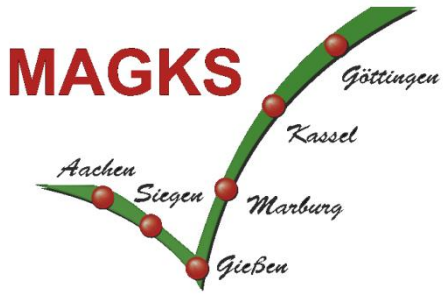

Joint Discussion Paper Series in Economics

by the Universities of

Aachen · Gießen · Göttingen
Kassel · Marburg · Siegen

ISSN 1867-3678

No. 24-2023

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Citizens' Acceptance of Sustainable Public Construction in Their Municipality

Ellen Sterk[a,b], Morten Endrikat[a] & Dmytro Katerusha[c]

Abstract

Green public procurement of construction activities has the potential to significantly reduce a municipality's environmental footprint. Moreover, it is likely to positively affect its citizens' implementation of green building practices. However, the degree of citizens' acceptance of sustainable building by their municipality remains unstudied as do the factors that are of influence in this regard. Through a survey in four German municipalities, this study investigates public acceptance of sustainable public construction in its two dimensions: attitude and action. The findings consistently reveal positive attitudes, which are driven by trust in the municipality and the perception of personal as well as social benefits. As anticipated, costs negatively impact citizens' attitudes. Despite these generally positive attitudes, only specific segments of the public demonstrate a willingness to actively support sustainable public construction. Whether or not citizens are willing to engage is influenced by the form of action, age, as well as their interest in and knowledge of sustainability and construction. In contrast, additional costs and the type of building in question do not appear to have an effect. The use of the default effect is demonstrated to have the potential to enhance the behavioral dimension of public acceptance. Implications for government institutions and suggestions for further research are provided.

Acknowledgments

This work was carried out within the framework of the Research Group Verbund.NRW, which is funded by the Ministry of Culture and Science of the State of North Rhine-Westphalia (Germany).

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1. Introduction

Public procurement represents a significant proportion of governmental expenditures. In OECD member states, it accounts for nearly 30 % of total government spending and almost 14 % of GDP on average (OECD, n.d.). In Germany, the construction sector is the primary beneficiary of public tenders, being granted over a third of all contracts and second to only electricity and other energy sources in terms of economic value (Chiappinelli & Zipperer, 2017). Having invested roughly 58 billion EUR in 2022 (Hauptverband der Deutschen Bauindustrie e.V., 2023), the government is considered to be the largest construction client in Germany (e.g., Hinzmann et al., 2019). Given its significant share as well as its environmental impact, the construction industry offers large potential to reduce the environmental footprint of public procurement activities (e.g., Fischer & Küper, 2021). So-called *Green Public Procurement* (GPP) can be understood as "… a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured" (European Commission, 2008, p. 4). The European Commission has already designated the construction industry as a key sector for GPP approximately 15 years ago (European Commission, 2008). Several European nations, such as the Netherlands, Finland, Germany, and Slovenia, have established regulations or objectives to stimulate the procurement of environmentally sustainable products (Ferrer, 2020). However, the implementation of GPP is lacking in many cases. For example, in Germany, only 2.4 % of public tenders in 2015 included environmental criteria and the share is even lower for operations such as construction works (Chiappinelli & Zipperer, 2017). Some of the main barriers that government institutions face are the (perceived) necessity to invest both effort and financial resources as well as an information deficit (Chiappinelli & Zipperer, 2017; Fischer & Küper, 2021; Zu Castell-Rüdenhausen et al., 2021).

Due to the extent and visibility of construction activities commissioned by the government, its responsibility as a role model and pioneer in this regard is often emphasized (e.g., Dechantsreiter et al., 2015; Hinzmann et al., 2019; Ruiz Durán et al., 2019). The Federal Ministry for Housing, Urban Development and Building in Germany also avows itself to this role model function. One way in which it aims to contribute to the country's building culture is through its guidelines on sustainable construction[1] (BMWSB, n.d.). Researchers appeal to government institutions to publish neutral tenders that allow for the use of recycled building material, to include environmental criteria, and/or consider environmental externalities in their tenders (Chiappinelli & Zipperer, 2017; Dechantsreiter et al., 2015; Hinzmann et al., 2019). In addition to directly decreasing the environmental impact of public procurement in construction, such efforts might also lead to indirect outcomes. Firstly, since public demand serves as a quality signal, it could influence public opinion by shaping awareness and reinforcing acceptance of and interest in sustainable construction. Secondly, secure demand from government institutions could create investment securities for producers and contribute to price reductions through scale and learning effects (Chiappinelli & Zipperer, 2017; Fischer & Küper, 2021; Franco et al., 2021; Wagner et al., 2022). GPP is key in promoting business model creation for the circular economy (Zu Castell-Rüdenhausen et al., 2021).

Public institutions' purpose is to serve the citizens under their government. Therefore, in addition to the environmental rationale and the duty as a role model for sustainable building procurement, the public interest must also be considered. In the context of local construction,

[1] BMI. (2019). Leitfaden Nachhaltiges Bauen—Zukunftsfähiges Planen, Bauen und Betreiben von Gebäuden. Bundesministerium des Innern, für Bau und Heimat (BMI). https://www.bundesregierung.de/breg-de/suche/nachhaltiges-bauen-2156224

this means that government authorities should commission construction projects that align with the preferences and needs of their citizens. In this paper, we concentrate on municipalities as they account for the majority of public investments in the German construction sector, specifically 59 %. In contrast, federal states and the general government only make up 19 % and 22 %, respectively (Hauptverband der Deutschen Bauindustrie e.V., 2023). Environmental considerations, amplified through the role model position government bodies hold, clearly point towards building sustainably as a municipality. However, it is not necessarily clear whether the citizens' interests align with this direction for public construction. As highlighted by Zhao et al. (2015), public sentiment toward sustainable construction can impact its implementation, yet there is limited research on citizens' perceptions of this matter. This study aims to fill this research gap by investigating the level of public acceptance of sustainable public construction in their municipality and the associated influential factors.

We concentrate on buildings that are commissioned by the municipality or other public institutions and that are open to all citizens. Examples of such buildings include hospitals, town halls, schools, and fire stations. Projects such as public housing construction are not included. We define sustainable public construction as construction projects commissioned by government bodies (i.e. the state, federal states, and municipalities), which are executed in a way that satisfies the needs of the current generation while preserving the possibility of future generations to fulfill theirs (Brundtland, 1987). We conducted a survey employing a combination of a factorial survey and a discrete choice experiment among citizens from four German municipalities. We find acceptance especially in terms of a positive attitude, while only some segments of the public display a willingness to act. The level of acceptance among citizens is influenced by their trust in the municipality, their perception of benefits and drawbacks, and associated costs. Finally, the *default effect* (i.e., a higher rate of compliance with the option that is portrayed as the default) appears to be a promising method for promoting acceptance. The paper is organized as follows: Chapter 2 provides a comprehensive review of the literature on citizens' involvement, their level of acceptance, and relevant influencing factors. This review serves as a basis for deriving the hypotheses of this study. In Chapter 3, the applied research methodology is presented, followed by the presentation of results in Chapter 4. These are further discussed in Chapter 5, with Chapter 6 serving as the conclusion of this paper.

2. Literature Review and Hypotheses

Since the public is, by definition, affected by public construction projects, it can be seen as a stakeholder that should be involved in the respective decision-making processes. Lam and his colleagues (2010), for example, survey construction stakeholders in Hong Kong to identify success factors for implementing green specifications in construction and find that stakeholder involvement is among the most crucial ones. Similarly, Valdes-Vasquez and Klotz (2013) develop a framework of processes for social sustainability in construction projects and point to the relevance of stakeholder involvement for achieving this objective. In a practical guide, the authors illustrate this through actions such as engaging the final and temporary users and involving the community. Experts ranked stakeholder involvement to be the most important process to incorporate in the planning and design stages of buildings, closely followed by user considerations. Although these processes are often considered within the context of private construction projects, they are also applicable in public ones, where the users are members of the public. End-users' attitudes have been shown to play a critical role in promoting green buildings (Zuo & Zhao, 2014). Franco and her colleagues (2021) go beyond passive stakeholder involvement. They compare and analyze green building policies in cities and apply their findings in a case study of the Philippines' capital Manila. Their research highlights the need

for active participation and engagement by local stakeholders and actors to complement national policies. For support to be achieved, acceptance is a prerequisite (Batel et al., 2013). With the growing prevalence of civic initiatives and protests, it is increasingly important for the effective execution of political measures to gain public approval (Schubert & Klein, 2018). This is also a finding reached by Greiff (2012) in his analysis of the social dimension of sustainable construction. His study aims to identify social indicators that can complement the existing environmental and economic aspects in the first guidelines on sustainable construction by the state[2]. The first of the ten indicators established is public acceptance.

