

Municipalities as Buyers of Reclaimed Building Material: Previous Experience and Future Outlook

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Abstract

Circularity of construction material can counteract the large resource and waste footprint of the built environment. The public sector purchases a large volume of material and can potentially exemplify circular practices. This study aims to gauge which factors can influence local governments to include reclaimed construction materials in their tender process. Quantitative data was collected by surveying 104 municipalities in Norway via phone interviews. The survey revealed most municipalities had limited previous experience; however, a large majority stated high future likelihood of purchasing reclaimed material, partly influenced by the municipality size, projected population growth and prior positive experiences as explained by an ordered probit model. Top-ranked enablers for incorporating reclaimed materials in the tender process are economic incentives and infrastructure improvements, whereas regulation enablers and stakeholder pressures are ranked lower. Study findings can aid policymakers to develop public procurement guidelines that support circular practices in the tender process of local authorities.

Keywords Circular economy · Built environment · Public procurement · Reuse · Recycling · Municipalities.

1. Introduction

Circular economy implicates prolongation of the use phase of existing material resources and reduction of waste (European Commission, 2015). Transition to circular economy focuses on finding alternatives to the *end-of-life* of products via systemic changes (Kirchherr et al., 2017). Applying circular economy principles in the building and construction sector may aid to reduce its high amounts of waste generation and resource consumption (European Commission, n.d.). However, the construction sector is reputed to be *path dependent* where “experience, competencies, and well-established value chains are aligned to conventional building products” (Ludwig, 2019, p. 4), hence industry stakeholders adhere to paths that are already tested with well-known techniques. This can make it challenging for this sector to evolve from the current mainly linear economy to a circular one.

Public procurement can be used as a powerful tool in such a transition. Firstly, the public sector purchases a large volume of construction material and is responsible for managing a variety of buildings. Globally on average, 13-20% of a country’s GDP is represented by public procurement (World Bank, 2020). Secondly, public procurement is an important tool as it can act as a role model (Nykamp, 2020) and lead by example regarding use of reclaimed materials by adopting circular priority rules in public tenders (European Commission et al., 2024). Municipalities are seen as *keystone actors* to stimulate innovation and circularity in the built environment (Evertsen & Knotten, 2024). They can create benchmarks for the rest to follow including

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the private sector. Past research has indicated public procurement as an enabler of construction material circularity via green public procurement (Adams et al., 2017), collaborative processes (Knoth et al., 2022) and direct inclusion of circular economy principles in the procurement (Nußholz et al., 2019). Skill et al. (2024) marked an increase in research focusing on municipalities and how they can experiment with new and innovative practices. We believe that public buyers possess considerable influence through their procurement of large volumes of materials and their ability to create visibility for building projects utilizing reclaimed materials, however it can be observed that they are not fully leveraging this position at present. Consequently, this study seeks to explore how this potential can be more effectively harnessed and how local governments can be incentivized to incorporate reclaimed materials into public construction projects, thereby facilitating their wider adoption. In this study, 'reclaimed construction material' broadly refers to materials that have been previously used, typically sourced from demolished buildings, and are redirected back into the construction cycle through reuse or recycling processes, thereby reducing the need for new material extraction.

Circular economy has been a major policy objective for European leadership since 2015 (European Commission, 2015, 2020). The European Waste Directive of 2008 suggested to utilize sustainable public procurement to improve waste management and recycled material use (European Parliament, 2008). European Commission has consistently advocated for green public procurement as a way forward for the construction sector (European Commission, 2016; European Commission et al., 2024). A strategic partnership among Norway, Sweden, Denmark, and Finland has been formulated to facilitate circular solutions in green public procurement, where their priority lies with transport, textile and information and communication technology (ICT) sectors (DFØ, 2024). Modifications to contract and tender documents are viewed as opportunities to promote the use of low-carbon building materials (Giesekam et al., 2016). However, changes in the existing procurement process can be difficult to execute due to rigid contractual obligations in the construction sector (Knoth et al., 2022; Nawi et al., 2017). Since recycled construction materials are usually not stated in the contract specifications (Ramos & Martinho, 2022), construction companies have no obligation to supply such materials.

