, Canada and Germany",
      y = "WTPP Intention",
      x = "Visibility")+
theme(legend.position = 'none')
wtp
ggsave(wtp, filename = "GreenPlot2.png", dpi=300, w=6, h = 4)
```

## Appendix 9: ANOVA test

| ANOVA          |                |      |             |        |       |
|----------------|----------------|------|-------------|--------|-------|
| WTP_FINAL      |                |      |             |        |       |
|                | Sum of Squares | df   | Mean Square | F      | Sig.  |
| Between Groups | 1399.910       | 1    | 1399.910    | 11.488 | <,001 |
| Within Groups  | 170606.140     | 1400 | 121.862     |        |       |
| Total          | 172006.050     | 1401 |             |        |       |