We adopt Dethloff's (2004) definition of acceptance, which posits that acceptance is the positive approval or adoption of an idea, situation, or product. Acceptance goes beyond reactive tolerance as it not only requires a positive valuation but also an active willingness to act. The concept can thus be split into two dimensions: attitude (positive to negative) and action (active to passive). A lot of research on public acceptance in the field of environmental sustainability has been conducted on renewable energies (e.g., Bertsch et al., 2016; Langer et al., 2018; Sonnberger & Ruddat, 2017). However, limited research has been conducted on public acceptance of sustainable building, although the topic arises occasionally in studies that explore the barriers to its implementation. For an attitude or intention to act to be directed towards an object, awareness of it needs to be present. However, awareness is low (but growing) in the case of green building (e.g., Darko & Chan, 2017; Zhao et al., 2015). Eves and Kippes (2010) survey real estate offices in New Zealand and find that only buyers with a high socioeconomic status possess a strong awareness of environmental issues. Shooshtarian et al. (2020) also identify the lack of stakeholders' familiarity with recycled construction material as a main barrier to its application. Stakeholders' unfavorable perception, i.e. their lack of acceptance, towards utilizing recycled products presents another significant obstacle. Zhao and his colleagues (2015) conduct a literature review and survey citizens to assess the social issues related to green building. They find that the general public is largely unaware of the concept of green building, but upon receiving information about the environmental benefits, there is a considerable level of acceptance and support. More than 90 % of their respondents state that they would be willing to pay more for green buildings. Several other researchers identify a positive willingness to pay (WTP) for green housing, which belongs to the action dimension of acceptance, among stakeholders owning or living in the building (e.g., Khan et al., 2020; Mandell & Wilhelmsson, 2011; Portnov et al., 2018; Wiencke, 2013). However, the level of citizens' acceptance of sustainable public construction in their municipality remains unexplored. Considering that the relationship with public buildings is likely to differ significantly from that with private residences, attitudes and the inclination to act (e.g., contribute financially) may also vary substantially. Another strand of literature reveals that citizens are willing to pay for the avoidance or reduction of CO_2 emissions through policies (e.g., Alberini et al., 2018; Brännlund & Persson, 2010; Longo et al., 2008). Based on a combination of these findings, we hypothesize that citizens show acceptance of public green building in both the attitude and the action dimensions. To verify this notion, we study citizens' attitudes toward and willingness to act in favor of sustainable construction in their municipality directly. The following hypotheses guide this part of the research:

> **H1.** There is a generally positive attitude among citizens toward sustainable public construction in their municipality.

[2] BMI. (2019). Leitfaden Nachhaltiges Bauen—Zukunftsfähiges Planen, Bauen und Betreiben von Gebäuden. Bundesministerium des Innern, für Bau und Heimat (BMI). https://www.bundesregierung.de/breg-de/suche/nachhaltiges-bauen-2156224

H2. Citizens are willing to act in favor of sustainable public construction in their municipality.

While these first two hypotheses describe the general state of the two components that form public acceptance (attitude and willingness to act) of sustainable public construction, the following sections examine potential factors that influence these components, beginning with people's attitudes. It has been argued that trust in responsible organizations is one of the factors that affect attitudes toward green building. Rajaee et al. (2019) show that trust in the responsible organizations for green building technologies enhances attitudes and intentions toward using these technologies. Franco et al. (2021) argue that transparency and accountability in planning and implementing sustainable construction projects are essential for building citizens' trust, which is critical for acceptance. According to Greiff (2012), involving local citizens in construction projects by informing them about the project and related decisions fosters acceptance and social integration. Perceived benefits and risks are further aspects that influence attitudes. For the case of carbon capture and storage (CCS), Schumann (2015) distinguishes between perceived social and personal risks and benefits. As anticipated, the perceived risks have an adverse impact, whereas the perceived benefits have a positive effect on respondents' initial attitudes towards CCS. Since green building is not typically associated with risks that could harm one's health, we consider drawbacks rather than risks to be the opposite of benefits. Finally, higher costs for sustainable building processes and materials have repeatedly been found to hinder their adoption (e.g., Gan et al., 2015; Lam et al., 2009; Pitt et al., 2009; Shooshtarian et al., 2020). However, these studies concentrate on the direct expenses incurred by construction clients. In the case of public buildings, citizens are only indirectly impacted by additional costs through increased taxes or potentially foregoing other spending on public goods in the municipality. The influence of additional costs on citizens' perception of public buildings remains unclear. This study aims to examine whether these factors influence citizens' attitudes toward sustainable construction in their municipality. The following hypotheses have been formulated for this purpose:

H3.1 A feeling of **trust** in their local government positively influences citizens' attitudes toward sustainable public construction in the municipality.

H3.2 Perceiving **personal and social benefits/drawbacks** positively/negatively influences citizens' attitudes toward sustainable public construction in their municipality.

H3.3 Higher **costs** of green building negatively influence citizens' attitudes toward sustainable public construction in their municipality.

While the aforementioned aspects are thought to primarily impact the attitude dimension of acceptance, others are likely to affect the action dimension. One example is the default effect. Notably, Araña and León's (2013) survey respondents demonstrated a significantly greater willingness to pay for a carbon offsetting scheme when the default option was set to contributing, as compared to when they had to actively opt-in. Similarly, in a different study, when the default option was a green energy contract and respondents had to actively opt out, purchases of such contracts were nearly tenfold compared to when the default option was a conventional energy contract (Ebeling & Lotz, 2015). Another potential determinant of support for sustainability in public construction is the type of building in question. As the concept of sustainability is intertwined with future generations, the willingness of individuals to behave in an eco-friendly manner may be influenced by the association of the building with children. Specifically, we hypothesize that citizens are more likely to engage when the building in

question is a school instead of a town hall or a train station. The school represents buildings with a direct connection to children, whereas the town hall and train station exemplify administrative buildings and other institutional buildings, respectively. In contrast, sustainable construction processes exhibit environmental benefits over conventional ones independent of the building's usage profile. Therefore, if citizens were to act rationally, the type of building ought to have no bearing on their support for sustainable public construction. Finally, it is hypothesized that costs influence not only people's attitudes (see H3.3) but their willingness to act in favor of sustainable public construction as well. Some of these factors have not yet been put into the context of green building, and those that have remain untested empirically. The objective of this study is to examine the following hypotheses and thus bridge this gap:

> **H4.1** Presenting sustainable public construction as the **default** option positively influences citizens' willingness to act in favor of sustainable public construction in their municipality.
>
> **H4.2** Citizens' willingness to act in favor of sustainable public construction in their municipality depends on the **type of building** to be constructed. It is higher for a **school** than for a train station or a town hall.
> **H4.2a** Citizens' willingness to act in favor of sustainable public construction in their municipality does not depend on the **type of building** to be constructed.
>
> **H4.3** Higher **costs** of green building negatively influence citizens' willingness to act in favor of sustainable public construction in their municipality.

3. Methods

3.1 Research Strategy and Data Collection

Citizens of four German municipalities (three cities and one district) were surveyed between the end of May and the end of August 2022. The three cities are situated in the south (A), north (B), and west (C) of Germany. Cities A and B are part of a metropolitan region, while city C is in proximity to the biggest urban agglomeration in Germany. City B has slightly over 75.000 inhabitants and City A has close to 95.000 inhabitants, with City C being the most populous at just over 250.000 inhabitants. The district, municipality D, is located in the western part of Germany and has a total population of slightly over 300.000 inhabitants.

After giving their consent, respondents were asked some basic sociodemographic questions, followed by a section focusing on sustainability (in construction). They then answered questions regarding their perceptions of trust, perceived benefits and drawbacks associated with sustainable construction within their municipality, and willingness to participate in various formats on the subject. All questions up until this point were item-based. Then, the main and experimental parts of the survey followed: a factorial survey and a discrete choice experiment. Both will be described in detail in the following. The complete survey transcript can be found in Table A in the appendix.