Prior research has examined the perceptions regarding reclaimed construction materials from a spectrum of stakeholders; however, there is a scarcity of research on public buyers. A large majority of prior research studies related to circularity of building materials have gauged opinions and experiences from the perspective of construction professionals such as architects, developers, contractors, waste handlers, among others (Cohen et al., 2022; Condotta & Zatta, 2021; Densley Tingley et al., 2017; Heltorp et al., 2023; Mhatre et al., 2023; Sparrevik et al., 2018; Størdal et al., 2024; Tomczak et al., 2023). There are some consumer-focused studies but they do not incorporate public buyers as end-users of circular construction material (Craig, 2022; Fufa et al., 2023; Geldermans et al., 2019; Khatri et al., 2025). Kummen et al. (2024) interviewed municipality representatives from Nordic countries and identified several monitoring approaches to circular activities in the built environment such as establishing storage systems for reuse of building components. Hunka et al. (2023) interviewed municipal representatives in Sweden regarding uptake of circular public procurement and highlighted importance of knowledge about circular economy, policy brokers, networks and collaboration among the departments at the local government level. A handful of studies (Ding et al., 2022; Evertsen & Knotten, 2024; Høibye & Sand, 2018; Ottosen et al., 2021) have included a few municipal buyers and government representatives among those being surveyed or interviewed in the study, but they are not the primary focus of the research. Other research that focus on municipalities as primary survey-takers are for the larger context of green public procurement and not specific to circular material (Michelsen & de Boer, 2009; Sparrevik et al., 2018; Testa et al., 2012).

Therefore, there is an evident research gap for studies which focus on public representatives' viewpoints regarding use of reclaimed construction material. Our study aims to fill a part of that gap by surveying municipalities and examining factors that affect their behaviors. Norway serves as a relevant case for this research due to its large public sector, which operates with significant autonomy at the local governance level. Municipal property management in Norway represents an annual expenditure of 40 billion NOK (approximately 3.4 billion euros) (Statistics Norway, 2024b). Through this study, we aim to find answers to the following research questions: i) Have municipalities used reclaimed construction materials?, ii) Which municipalities are more likely to use reclaimed construction materials in the future?, iii) Which factors can convince municipalities to include reclaimed materials in the tender process of construction projects?

2. Conceptual Background

2.1. Decision-making of municipalities

Governance in Norway is divided into three administrative and political units: the central government, county authorities and municipalities. The municipalities are responsible for primary schools, healthcare and municipality roads, among other duties. The public sector is known to enjoy a high level of *local autonomy* in Norway (Nesse et al., 2021) including freedom in land use and urban planning. Municipalities own vast amounts of buildings spread across 27 million sqm around Norway (Statistics Norway, 2024b). The municipalities make decisions regarding renovation of existing buildings and construction of new buildings; hence, they are free to choose building materials for themselves. For instance, decisions regarding large investments in buildings are voted in municipal councils. We expect that variation in the decision-making could be attributed to the physical and demographic characteristics of the municipalities (Skill et al., 2024).

2.1.1. Size Size matters in municipal behavior and decisions. In the case of green public procurement, Michelsen and de Boer (2009) identified a positive correlation with the size of municipalities. Larger municipalities can achieve a *critical mass* (Fila et al., 2024) and benefit from *economies of scale* (Foged, 2016) due to the size of their administrative capacity. In a study, municipal planners in Sweden expressed that highly populated municipalities have more resources and likelihood to support *radical urban change or sustainability transition* in comparison to smaller municipalities (Skill et al., 2024). We hypothesize that a municipality's openness to the use of reclaimed construction materials is positively associated with its size. Population size, a commonly employed indicator, effectively captures municipal scale (Adserà et al., 2022; Di Marino et al., 2023; Nesse et al., 2021; Skill et al., 2024). By 2050, around two-thirds of municipalities in Norway are projected to experience population growth, while around one-third are expected to maintain or decline in population size. These divergent population trends are driven by factors such as urbanization, aging demographics, and immigration patterns (Statistics Norway, 2024a). We speculate that municipalities anticipating positive population growth in the coming decades may be more attentive to their resource footprint and, consequently, more inclined to adopt reclaimed construction materials, given the substantial volume of materials required to meet housing demands.

2.1.2. Political standpoint Municipal political ideologies may shape future outlooks and policy decisions. Foged (2016) examined the behavior of Danish municipalities and found that a higher share of left-wing mandates in municipal councils was associated with decisions to block contracting out public services. Apart from left-right political ideologies, other standpoints of political parties may also provide valuable insights into municipal behavior. Based on party manifesto statements, Egli et al. (2023) classified Norwegian political parties according to their positions on the petroleum sector, a contentious issue due to its environmental impacts. Acceptance of fossil fuel is an on-going dilemma in Norway where renewable energy accounts for most of its energy consumption; at the same time, Norway is one of the top exporters of oil and gas (CCPI, 2024). A political party's stance on this issue can be a proxy to their openness to climate change mitigation. We hypothesize that Norwegian municipalities governed by political parties that support climate change mitigation efforts, i.e. are pro-phaseout, would be more open to using reclaimed materials.

2.1.3. Economic condition The financial health of local governments varies across the region. In Norway, municipalities are funded primarily through tax revenues, but also a number of other sources such as grants from the central government and user payments from its residents (Ministry of Local Government and Regional Development, 2021). Municipal planners believe sustainability transitions and radical urban changes require resources however such funding is limited to their existing budgets (Skill et al., 2024). Foged (2016) found that municipalities with relatively lower ratio of expenditure budget over tax base, i.e. less fiscally stressed, were more likely to outsource public services. We hypothesize that municipal budget surplus positively influences openness to reclaimed construction materials, which often require greater financial, resource, and time investments due to limited mass-market availability.

2.1.4. Previous experience We hypothesize that public buyers' previous experience with reclaimed construction materials would contribute to their future likelihood. Liu et al. (2015) found that, in large-scale construction projects, contractors' *past performance* influences perceptions of their capabilities. In a study on supplier selection in construction projects, past supplier performance and buyer–supplier relationships accounted for approximately 5% and 4% of the selection criteria, respectively; however, factors such as cost and quality were prioritized (Cengiz et al., 2017). In the case of steel reuse, all construction sector representatives with previous experience unanimously agreed to reuse steel again due to their prior *positive experience* (Densley Tingley et al., 2017). Skepticism toward low-carbon materials, often fueled by *anecdotal stories of failure* (Giesekam et al., 2016), can be countered by sharing positive experiences and best practice case studies, which facilitate adoption of circular products in construction (Adams et al., 2017; Cohen et al., 2022).

2.2. Facilitation of reclaimed construction materials

The third research question of this study aims to determine which factors can make the municipalities adopt reclaimed construction materials in their tender process. In Norway, current Public Procurement Regulations mandate at least 30% weight to *climate and environmental considerations* in the award criteria since 2024 (Nærings- og fiskeridepartementet, 2024). Despite a focus on environmental consciousness, the purchase of reclaimed construction materials remains uncommon, with ongoing debate regarding how such considerations should be weighted and their actual impact on procurement decisions.

2.2.1. Economic factors In the case of reusing construction material, various stakeholders have underscored cost savings to be an important pull factor (Ding et al., 2022; Fufa et al., 2023). Currently, the market has perceptions of high costs associated with material reuse, making them look uncompetitive or economically unfeasible (Anastasiades et al., 2023; Densley Tingley et al., 2017; Ramos & Martinho, 2022). The implication is that if reclaimed construction products are found to be less costly than new products, purchasers would be willing to accept them more easily. However during the procurement award stage, public buyers have been observed to prefer the most economically advantageous tender (MEAT) criterion over the lowest price (LP) criterion, as MEAT accounts for both price and quality of bids (Fauske & Schrader, 2017; Parikka-Alhola et al., 2007). Prior research has also highlighted that financial incentives from the government can encourage circularity of construction material (Adams et al., 2017; Cohen et al., 2022; Nußholz et al., 2019). Examples of such economic instruments include funding schemes, subsidies and grants.

2.2.2. Regulation changes Prior research emphasizes the role of government intervention in advancing the circular economy within the construction sector (Anastasiades et al., 2023; Nußholz et al., 2019). The lack of policies is a barrier (Adams et al., 2017; Fufa et al., 2023) which can be counteracted by *reuse-friendly regulations* (Giesekam et al., 2016). There is an identified need for national-level road maps or green deals (Giorgi et al., 2022; Ottosen et al., 2021) that can guide public procurement to align with broader countrywide objectives. Regulation of carbon emissions or of carbon saving potential in building projects (Fufa et al., 2023; Nußholz et al., 2019) can serve as an environmental impact assessment and may incentivize the use of reclaimed materials. Standards specifically developed for secondary materials can be valuable (Anastasiades et al., 2023; European Commission, 2016); however, their current absence presents a barrier (Mhatre et al., 2023; Nußholz et al., 2019). In Norway, newly developed standards for reclaimed wood are expected to be adopted in the near future (Standard Norge, n.d.).