Factorial surveys depict hypothetical situations and ask participants to indicate the likelihood of exhibiting specific behaviors in those situations. Aspects of these situation descriptions (so-called *vignettes*) are varied to determine their influence on the likelihood of the behavior (Rossi, 1951). In this study, the hypothetical situation is the new construction of a public building in the respondents' municipality. The varied attributes encompass the type of building (school,

town hall, or train station[3]), whether sustainable standards[4] are to be applied or not (default effect), and the additional costs associated with these standards (5, 10, 15, 20, or 25 %). The respondent is asked to assume that a petition with sufficient signatures can enforce or prohibit the application of sustainable standards (depending on the default option stated). The question then is how likely the respondent is to sign the petition on a 100-point scale from "very unlikely" to "very likely". The following is an exemplary vignette (the attributes that are variable are highlighted in bold):

> Imagine, the city of x is planning the new construction of a **train station**. It was decided that the city will **abstain** from using sustainable building standards. For the construction project to **still be executed along** these standards, enough signatures need to be collected in a petition. Compared to the conventional way of building, the construction along sustainable standards would incur additional costs of **15 %**.

Through the combination of the variable attributes, there are 30 unique vignettes. Each participant was randomly presented with one vignette, drawn from an urn without replacement, to ensure an equal number of presentations and responses for each vignette.

Discrete choice experiments (DCE), based on McFadden (1986), enable the researcher to assess the impact of attributes of different choice options on the probability of being chosen by a respondent. The inclusion of the price of the options as an attribute permits the computation of a willingness to pay (WTP) for the other attributes. The options presented in this DCE correspond to policies that promote the enhancement of sustainability in new public construction projects within the municipality. The policies are characterized by four attributes, one of which is the additional monthly costs imposed on the respondent. These costs can take the values of 3, 9, and 15 €, which are collected through duties from all citizens. These values were deemed appropriate as affordable monthly contributions that citizens would be willing to make towards the enactment of the policies proposed. They also align with values from other researchers estimating the WTP for policies that target environmental improvements (e.g., Alberini et al., 2018; Dietz & Atkinson, 2010; Longo et al., 2008). Finally, selecting values that are easily divided by 30 enables the respondents to calculate the respective daily contribution. The remaining three attributes correspond to environmental aspects throughout the life cycle of a building. The first attribute pertains to the construction phase and represents the proportion of recycled material to be used in public construction projects. It can take the values of 20, 35, and 50 %. These figures are based on an estimated current value of 5 %[5] and a (current) realistic maximum of 20 to 30 % (based on personal communication with industry experts). The values exceeding this realistic maximum demonstrate an advantage of DCEs, namely the hypothetical nature of the choice situation. The second attribute is the reduction of greenhouse gas (GHG) emissions during the use phase compared to a situation in which no policy is implemented. The possible values are 33, 67, and 100 %. A 100 % reduction in GHG emissions would imply carbon neutrality in buildings, which has already been accomplished in selective buildings and for which guidelines exist (e.g., Braune et al., 2020). The other values represent equal increments between the current status quo of 0 % and the maximum. Finally, the recycling rate,

[3] While the Deutsche Bahn (the main German railway operator) is one of the main stakeholders and actors when it comes to building train stations, it does so in cooperation with the state, federal states, and municipalities (Deutsche Bahn, n.d.).

[4] In this context, sustainable standards are to be understood as a set of guidelines for construction that ensure that the environmental impact of a building is kept as small as possible.

[5] In 2020, 13.2 % of aggregates used in the construction industry were recycled aggregates. However, only approximately 20 % of these recycled aggregates are used in building construction as opposed to civil and underground engineering (Kreislaufwirtschaft Bau, 2023). Thus, 5 % is an optimistic estimation when considering mineral aggregates only. However, steal and synthetic materials are also candidates to be recycled and used.

referring to the end of life of the building, can take values of 40, 60, and 80 %. Here, we assume a current value of around 20 %[6] and a feasible maximum of 80 %, such that 40 and 60 % are intermediate increments of equal magnitude. There are three policy options, labeled A, B, and C, that are characterized by these attributes. In addition, an opt-put alternative exists in the form of a no-policy option, which remains consistent across choice sets. This option entails no additional costs and no changes in the environmental attributes to the current status quo. A status quo alternative allows the interpretation of respondents' choices in the light of standard welfare economic terms (Hanley et al., 2002) and is typically included when the alternatives consist of policies (e.g., Alberini et al., 2018; Longo et al., 2008). To avoid imposing a decision on participants, we include choice "I cannot answer this question". An exemplary choice set is shown in Figure 1.

	Policy A	Policy B	Policy C	No policy
Share of recycled construction material	50 %	35 %	20 %	no change
Reduction of greenhouse gas emissions	67 %	100 %	67 %	no change
Recycling rate	60 %	40 %	40 %	no change
Additional monthly costs for you	9 €	15 €	3 €	0 €
Which policy do you choose?	○	○	○	○

○ I cannot answer this question.

Figure 1: Exemplary choice set

Respondents were instructed to imagine that their municipality is planning to introduce a policy aimed at increasing sustainability in the construction of public buildings. They were then asked to choose the policy that aligns best with their interests from a selection of three. Then, the attributes describing the policies were explained. It was pointed out that these policies may generate future financial savings, which could be redistributed among the citizens, but that this is omitted for simplification. Information was provided on the construction industry's environmental impact for orientation, specifically addressing yearly natural resource extraction, CO_2 emissions, and construction and demolition waste. Finally, respondents were asked to assume that the share of recycled construction material and the recycling rate, in the absence of any policy, is around 5 % and 20 %, respectively. Each participant was presented with six distinct choice sets.

Since a full factorial design – comprising all possible choice sets – is not feasible, a fractional factorial design was generated using the Balanced Overlap design option from the Lighthouse Studio software. This method balances statistical efficiency with some overlap to allow for interaction effects (Sawtooth Software, 2021). The survey itself was programmed within the online platform SoSci Survey and was made available for respondents via https://www.soscisurvey.de (Leiner, 2021). Participants were primarily approached by the respective municipal administration through social media posts, press releases, and word-of-mouth promotion.

[6] While the official recycling rate in Germany is almost at 90 % (Destatis, n.d.), this figure includes road- and backfilling. Actual recycling of mineral waste, which entails retaining the original material's value, is much lower (in the single-digit scope). Recycling rates for other materials, such as metal, are significantly higher (EuRIC, 2022). Therefore, a recycling rate of 20 % is an approximation across all construction materials.

3.2 Empirical Model

The data gathered through the factorial survey are analyzed using a linear regression model of the following form:

$$\text{likelihood to sign the petition} = \beta_0 + \beta_1 \text{ default} + \beta_2 \text{ building type} + \beta_3 \text{ additional costs} + \boldsymbol{\beta}' \boldsymbol{Z_i} + \epsilon$$

where β_0 denotes the constant, β_{1-3} are the coefficients describing the effects of the variable aspects, and $\boldsymbol{Z_i}$ is a vector of respondents' individual characteristics. ϵ describes the error term.

The choices respondents made in the DCE are analyzed based on random utility theory (McFadden, 1986). Louviere et al. (2010) formalize a consumer's utility of different choices with the following equation:

$$U_{ia} = V_{ia} + \varepsilon_{ia}.$$

U_{ia} describes individual i's utility of alternative a and consists of a systematic component V_{ia} that can be observed and an unobservable random component ε_{ia}. The consumer (individual i) will choose an option (alternative a) when the utility derived from that option is larger than the utility derived from any other option:

$$U_{ia} > U_{ib} \qquad all\ b \neq a \in A$$

Combining the two previous equations, the following probability of choice can be derived:

$$P(a|C_i) = P[(V_{ia} + \varepsilon_{ia}) > Max(V_{ib} + \varepsilon_{ib})], \text{ for all } b \text{ alternatives in choice set } C_i$$

where C describes a choice set with several options, among which alternative a. The choice model one applies depends on the assumptions made about the probability distribution of the random components ε_{ai}. The most basic one is the multinomial logit (MNL) model (McFadden, 1974), which assumes ε_{ai} to be iid (independently and identically distributed) among the alternatives. It also relies on the Independence of Irrelevant Alternatives (IIA) assumption (Louviere et al., 2010). The inclusion of an opt-out option often violates this assumption (Dhar & Simonson, 2003), which states that adding a further option may not alter the relative probabilities of choice of the other options. The assumption is relaxed in McFadden and Train's (2000) mixed logit (ML) model, which allows some of the attribute coefficients to be random, thereby allowing for preference heterogeneity.

Our dataset has a panel form since respondents made six choices each, which adds a time dimension to the utility function:

$$U_{iat} = \boldsymbol{\beta'}_i \boldsymbol{x_{iat}} + \boldsymbol{\alpha'} \boldsymbol{w_{iat}} + \boldsymbol{\delta'}_a \boldsymbol{z_{it}} + \varepsilon_{iat}$$

$\boldsymbol{x_{iat}}$ and $\boldsymbol{w_{iat}}$ represent vectors of the attributes that define the alternatives, where $\boldsymbol{\beta'}$ is the vector of random coefficients and $\boldsymbol{\alpha'}$ are fixed coefficients. $\boldsymbol{z_{it}}$ describes a vector of the decision-makers' individual characteristics, where $\boldsymbol{\delta'}_a$ are also fixed coefficients.

To ensure the robustness of the results, we apply a nested logit model (Hensher & Greene, 2002). This model creates a hierarchical choice by grouping similar alternatives into nests. In our case, respondents' choice can be formalized as a first choice between a policy and the status

quo and (if applicable) a second choice between the three policies (see Figure 2). This approach also relaxes the assumptions made by the MNL model.

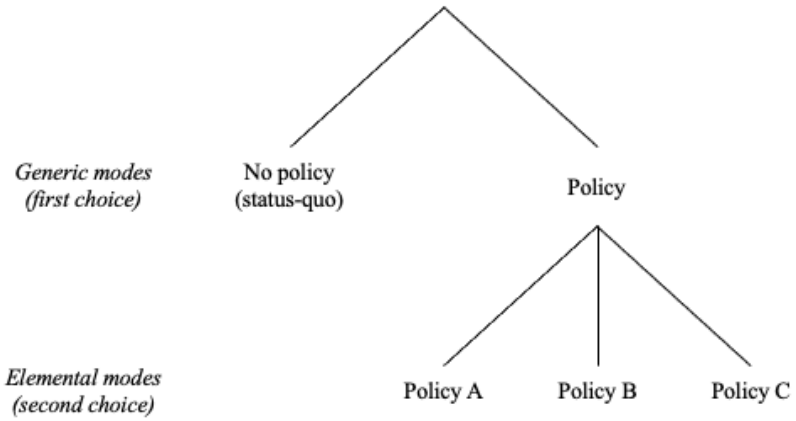

Figure 2: Hierarchical choice

The utility a decision-maker derives from a policy (a so-called *elemental mode* m, which is contained within a *generic mode* g) can be formalized as follows:

$$U_{gm} = U_g + U_{m|g}, m \in M_g, g \in G$$

or in terms of the systematic and unobserved components of utility:

$$U_{gm} = V_g + V_{m|g} + \mu_g + \varepsilon_{m|g}, m = 1, \dots, M_g, g = 1, \dots, G$$ (Louviere et al., 2010).

All models are calculated using Stata (StataCorp, 2021).

4. Results

A total of 514 citizens took part in the study. 214, 142, 87, and 71 are from the same city or district, respectively. Approximately two thirds of all participants completed the entire survey (n = 337). The descriptive characteristics of the sample (socio-demographic information) can be found in Table B1 in the appendix. Respondents gave an average rating of 72.2 (n = 383, sd = 24.48) regarding their perception of personal benefits versus drawbacks of sustainable public construction. The scale ranged from only personal drawbacks (0) to only personal benefits (100). With a score of 80.60 (n = 394, sd = 23.95), the rating is even higher when it comes to perceived social benefits and drawbacks (refer to Table B2 in the appendix). This result supports our first hypothesis (H1), which implies a positive attitude among citizens toward sustainable construction. The respondents' associations with sustainable construction are also predominantly positive. The negative and positive values for each pair of potential associations were coded 0 and 100, respectively. Only effort and space scored below 50. The aspect of higher versus lower costs obtained a score of 51.2. All other aspects (design, comfort, environmental impact, health, and quality) were rated well above 50 (see Table B3 in the appendix). Thus, citizens' positive associations with sustainable construction dominate, also aligning with our first hypothesis (H1).

Table 1 displays the results of the DCE. The signs of the alternative-specific coefficients are consistent with expectations: higher costs lower the choice probability of a policy, while a higher share of recycled material and reductions in greenhouse gas emissions, and an increased recycling rate each have a positive effect. The negative impact of the cost attribute supports our hypothesis that higher costs influence citizens' attitudes toward sustainable construction in their municipality negatively (H3.3). Since the coefficients in a mixed logit model are difficult to interpret, we calculate marginal effects. An increase of 9 € in monthly costs for the respondents' household[7] reduces the likelihood of choosing that policy by 12.5 percentage points. As the other three attributes are all measured in percentage points, a direct comparison of their impact is possible. An increase of 20 percentage points in the share of recycled material, reduction of GHG emissions, and recycling rate results in an increase in the choice probabilities of 8.8, 9.4, and 6.3 percentage points, respectively. Thus, the reduction of GHG emissions has the largest impact on policy choice. The coefficient of the alternative-specific constant (ASC), which is coded 0 for the status quo alternative and 1 for all policy alternatives, indicates that respondents were more inclined to choose a policy than to choose the status quo (see Table 1). This finding again confirms our hypothesis regarding the positive attitude of citizens toward sustainable construction (H1). The lower half of the table displays the standard deviations of the attributes, whose significance confirms the suitability of a mixed logit model.

Table 1: Regression results from the DCE (cmxtmixlogit)

	Baseline
Costs	– 0.157***
	(0.0142)
Rec. Material	0.0436***
	(0.00491)
GHG Reduction	0.0529***
	(0.00377)
Recycling Rate	0.0301***
	(0.00375)
ASC	8.896***
	(2.370)
/Normal	
sd(Rec. Material)	0.0419***
	(0.00594)
sd(GHG Reduction)	0.0345***
	(0.00361)
sd(Recycling Rate)	0.0331***
	(0.00506)
sd(ASC)	9.612***

[7] 9 € was selected as it represents the median value among the possible cost attribute values in the discrete choice experiment. 9 € corresponds to roughly 0.3 % of the median monthly household income in our sample.

	(2.705)
N	7536

Standard errors in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The WTP for the three environmental attributes can be calculated by dividing the respective coefficient by the cost variable coefficient (Hole, 2007). Although preference heterogeneity concerning costs is likely to exist, it is statistically problematic to model the cost coefficient as random (Carson & Czajkowski, 2019). Therefore, we model it as fixed and report the confidence intervals of the estimates that we obtain using the delta method (Hole, 2007; StataCorp, 2021). Table 2 provides the WTP estimates for the share of recycled material, the reduction of GHG emissions, and the recycling rate. The estimates refer to a one percentage point change. Thus, citizens are most willing to pay for a percentage point increase in GHG reductions (0.34 EUR), followed by a percentage point increase in the share of recycled material (0.28 EUR). The WTP for a percentage point increase in the recycling rate is the lowest (0.19 EUR). The difference between the recycling rate and the other two attributes is significant since this WTP estimate is not within the confidence intervals of the other estimates. The positive WTP estimates align with our hypothesis that citizens are willing to act in favor of sustainable construction in their municipality (H2). A nested logit model is additionally implemented to ensure the robustness of the results. This alternative specification confirms the findings, as can be seen in Table C1 and Table C2 in the appendix.

Table 2: WTP estimates for environmental attributes in EUR

	Rec. Material	GHG Reduction	Recycling Rate
WTP	0.28	0.34	0.19
Lower limit	0.22	0.28	0.14
Upper limit	0.34	0.39	0.24

A further result that sheds light on the second hypothesis is the degree of citizens' willingness to participate in different hypothetical offers by the city. These offers include a discussion round, an online platform, and two kinds of newsletters: one with additional information on subsidies for private construction clients and the other without. All of these were described to be on the topic of sustainability in public construction. Respondents were assigned randomly to one of four groups, being presented with only one offer. They were then asked to rate their likelihood of engagement on a scale from 0 (very unlikely) to 100 (very likely). The results show an average response of 50.42 (n = 390, sd = 35.10) and no significant difference between the formats (see Table B4 in the appendix). A score of 50 can be interpreted as "neither likely nor unlikely" or "ambivalent", which does not provide substantial support for our hypothesis of a positive willingness to act (H2).