2.2.3. Stakeholder pressures Yu et al. (2022) determined that purchase of construction and demolition waste products is directly influenced by subjective norms, defined as social pressures from surrounding actors (Ajzen, 1991). While, positive *social values* facilitate material reuse (Ding et al., 2022), perceptions may differ across groups (Fufa et al., 2023). Giesekam et al. (2016) revealed that architect's preference for low-carbon building materials can influence material selection. Environmentally conscious construction professionals with

long-term thinking may also persuade clients towards circularity of construction materials (Chan et al., 2022; Tomczak et al., 2023).

Despite supposition of negative perceptions from consumers of reclaimed building material (Condotta & Zatta, 2021; Gieseckam et al., 2016), many consumers are highly willing to accept such material in their homes (Khatri et al., 2025). Attention to recycled building materials is increasing *among people* (Balador et al., 2020), and reclaimed materials are being perceived as *profitable for communities* due to their environmental and social benefits (Craig, 2022). Ongoing environmental activism, particularly among youth in Norway (OSCE, 2024), may lead citizens to exert pressure on public buyers to make more responsible procurement choices, such as the use of reclaimed construction materials. Prior research has noted *awareness raising campaigns* as enablers for construction material circularity (Adams et al., 2017; Knoth et al., 2022). Accordingly, media and local political groups could serve as effective sources of pressure to support such initiatives.

2.2.4. Infrastructure improvements Transformation towards a circular economy in the construction sector necessitates a supporting infrastructure that challenges the existent linear economy. Reclaimed materials are often associated with *inconsistent supply* or being *difficult to find* (da Rocha & Sattler, 2009; Yu et al., 2022). Ensuring that reclaimed products match the availability and quality of new materials could encourage their adoption (Fufa et al., 2023; Heltorp et al., 2023). The lack of construction product information has been recognized as a barrier to its re-employability (Balador et al., 2020; Cohen et al., 2022; Densley Tingley et al., 2017). Publicly available data on construction products may enhance the perceived reliability of reclaimed materials. Additionally, increased awareness and technical knowledge among construction professionals and suppliers are considered key enablers for supporting circular material infrastructure (Craig, 2022; Nawi et al., 2017). Apart from knowledge gaps, a lack of coordination among stakeholders remains a significant concern (Mhatre et al., 2023). Improved cooperation and communication across the supply chain can strengthen the infrastructure for reclaimed construction materials (Anastasiades et al., 2023; Knoth et al., 2022). Furthermore, dissemination of best-practice case studies and demonstration projects can encourage others to follow suit (Adams et al., 2017; Cohen et al., 2022).

3. Materials and Methods

3.1. Data collection via survey

A quantitative approach was employed for this study and data was collected via telephonic surveys administered by Norstat AS. Norstat's data collection method has been used in prior research to gauge market perceptions regarding food waste and recycled construction wood (Austgulen et al., 2018; Gangsø et al., 2025; Khatri et al., 2025). Our data collection took place from 19th August till 5th September 2024 during which almost every municipality in Norway was called for a response. We gathered completed surveys from 104 out of 357 municipalities, representing 29% of Norway's municipalities. All five regions and 14 out of 15 counties of Norway were captured by our collected data. Among the regions, 26 completed surveys were received from both Nord-Norge and Østlandet, 18 from both Midt-Norge and Vestlandet, and 16 from Sørlandet. Figure 1 shows the spread of municipalities covered by the survey.