We hypothesized that certain individual traits could impact citizens' attitudes, specifically their level of trust in the local government and their perception of benefits and drawbacks. We test these hypotheses using a nested logit model, the results of which are presented in Table 3. As expected, a higher level of trust in their municipality increases respondents' likelihood of opting for a policy over the status quo (no policy; H3.1). The trust variable comprises general trust, trust in the intention and in the competence of the municipality to act in the best interest of the citizens and the environment, and feeling adequately informed regarding new construction projects and their sustainability efforts (see Table B5 in the appendix for descriptive results of these aspects). Likewise, perceiving more benefits than drawbacks to sustainable construction in the municipality, both personally and socially, raises the likelihood of choosing a policy.

These results are in line with our hypothesis (H3.2). Including these factors renders the coefficients of the alternative-specific attributes insignificant. Thus, their effects on the choice probability of a green building policy, as opposed to no policy, are driven by respondents' trust in the municipality and the benefits they associate with green building[8].

Table 3: Regression results with individual factors of influence (nlogit)

	Baseline nlogit
Alternative	
Costs	– 0.0215
	(0.0228)
Rec. Material	0.00651
	(0.00687)
GHG Reduction	0.00681
	(0.00722)
Recycling Rate	0.00408
	(0.00434)
ASC	– 1.014
	(1.054)
Policy (nest)	
Trust	0.688***
	(0.168)
Personal drawbacks vs. benefits	1.278***
	(0.355)
Social drawbacks vs. benefits	1.762***
	(0.316)
N	6160

Standard errors in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The factorial survey results reveal that the default effect significantly impacts respondents' (hypothetical) willingness to act. When the default is a conventional construction process, the average likelihood of signing the petition (in favor of using sustainability standards instead) is 65.52 %. This value differs significantly from a value of 50 %, which we denote as ambivalence ($t(187) = 5.58$, $p = 0.00$). Thereby, this finding also supports our hypothesis that citizens are willing to act in support of sustainable construction in their municipality (H2). If sustainable standards are meant to be implemented, the probability of signing a petition against their use is only 19.55 % on average. This value significantly differs from 50 % (indicating ambivalence; $t(186) = – 12.32$, $p = 0.00$). Thus, as hypothesized (H4.1), the default effect has a significant influence on citizens' willingness to actively support sustainability in public construction. Although the willingness to act, whether in favor of or against sustainability standards, varies

[8] Both specifications with only trust and only perceived drawbacks and benefits as individual characteristics yield the same result with respect to the insignificance of the alternative-specific attributes.

according to the default, the more intriguing finding is that the extent of citizens' acceptance of sustainable public construction differs. If sustainability measures are not planned to be implemented, there is a 65.52 % likelihood of acting against this decision (and thus favoring sustainability). However, if sustainability measures are presented as the default option, the average probability to (silently) agree increases to 81.45 % (100 % – 19.55 %). These values differ significantly from each other ($t(373) = -4.01$, $p = 0.00$).

The willingness to sign a petition supporting sustainability standards is highest when the building in question is a school (see Table 4)[9]. However, the differences in likelihood in comparison to a train station and a town hall are either insignificant or only marginally significant, respectively. Consequently, the results are not conclusive regarding our hypothesis (H4.2).

Table 4: Regression results on the effect of building type in the factorial survey

Default: no standards	
Building types[10]	
Train station	– 5.435
	(6.529)
City hall	– 12.91^{+}
	(6.893)
_cons	71.80***
	(4.651)
N	188

Standard errors in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

There is a lack of conclusive evidence on the effect of the additional costs that building according to sustainability standards imposes on respondents' willingness to sign a petition for or against using these standards. If such standards are planned to be implemented, additional costs of 25 % for a train station decrease, whereas additional costs of 15 % for a town hall increase respondents' likelihood to sign a petition against these standards. Both effects are difficult to explain and are likely to be artifacts. If the plan is to build conventionally, additional costs of 25 % for building a town hall according to sustainability standards significantly decrease respondents' likelihood to sign a petition in favor of such standards. Table 5 displays these results. Overall, we cannot confirm nor reject our hypothesis regarding the effect of costs on the public's willingness to act in favor of sustainable construction in their municipality (H4.3).

Table 5: Regression results on the effect of building type and additional costs in the factorial survey

Default	(1) Sustainability standards	(2) No sustainability standards

[9] There are no significant differences between building types if the default is the adherence to sustainability standards.
[10] The building type school is the base category.

School x 10 %	9.225	1.230
	(14.38)	(16.22)
School x 15 %	11.48	– 3.182
	(12.24)	(16.52)
School x 20 %	2.010	1.929
	(8.851)	(17.67)
School x 25 %	9.548	3.364
	(11.16)	(15.60)
Train station x 5 %	8.292	– 7.610
	(12.12)	(16.85)
Train station x 10 %	11.24	– 4.825
	(11.01)	(16.54)
Train station x 15 %	11.53	5.000
	(14.09)	(16.27)
Train station x 20 %	– 7.675	– 14.43
	(6.336)	(16.78)
Train station x 25 %	– 11.37^{+}	– 0.932
	(5.928)	(16.75)
City hall x 5 %	0.989	1.118
	(9.193)	(17.69)
City hall x 10 %	22.62	– 14.98
	(14.22)	(17.71)
City hall x 15 %	30.72*	– 7.610
	(14.53)	(16.90)
City hall x 20 %	9.625	0.218
	(11.35)	(16.40)
City hall x 25 %	13.49	– 34.81*
	(10.88)	(16.85)
_cons	11.37^{+}	71.18***
	(5.928)	(13.02)
N	187	188

Standard errors in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

We also examine the impact of sociodemographic information on the likelihood of choosing a policy over the status quo. The importance people place on sustainability in their personal lives significantly increases the probability of choosing a policy. Moreover, younger and higher-income respondents display a marginally significantly higher likelihood to do so than their respective counterparts. Significant differences exist between the municipalities regarding their citizens' likelihood of choosing a policy. Refer to Table C3 and Table C4 in the appendix for the regression results.

5. Discussion

Government bodies should serve the citizens they are responsible for. Part of that service is to involve and act in the interest of these citizens, and construction projects and the associated sustainability efforts are no exception. Our findings indicate that citizens are generally accepting of sustainable public construction, mainly in terms of positive attitudes and, to some extent, a willingness to act. Participants' positive attitudes were identified in several ways. One of these is their perception of significantly more benefits than drawbacks to sustainable construction in their municipality, both on a personal and a societal level. Furthermore, most of their associations with building sustainably are positive. The only exceptions are effort, space, and costs, with participants associating more effort and less space with sustainable construction and being undecided about costs. These negative associations are mostly a reflection of reality, at least for now. As sustainable construction practices are not (yet) the norm, it takes extra effort to apply them. This may be one of the reasons for increased costs, as well as the lower availability of green building materials and consultants. However, both factors are likely to become negligible as sustainable building practices become more common, at least in cases where sustainable products or processes replace conventional ones rather than requiring additional materials or steps. In addition, some products or processes that are considered sustainable can be seen as a form of investment. For example, renewable energy systems require direct costs now but may generate profits in the future (Dietrich, 2023). Furthermore, the difference in costs between conventional and sustainable options could strongly decline if not vanish in many cases, if externalities were internalized, for example, through a tax (Söderholm, 2011). While government institutions would be equally affected by such a consumption tax as private individuals, they are additionally driven to choose the sustainable option because of their duty to act in the interest of the general welfare. The idea that less space generates less of an environmental impact compared to more space is likely to remain valid since building space inevitably consumes resources and energy (e.g., Goldstein et al., 2020; Lavagna et al., 2018). Despite these factors, respondents' attitudes are dominated by positive associations, which is also reflected in their choice of policies in the DCE. They chose policies meant to decrease public buildings' environmental footprint throughout their life cycle over the status quo, despite it costing them personally. These choices are hypothetical and should be interpreted as such. However, research indicates that the so-called *hypothetical bias* in stated preference studies is not as pronounced as previously believed, especially when choice-based elicitation methods are employed, as in this case (Murphy et al., 2005).