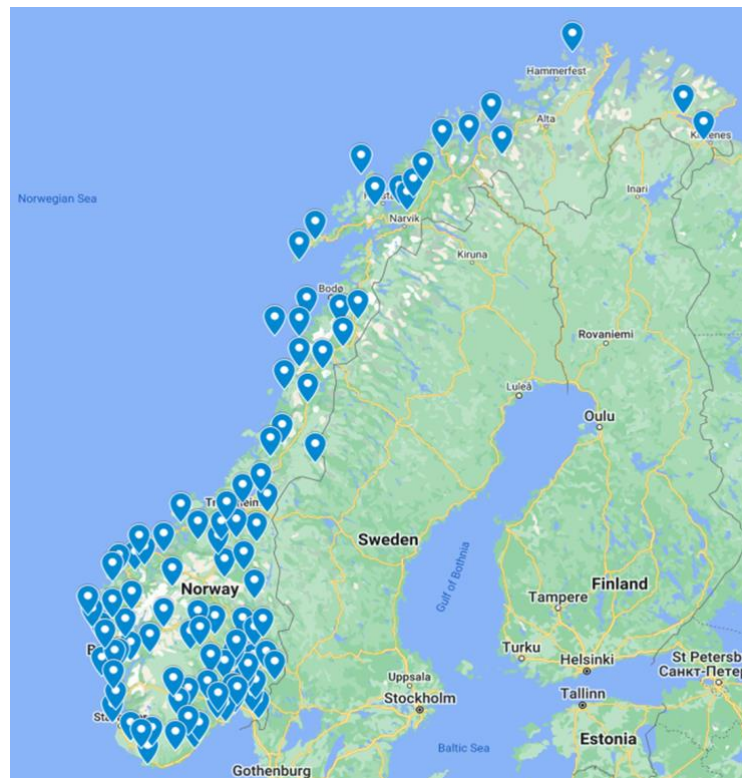


Figure 1. Geographical representation of collected data where each blue icon represents one municipality, created by Google's My Maps.

The survey was administered in Norwegian language and spanned 9 minutes in length on average. The survey employed the Norwegian term *gjenvunnet*, which loosely translates to “reclaimed” in English, to encompass both reused and recycled materials, in alignment with how the term is commonly referred to within the local context. For clarification, participants were informed of the definition of the terminology at the beginning of the survey. Municipalities were asked questions about their prior experience with reclaimed construction material, future likelihood, enabling factors and material uses. Most items in the survey were obtained on a Likert scale ranging from 1 (to a very small extent) to 4 (to a very large extent). Table 1 lists the survey items employed in the study alongside their measurement scales.

Table 1. Survey questionnaire items for the study.

Variable	Questionnaire item	Answer options
<i>Municipality</i>	Name of municipality	[Selection from list]
<i>Department</i>	Which department in the municipality do you belong to?	[Open-ended]
<i>Position</i>	What is your current position?	[Open-ended]
<i>Previous_exp</i>	Has your municipality, as far as you know, used reclaimed material in the construction or renovation of buildings?	*4-point Likert scale and option 5 for ‘I don’t know’
<i>Reasons**</i>	In the previous project where reclaimed materials were used, rank the three most important factors for using reclaimed materials	Six factors listed in Table 3
<i>Good_exp**</i>	What was the municipality's experience with using reclaimed building material?	4-point Likert scale where 1 was ‘Good’, 2 was ‘Somewhat good’, 3 was ‘Somewhat bad’ and 4 was ‘Bad’
<i>Future_use</i>	How likely is it that your municipality will use reclaimed materials in the next 5 years?	*4-point Likert scale

Table 1(Cont.). Survey questionnaire items for the study.

Variable	Questionnaire item	Answer options
<i>Materials</i>	What types of materials do you consider to be best suited to reuse in construction?	Wood, Metal, Concrete, Bricks, Plastic, Plaster, Glass
The following 16 statements addressed the question: <i>To what extent would the following encourage your municipality to consider reclaimed materials in the tender process for construction projects, either for new construction or renovation?</i>		
<i>Cheaper</i>	If reclaimed materials are cheaper than new materials	*4-point Likert scale
<i>Grants</i>	National authorities provide grants/funds for using reclaimed materials	*4-point Likert scale
<i>Guidelines</i>	Specific guidelines from national authorities for increased use of reclaimed materials	*4-point Likert scale
<i>Standards</i>	More building standards that support reclaimed materials are becoming available	*4-point Likert scale
<i>Municipality_target</i>	Reclaimed materials count towards the municipality's target for reducing greenhouse gas emissions (GHG)	*4-point Likert scale
<i>National_target</i>	Reclaimed materials are included in the national target for reducing greenhouse gas emissions	*4-point Likert scale
<i>Model_proj</i>	Model projects on the use of reclaimed materials in buildings by others	*4-point Likert scale
<i>Citizens</i>	Pressure from citizens for increased use of reclaimed materials	*4-point Likert scale
<i>Architects</i>	Pressure from builders and architects for increased use of reclaimed materials	*4-point Likert scale
<i>Local_politicians</i>	Pressure from local politicians for increased use of reclaimed materials	*4-point Likert scale
<i>Media</i>	Pressure from the media for increased use of reclaimed materials	*4-point Likert scale
<i>Supply</i>	Reliable deliveries of reclaimed materials of the right quality	*4-point Likert scale
<i>Cooperation</i>	Close cooperation with suppliers and contractors on reclaimed materials	*4-point Likert scale
<i>More_knowledge</i>	More knowledge among suppliers and contractors about reclaimed materials	*4-point Likert scale
<i>Material_info</i>	More available information on reclaimed materials	*4-point Likert scale
<i>GHG_budget</i>	According to ***Tek17, greenhouse gas accounts must be prepared from materials, but there is no limit to this as of today. If the use of building materials is subject to a limit with a "greenhouse gas budget" that limits how much greenhouse gas emissions can be linked to the building materials, to what extent will this stimulate your municipality to consider reclaimed materials?	*4-point Likert scale and 'I don't know'

Note: *4-point Likert scale meant 1 was 'To a very small extent' and 4 was 'To a very large extent' unless stated otherwise; **Survey items were only given to those survey-takers who answered 2, 3, or 4 on *Previous_exp* in order to not ask these questions to those with no experience; ***Tek17 refers to Byggteknisk forskrift, which is 'Building Technical Regulations' in Norway (Kommunal- og distriktsdepartementet, 2022; Kommunal- og moderniseringsdepartementet, 2017).

The data collection staff were instructed to speak to those individuals in each municipality who had some knowledge of building materials and were involved in the procurement process of their municipality to some extent. The respondents consisted of Managers (68%), Heads of department (16%), Advisors (5%), Engineers (3%), Supervisors (5%) and others (5%). They represented various relevant departments at the municipal offices such as property management, building and construction, operations and maintenance, technical, etc.

3.2. Municipality data

Apart from the survey, the study also utilizes secondary data sources to gather information on municipalities that had responded to the survey. Municipality-level data for populations in 2024, variable *Size_pop*, and population projections for 2050 were acquired from Statistics Norway's data portals (Statistics Norway, n.d.-a, n.d.-b). The variable *Pop2050* was derived by calculating the change of projected 2050 population relative to current figure (Foged, 2016). The economic variable, *Annualsurplus*, was acquired from Statistics Norway's

data portal on financial key figures that archives municipality-level records (Statistics Norway, 2025). *Annualsurplus* is defined as the accumulated surplus or deficit in a particular year as a percentage of the municipality's gross operating revenue of the same year.

The average municipal population size in our survey sample, 11,286, is slightly lower than the national municipal average of 15,547 (Statistics Norway, n.d.-a). In the same vein, the average projected relative change in municipal population in our sample is an increase of 4.4% from 2024 to 2050, compared to a slightly higher national average of 5.1% (Statistics Norway, n.d.-b), albeit reflecting a similar positive trend. With respect to the *Annualsurplus* variable, the average value among municipalities in our sample is -0.48 , compared to the national municipal average of -0.44 (Statistics Norway, 2025).

To capture the variable *Polparty*, firstly we used the municipal websites (Jacobsen & Holtskog, 2013) of those municipalities that had responded to the survey alongside other internet sources to collect information on their current mayor's party affiliation, i.e. mayor during 2024. The mayor represents the highest elected authority on the municipality-level in Norway. Municipal council elections are held after every four years in Norway and the last of such election was in 2023 (Valgdirektoratet, n.d.). Secondly, the political party's stance on fossil fuel was derived from the work of Egli et al. (2023). Each municipality was categorized as pro-phaseout, ambiguous or pro-petroleum, based on their mayor's party affiliation. Table A.1 in the Appendix details the political parties and the variable values that were used in the analysis.

4. Results

4.1. Prior experience

A large majority, i.e. around 79% of respondents, stated having little to no prior experience with reclaimed construction materials. Around 1% of respondents stated that they did not know. Only 8% of the municipalities acknowledged to previously using reclaimed material to a large extent. Figure 2 showcases their responses on a 4-point Likert scale (variable *Previous_exp*).