The factors that we hypothesized to influence citizens' attitudes did indeed show the expected effect (see Table 3). Trust in the municipality and perceiving more benefits than drawbacks to sustainable public construction had a positive impact on participants' likelihood of choosing a policy that reduces the environmental footprint of buildings. Similar results have been found in other areas. For instance, Siegrist (2000) analyses the role of trust in the acceptance of gene technology. Through a questionnaire survey, he discovers that the most important influence on gene technology perception is trust in the responsible institutions. Additionally, Suh and Han's research on attitudes toward internet banking in the early 2000s shows that trust in the banking website has a significant positive effect on both attitudes toward and intention to use internet banking (Suh & Han, 2002). This pivotal role of trust extends the so-called *Technology Acceptance Model* (Davis, 1985) beyond the factors of perceived usefulness and perceived ease of use. Perceived usefulness is one path through which the impact of trust in the municipality on citizens' attitudes can be explained. Researchers find that trust influences the perceived usefulness of green buildings and their respective technologies, which in turn positively affects attitudes (Liu et al., 2018; Rajaee et al., 2019). However, it should be noted that the findings from these studies only apply to private buildings and cannot be directly transferred to public

construction. Future research could identify whether perceived usefulness also functions as a mediator in this case. Another common finding in the studies by Liu et al. (2018) and Rajaee et al. (2019) is that trust influences the behavioral intention to use or apply the technology under consideration. As this effect refers to the behavioral dimension of acceptance, it goes beyond our hypothesized influence of trust on its attitudinal dimension. We check whether our data support this result and indeed find that trust also positively influences the willingness to act[11] (refer to Table D2 in the appendix). This influence can be utilized by municipalities seeking to enhance their citizens' acceptance of sustainable public construction. Through transparency and participatory offers (in public building projects), trust in the municipality can be increased, thereby fostering citizens' acceptance.

Another reason why trust is important is that it affects the perceived risks (drawbacks) and benefits of the object or process, which in turn directly determine its acceptance (Siegrist, 2000). Since trust reduces uncertainty and thus perceived risk, it is particularly important in cases of high complexity or unfamiliar areas (Rajaee et al., 2019). Green building is likely to fulfill this criterion for most of our participants being lay people. Thus, trust and the perception of benefits and risks (drawbacks) are closely linked. In the context of sustainability, both personal and social benefits and risks (drawbacks) play a role. Schumann's (2015) study on attitudes toward carbon capture and storage reveals that perceived social benefits have the largest impact in comparison to social risks, personal risks, and personal benefits. Since we model risks (drawbacks) and benefits on the same scale, identifying the distinct effect of these two opposites is infeasible. However, our results support Schumann's (2015) finding that social effects have a greater influence on the likelihood of choosing environmentally friendly policies over the status quo than personal effects. Municipalities should consider this in their communication on construction projects. Focusing on the benefits, especially those to society, could foster the public's positive attitudes further. Nevertheless, it is critical to also communicate any potential drawbacks transparently.

Our results support our hypothesis regarding the negative influence of costs on attitudes toward sustainable public construction. Costs have been consistently identified as a barrier to the adoption of green building practices. For instance, Pitt et al. (2009) study factors that prevent sustainable construction and identify affordability to be the most important barrier. Similarly, Lam et al. (2009), in their survey of clients, consultants, and contractors, find that additional costs are viewed as the primary barrier by all stakeholder groups. Huijts et al. (2012) examine the relationship between costs and public acceptance in sustainable energy technology in their study. The researchers set up a framework of energy technology acceptance based on psychological theories and empirical studies in the field. They posit that the perceived costs of a technology directly influence people's attitudes toward it, which consequently affect its level of acceptance. Our results verify this premise in relation to public construction.

The identified WTP for an increase in the environmental aspects serves as an indication for a positive willingness to act for sustainable public construction, which constitutes the second dimension of public acceptance. Participants were found to be willing to pay the most for a reduction in GHG emissions, followed by an increase in the share of recycled material, whereas their WTP for increasing the recycling rate is the lowest. The estimated values translate to a monthly WTP of 6.80 €, 5.60 €, and 3.80 €, for a reduction in GHG emissions, an increase in the share of recycled material, and an increase in recycling rate by 20 percentage points in public buildings, respectively. Robbins and Perez-Garcia's (2005) survey of the general population and real estate agents on their valuation of environmental improvements produce

[11] We used the likelihood of signing a petition in favor of applying sustainability standards in a public construction project as the dependent variable.

results consistent with this implied ranking. The researchers find that the general public is significantly more willing to pay for a reduction in GHG emissions than for a reduction in air pollution or solid waste emissions. Remarkably, real estate agents exhibit the highest WTP for reducing solid waste emissions. At least two reasons may explain why the WTP for GHG emissions are highest among our respondents. Firstly, the topics of GHG emissions and climate change are arguably the most prominent in the public debate surrounding sustainability. Respondents may not be as aware of the issue of resource scarcity[12] and, as a result, may not be as willing to pay for improvements in this area. Secondly, the reduction of GHG emissions was explicitly stated to apply to the use phase of the building, while the share of recycled material and the recycling rate were linked to the construction and demolition phases, respectively. As the respondents represent the general public, rather than construction stakeholders or experts, they are presumably most familiar with the use phase of a building. Some may never have been involved in construction or demolition processes. Therefore, the reduction of GHG emissions is likely to be the most relatable aspect for them. The disparities between the general public and real estate agents with respect to their WTP to reduce GHG emissions versus solid waste emissions, as revealed by Robbins and Perez-Garcia's (2005) study, corroborate this explanation. Our WTP estimates for reducing GHG emissions are in line with prior research (Dietz & Atkinson, 2010; Ščasný et al., 2017). One potential reason for the lowest WTP for increasing the recycling rate could be the tendency to neglect the end of life of buildings. Adams and her colleagues (2017) find that a significant challenge for implementing a circular economy in the construction sector is the lack of consideration of end-of-life issues among stakeholders. It is conceivable that this issue extends to our respondents as well. Moreover, the demolition process and, where applicable, recycling lie the furthest in the future, resulting in the utility of a higher recycling rate being most strongly discounted (Fishburn & Rubinstein, 1982).

Another finding that supports citizens' positive willingness to act in support of sustainable public construction is their expressed intent to sign a petition advocating for the use of sustainability criteria in public construction projects (and not against it). In contrast, the results regarding their willingness to engage in various formats offered by the municipality on the subject, remain inconclusive. Overall, participants report to be neither very likely nor very unlikely to engage, independent of the format. The reported likelihood to engage differs substantially between participants (refer to Table B4 in the appendix), suggesting that individual factors may play a role in the decision to engage. In an attempt to identify these factors, we find that age plays a role, with older respondents (56 and above) being significantly more likely to participate in these formats. Additionally, those who place a higher value on sustainability in their personal lives and possess knowledge of sustainable construction are more likely to engage. See Table D1 in the appendix for these results. It remains unclear, however, why the overall willingness to engage is substantially lower than it is to pay or to sign a petition. Further research is necessary to identify the factors influencing whether or not citizens will act in favor of sustainable public construction.

Regarding the determinants of the willingness to act in favor of sustainable public construction, our results are largely inconclusive. However, one aspect that clearly showed an effect is default framing. A significantly higher proportion of citizens approve of implementing sustainability standards in public construction when it is presented as the default option. Researchers have proposed three explanations for the default effect. One reason for people favoring the default option is the lower effort and cost involved compared to choosing an alternative (Araña & León, 2013; Dinner et al., 2011). In the case of signing a petition, although not a large amount of

[12] Naturally, recycling building material is also directly linked to the emissions of GHG (whether positive or negative depends on the material and the processing necessary). However, we assume that the aspect of resource use is more prominent in this setting.

effort is required, it does take up some time and potentially involves travel. A second explanation is implied endorsement, meaning that setting an option as the default signals that this option is the desired or beneficial one (Dinner et al., 2011). Participants may have assumed that the standards were desirable because the municipality allegedly endorsed them. This relates to the importance of trust in the responsible institution, as previously discussed. The anchoring effect or reference dependence constitutes the third and final explanation for the default effect. The concept suggests that the default option is interpreted as the status quo, against which other options are compared and perceived as either gains or losses (Araña & León, 2013; Dinner et al., 2011). If the implementation of sustainability standards is the default option, building conventionally may be perceived as a loss, which is typically disliked by individuals (known as *loss aversion*; Tversky & Kahneman, 1991). Our research has demonstrated that default framing represents an effective nudge for promoting sustainable construction. Especially given that it steers behavior in a desired direction while preserving freedom of choice, default framing is an attractive policy instrument to encourage the adoption of green building practices (Thaler & Sunstein, 2008). The results regarding the default effect restrict the apparent extent of the public's willingness to act in favor of sustainable construction. When conventional building is the default, it requires active behavior to demonstrate one's support for sustainable construction. Conversely, when sustainable standards are to be implemented by default, doing nothing implies agreement or acceptance. The difference in the likelihood of accepting sustainable construction in the two settings shows that not all citizens who have a positive attitude are willing to act on it.