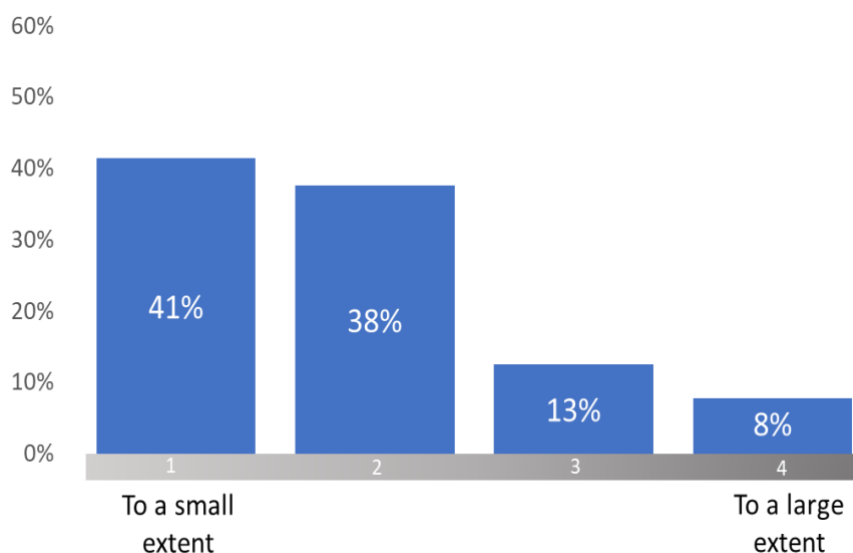


Figure 2. Municipalities' responses on a 4-point Likert scale to previous experience with reclaimed material in the construction or renovation of buildings. Note: Percentages are rounded to the nearest percent value.

The respondents that stated previous use of reclaimed construction material, marked by 2-4 in the previous question, were asked to rank given reasons which had facilitated them to use such material (variable *Reasons*). Overall, the "desire to save money" was the most frequently selected reason followed by the municipal's administration's and politicians' "desire to take environmental considerations into account". Calculation of overall rankings from survey responses is detailed in Table A.2 in the Appendix. Other reasons related to

regulations, best examples, simple process and pressure from citizens in the municipality were not highly ranked. Table 3 lists the reasons in the order of overall ranking.

Table 3. Reasons ranked by respondents for previously using reclaimed construction material.

Reasons	Overall Rank
Desire to save money	1
The municipal administration's desire to take environmental considerations into account	2
The municipal politicians' desire to take environmental considerations into account	3
Regulations	4
Examples from other construction projects & Simple process for obtaining such material	5
Pressure from citizens	6

The same group of respondents who had admitted to using some reclaimed construction materials in the past, were also asked about their overall experience (variable *Good_exp*). We found that 88% of those respondents in total have a 'somewhat good' or 'good' experience.

4.2. Likelihood of future use

The second research question of the study pertained to municipalities' expectations of how likely they are to use reclaimed construction material in the future, i.e. in the next five years (variable *Future_use*). 84% of the respondents stated that they likely will use such materials in the next five years (Figure 3).

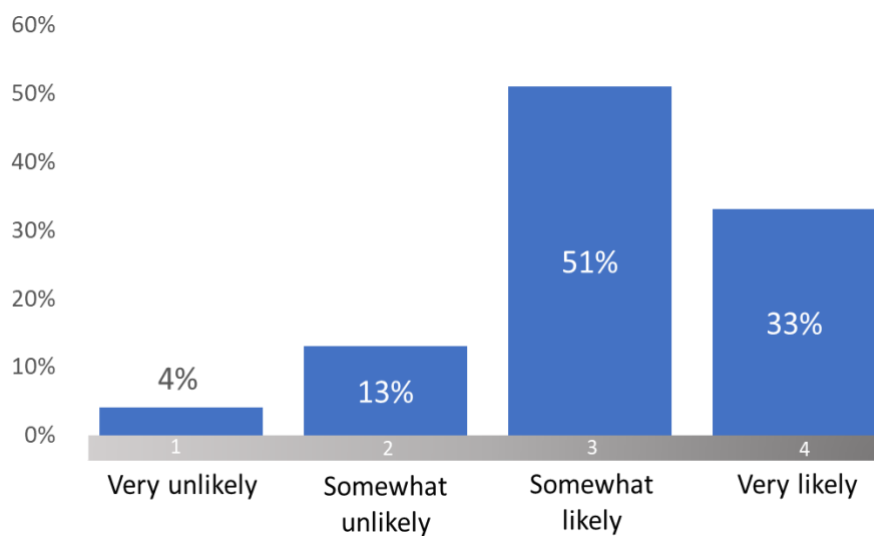


Figure 3. Municipalities' responses on a 4-point Likert scale to likelihood of using reclaimed materials in the next 5 years.