Although our results indicate that costs have a negative impact on the attitudinal dimension of acceptance of sustainable public construction, no concrete evidence was found to support this effect on the behavioral dimension. The setting in the study was a newly constructed public building that would incur additional costs if built along sustainability standards. The situation description did not specify who would bear these expenses. Thus, one potential reason why we did not find an effect is that participants did not perceive these costs as disadvantageous to themselves. Despite citizens contributing a significant proportion of municipal funds, this relation might be too indirect or even unknown. Rajaee et al. (2019) find that costs have a negative impact on decision-makers' intention to adopt green building technologies when they perceive these costs to be their burden, for example because the building in question is their home. Further research is required to determine if citizens are genuinely indifferent toward additional costs for sustainable public construction or if they would behave differently when made aware that they are eventually responsible for bearing (at least some of) these costs.

Finally, the building type in question (i.e., school, train station, or town hall) was found to have no impact on the decision to support sustainability standards in public construction. Our hypothesis predicted that support would be highest for schools, and while we did find the expected signs, the results were not significant or only marginally so. The hypothesis was based on the connection between sustainability and future generations. Therefore, we tested whether this effect is present for participants with children, given that this connection is likely to be more salient for parents. However, the results indicate that this is not the case. Accordingly, we conclude that the type of building does not influence citizens' willingness to act in favor of constructing it along sustainability standards. Instead, citizens appear to behave rationally and advocate for implementing such standards regardless of the type of building.

The results above are averaged across the four municipalities in our sample. Naturally, variations in size, geographical location, industrial focus, and the extent to which they already employ practices of green public procurement and sustainable construction exist. As a result, the respective levels of their citizens' acceptance may differ. For example, in Table D3, we

analyzed whether trust and perceived benefits vs. drawbacks have varying effects in different municipalities. Indeed, we find that in one municipality (A), only the perception of social but not personal benefits vs. drawbacks increases the likelihood of choosing a policy promoting sustainable construction over the status quo. Moreover, trust does not seem to have an effect in this municipality. Thus, municipalities should check these factors within their specific context before potentially designing measures based on them.

6. Conclusion

Sustainable public construction provides a solution for the large environmental impact caused by government bodies in procuring new buildings. As with any decision or action that affects citizens, following the public's interest is desired and attaining acceptance is key. Therefore, this study sets out to identify citizens' stance on sustainable construction in their city or district through a survey in four German municipalities. The survey primarily consisted of a factorial survey and a DCE. The main findings are the following: overall, citizens show acceptance of sustainable public construction, particularly regarding its attitudinal dimension. They consider the concept as beneficial for themselves and society, associate it primarily with positive factors, and would opt for policies that encourage sustainable construction in their municipality over the status quo of conventional construction. Trust in the municipality and perceived benefits compared to drawbacks have a positive impact, while associated costs negatively affect attitudes. Results are more mixed regarding the behavioral dimension of acceptance. On the one hand, we find evidence of a willingness to act in terms of financial contributions and signing a petition to implement sustainability standards in buildings. The default framing appears to be an effective tool to increase the acceptance of sustainable public construction. On the other hand, only certain segments of the public seem to be willing to engage in formats offered by the municipality to inform on and discuss topics of sustainable construction. Elderly citizens and individuals with an interest in and knowledge of sustainability and construction are more likely to engage. However, overall, the likelihood of engagement is only moderate. Furthermore, our results indicate that not all citizens who passively accept sustainable construction would be willing to actively show their support. To summarize, public acceptance of sustainable construction in the municipality exists, but it is stronger in the attitudinal compared to the behavioral dimension. Further research is needed to determine more precisely the factors that may influence and foster citizens' willingness to act in favor of sustainable construction. Our results suggest that one promising avenue is the use of the default effect. Municipalities seeking to limit their environmental impact and utilize the potential offered by construction in this regard could establish the implementation of sustainability standards as the default for new buildings. Based on our findings, the local government would likely be met with a favorable response from the public while still having the option to diverge from imposed regulations if deemed necessary. Theoretically, very courageous municipalities could set a financial contribution by citizens as the default. In practice, fiscal responsibilities would need to be transferred from the central government to local authorities for them to be able to set tax rates autonomously. Such a (partly) decentralized tax system may further contribute to a higher level of acceptance and WTP since it implies that tax money is being spent locally. Accompanied by clear and transparent communication, a financial contribution as the default may be an effective strategy given our results which indicate that the public is willing to pay for an increase in environmental sustainability in the construction of public buildings.

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Appendix A

Survey Transcript

Table A: Full survey transcript

Question	Wording	Response options
Start		
Consent (filter question)	*Information on the survey and data protection.*	→ I give my consent and wish to participate in this survey. (Survey continues.) → I do not want to participate in this survey. (Survey is terminated.)
Sociodemographic information		
Gender	Which gender are you?	→ female → male → other → not specified
Age	How old are you?	→ younger than 16 → 16 – 25 → 26 – 35 → 36 – 45 → 46 – 55 → 56 – 65 → older than 65
Education	Which educational status do you have?	→ no degree → Certificate of Secondary Education → General Certificate of Secondary Education → completed apprenticeship → vocational diploma → general qualification for university entrance → graduate degree → other: *Text*
Income	How high is your monthly net household income?	→ less than 500 € → 500 € to less than 1000 € → 1000 € to less than 2000 € → 2000 € to less than 3000 € → 3000 € to less than 4000 € → 4000 € to less than 5000 € → 5000 € to less than 6000€ → 6000 € to less than 7000 € → 7000 € to less than 8000 € → more than 8000 € → not specified
Children	How many children do you have?	→ 0 → 1 → 2 → 3 → more than 3

Residency	Please indicate your postal code.	*Text*
The municipality		
Information channels	Which of the following channels do you use to inform yourself about news from [*the respective city or district*]?	→ local newspaper → local radio → local TV → website of [the respective city or district] → newsletter from [the respective city or district] → notice, e.g. in the city hall → (digital) placards → Facebook → Instagram → LinkedIn → Twitter → other: *Text* *Options are partly adapted to the municipality*
Sustainability		
Importance of sustainability	How important is sustainability (sustainable behavior) in your private life to you?	*Slider from 0 (not at all important) to 100 % (very important)*
Knowledge of sustainable construction	How do you evaluate your knowledge on sustainable construction?	*Slider from 0 (no knowledge at all) to 100 % (very good knowledge)*
Associations with sustainable construction	Which of the opposed characteristics do you rather associate with sustainable construction? *All pairs listed.*	*Slider from – 50 (negative characteristic) to + 50 (positive characteristic) for each pair*
Sustainability in construction in [*the respective city or district*]		
Identification	How strongly do you identify with [*the respective city or district*]?	*Slider from 0 (not at all) to 100 % (very strongly)*
Trust and feeling of being informed	To what extent do you agree with the following statements? • I have great trust in the political and administrative entities of [*the respective city or district*]. • I trust that the political and administrative entities of [*the respective city or district*] have the intention to consider the interests of citizens as well as the environment. • I trust that the political and administrative entities of [*the respective city or district*] have the competency to consider the interests of the citizens as well as the environment. • I feel sufficiently informed about new construction projects and their	*5-point Likert scale from 1 (I do not agree at all) to 5 (I totally agree).* *Opt-out option: I cannot assess this.*

	sustainability in [*the respective city or district*].	
Source of information	Where would you like to see this type of information?	*Text*
Personal and social benefits and drawbacks	Which of the opposed statements fits you better? • I personally experience disadvantages if there would be more sustainable construction in [the respective city or district]. – I personally benefit if there would be more sustainable construction in [*the respective city or district*]. • The society experiences disadvantages if there would be more sustainable construction in [the respective city or district]. – The society benefit if there would be more sustainable construction in [*the respective city or district*].	*Slider from – 50 (disadvantages) to + 50 (benefit) for each pair*
Engagement		
Likelihood to engage in different formats	*Situation description (newsletter, newsletter with information on subsidies, online platform, or discussion round)* How likely do you think it is that you would *[register for the newsletter / engage on the platform / participate in the event]?*	*Slider from 0 (very unlikely) to 100 % (very likely)*
Factorial survey		
Factorial survey	*Explanation.* *Situation description (vignette).* How likely is it, that you would sign this petition?	*Slider from 0 (very unlikely) to 100 % (very likely)*
Discrete choice experiment		
Discrete choice experiment	*Explanation.* *Facts for orientation.* Which policy would you choose? *6 choice sets with differing attribute levels (see text).*	→ Policy A → Policy B → Policy C → no policy → I cannot answer this question.

Appendix B

Descriptive Results

Table B1: Respondents' sociodemographic information

Gender		
Female	238	50.96 %

Male	209	44.75 %
No statement	12	2.57 %
Not answered	8	1.71 %
Total	467	100 %
Age		
< 16	1	0.21 %
16 – 25	48	10.28 %
26 – 35	116	24.84 %
36 – 45	102	21.84 %
46 – 55	89	19.06 %
56 – 65	63	13.49 %
> 65	29	6.21 %
Not answered	19	4.07 %
Total	467	100 %
Education		
Certificate of Secondary Education	6	1.28 %
General Certificate of Secondary Education	33	7.07 %
Completed apprenticeship	43	9.21 %
Vocational diploma	40	8.57 %
General qualification for university entrance	82	17.56 %
Graduate degree	246	52.68 %
Other	10	2.14 %
Not answered	7	1.50 %
Total	467	100 %
Monthly Net Household Income		
< 500 €	7	1.50 %
500 <= x < 1000 €	23	4.93 %
1000 <= x < 2000 €	51	10.92 %
2000 <= x < 3000 €	89	19.06 %
3000 <= x < 4000 €	80	17.13 %
4000 <= x < 5000 €	64	13.70 %
5000 <= x < 6000 €	66	14.13 %
6000 <= x < 7000 €	22	4.71 %
7000 <= x < 8000 €	9	1.93 %
> 8000 €	15	3.21 %
No statement	22	4.71 %
Not answered		
Total	467	100 %
Number of Children		
0	340	41.92 %
1	67	14.35 %
2	111	23.77 %
3	23	4.93 %
> 3	11	2.36 %
Not answered	22	4.71
Total	467	100 %

Table B2: Sustainability (in construction)

Variable	Nr. of Observations	Mean	Std. Deviation	Min.	Max.
Importance of sustainability	420	79.00	20.80	0	100
Knowledge of sustainable construction	419	52.03	25.91	0	100
Personal consequences	383	72.20	24.28	0	100
Social consequence	394	80.60	23.95	0	100

Table B3: Associations with sustainable construction

Variable	Nr. of Observations	Mean	Std. Deviation	Min.	Max.
Financial costs vs. win	403	51.20	27.76	0	100
More vs. less effort	409	34.22	22.15	0	100
Attractive vs. unattractive design	389	68.96	21.88	0	100
Less vs. more comfort	394	64.92	21.69	0	100
Less vs. more space	386	46.77	20.43	0	100
Negative vs. positive consequences environment	416	91.05	15.22	0	100
Negative vs. positive consequences health	408	86.35	17.61	0	100
Lower vs. higher quality	406	79.53	20.80	0	100

Table B4: Likelihood to participate in different formats

Variable	Nr. of Observations	Mean	Std. Deviation	Min.	Max.
Discussion round	102	50.75	31.71	0	100
Online platform	93	52.55	31.79	0	100
Newsletter	99	49.25	38.00	0	100

Newsletter with information on subsidies	96	49.21	38.71	0	100

Table B5: Trust in the municipality (different dimensions)

Variable	Nr. of Observations	Mean	Std. Deviation	Min.	Max.
General trust	374	3.01	1.08	1	5
Trust in municipality's intention	380	3.37	1.17	1	5
Trust in municipality's competency	372	2.99	1.12	1	5
Being sufficiently informed	357	2.55	1.14	1	5

Appendix C

Robustness Checks

Table C1: Baseline regression results (DCE) using a nested logit model

	Baseline nlogit
Costs	– 0.0645***
	(0.00493)
Rec. Material	0.0188***
	(0.00147)
GHG Reduction	0.0206***
	(0.000950)
Recycling Rate	0.0125***
	(0.00116)
N	7536

Standard errors in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C2: WTP estimates for environmental attributes based on the nested logit model

	Rec. Material	GHG Reduction	Recycling Rate
WTP	0.29	0.32	0.19
Lower limit	0.24	0.28	0.15
Upper limit	0.34	0.36	0.24

Table C3: Influence of individual characteristics (nested logit model)

	nlogit with individual characteristics
Costs	– 0.0300**
	(0.0114)
Rec. Material	0.00886**
	(0.00335)
GHG Reduction	0.00959**
	(0.00359)
Recycling Rate	0.00557*
	(0.00217)
policies	
Gender	0.0999
	(0.225)
Age	– 0.492+
	(0.292)
Education	0.411
	(0.283)
Income	0.557+
	(0.288)
Children	0.335
	(0.311)
Importance of sustainability	1.830***
	(0.315)
Knowledge of sustainable construction	0.00734
	(0.00535)
N	6652

Standard errors in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C4: Difference in municipalities (nested logit model)

	nlogit with municipality dummies
Costs	– 0.0841***
	(0.00774)
Rec. Material	0.0246***
	(0.00233)
GHG Reduction	0.0270***
	(0.00191)
Recycling Rate	0.0165***
	(0.00176)
policies	
Municipality	
B	– 1.247***
	(0.295)
C	– 0.940*
	(0.374)
D	– 1.019***
	(0.261)
N	7536

Standard errors in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix D

Continuative Analyses

Table D1: Influence of individual characteristics on the willingness to engage

	OLS with individual characteristics
Format	
Online platform	6.522
	(5.210)
Newsletter	1.704
	(4.941)
Newsletter +	– 2.074
	(5.050)
Gender	– 1.353

	(3.782)
Age	
26 to 35 years	13.56^{+}
	(6.897)
36 to 45 years	6.589
	(7.708)
46 to 55 years	15.41^{+}
	(8.148)
56 to 65 years	23.04**
	(8.369)
older than 65 years	29.18**
	(9.871)
Education	– 4.489
	(4.835)
Income	– 1.597
	(3.921)
Children	2.093
	(4.346)
Importance of sustainability	0.453***
	(0.0898)
Knowledge of sustainable construction	0.277***
	(0.0750)
_cons	– 8.258
	(12.84)
N	335

Standard errors in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table D2: Influence of trust and perceived benefits and drawbacks on the willingness to act (sign a petition in favor of applying sustainability standards)

	OLS with individual factors of influence	
	(1)	(2)
Trust	12.77***	5.347^{+}
	(2.631)	(2.906)
Personal drawbacks vs. benefits		0.190
		(0.131)
Social drawbacks vs. benefits		0.436**
		(0.164)
_cons	26.58**	1.941

	(9.151)	(9.889)
N	166	156

Standard errors in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table D3: Regression results with individual factors of influence per municipality (nlogit)

	(1)	(2)	(3)	(4)
Municipality	A	B	C	D
Alternative Costs	– 0.115	– 0.0160	– 0.0278	– 0.0151
	(0.0952)	(0.0318)	(0.0699)	(0.0308)
Rec. Material	0.0322	0.00720	0.00704	0.00428
	(0.0261)	(0.0144)	(0.0163)	(0.00871)
GHG Reduction	0.0256	0.00723	0.0124	0.00481
	(0.0207)	(0.0143)	(0.0311)	(0.00982)
Recycling Rate	0.0166	0.00363	0.00748	0.00304
	(0.0146)	(0.00726)	(0.0186)	(0.00622)
ASC	3.497	– 2.954	– 2.077	– 1.118
	(3.697)	(2.206)	(4.161)	(1.378)
Policy (nest)				
Personal drawbacks vs. benefits	– 0.641	18.80***	16.48***	1.970*
	(0.628)	(0.271)	(0.669)	(0.797)
Social drawbacks vs. benefits	1.664**	1.148*	18.35***	3.808***
	(0.618)	(0.459)	(0.395)	(1.084)
Trust	– 1.149	1.368***	0.797^{+}	0.611***
	(0.866)	(0.345)	(0.432)	(0.183)
N	1788	1164	632	2576

Standard errors in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$