In this study, we were interested to understand which kind of municipalities were more likely to envision future use of reclaimed construction materials. Therefore, we ran an ordered probit regression model with *Future_use*, their future likelihood of use, as the dependent variable and five demographic variables describing the municipalities as explanatory variables. The dataset contained one missing value in *Previous_exp* and eight in *Annualsurplus*, which were handled through mean imputation. Table 4 lists the five demographic variables along with their descriptive statistics. The explanatory variables in the regression model were assessed for multicollinearity using Variance Inflation Factor (VIF) and Tolerance values, all of which met acceptable thresholds, i.e. $VIF < 5$ and $Tolerance > 0.1$, indicating no multicollinearity concerns (Table A.3 in the Appendix).

Table 4. Description and descriptive statistics of one explained variable and five explanatory variables.

Variable	Description	Mean	Std Dev.	Min	Max
<i>Future_use</i>	Municipality's likelihood of using reclaimed construction material in the future (4-point Likert scale)	3.125	0.772	1	4
<i>Size_pop</i>	Municipality's population in 2024	11286	15416	384	78745
<i>Pop2050</i>	Relative change in municipality's population from 2024 to 2050 projection	0.044	0.100	-0.175	0.324
<i>Polparty</i>	Political stance on fossil fuel of municipality's mayor's political party (higher value is more pro-petroleum as listed in Table A.1 in Appendix).	2.548	0.573	1	3
<i>Annualsurplus</i>	Annual accumulated surplus/deficit as a percentage of gross operating revenues (percent)	-0.484	1.422	-8.0	0.1
<i>Previous_exp</i>	Municipality's extent of using reclaimed construction material previously (4-point Likert scale)	1.864	0.914	1	4

In our study, the ordered probit regression model yields a pseudo-R² of 0.20. Three out of the five explanatory variables included in the model exhibit statistically significant effects. The full results of the ordered probit regression are presented in Table 5.

Table 5. Results of the ordered probit regression model.

Variable	Coefficient	P> z	[95% conf. interval]	
<i>Size_pop</i>	0.0000187	0.068*	-0.0000014	0.0000388
<i>Pop2050</i>	2.5769820	0.046**	0.0405533	5.1134110
<i>Polparty</i>	0.0427756	0.843	-0.3793680	0.4649193
<i>Annualsurplus</i>	-0.0901048	0.288	-0.2563868	0.0761772
<i>Previous_exp</i>	0.8573163	0.000***	0.5360862	1.1785460

Note: *** significant at 1%, ** significant at 5%, * significant at 10%.

The size of the municipality operationalized by the current population, *Size_pop*, is found to be an influential factor in the model, albeit at 10% significance level. This relation implies that larger municipalities are more likely to agree to use reclaimed construction material in the future. The marginal effects from the ordered probit model indicate that a population increase of approximately 10,000 in a municipality is associated with a 5% higher probability of selecting the highest level of *Future_use*. Full marginal effect results are presented in Table A.4 of the Appendix. Additionally, *Pop2050*, the population change from 2024 to 2050 has a direct effect on the municipality's future choice, at 5% significance level. The marginal effects indicate that a 100% increase in population from 2024 to 2050 is associated with a 66% higher probability that a municipality will choose the highest level of *Future_use*. Another indicator that we tested in the model was *Polparty*, an ordinal variable where higher value means the municipality has a more phase-out orientation versus pro fossil fuel. We did not find a statistically significant effect from *Polparty* in our regression model. Similarly, the economic variable, *Annualsurplus*, which captured the relative surplus of the municipality to its gross operating revenue, is found not to have an effect on the municipality's future likelihood. The explanatory variable, *Previous_exp*, describes the municipality's previous experience with reclaimed construction materials, as described in the prior sub-section of Results. In our regression model, such previous experience showed a positive influence, at 1% significance level, on the municipality's future likelihood of using reclaimed construction material. According to the marginal effects, moving up one level on the 4-point scale of previous experience increases the likelihood of a municipality choosing the highest level of *Future_use* by 22%.

In this survey, we also asked the public buyers which building material types can be envisioned as circular in the future (variable *Materials*). Figure 4 showcases the frequency of material types selected by respondents where wood and metal were seen as most suited for reuse in construction.

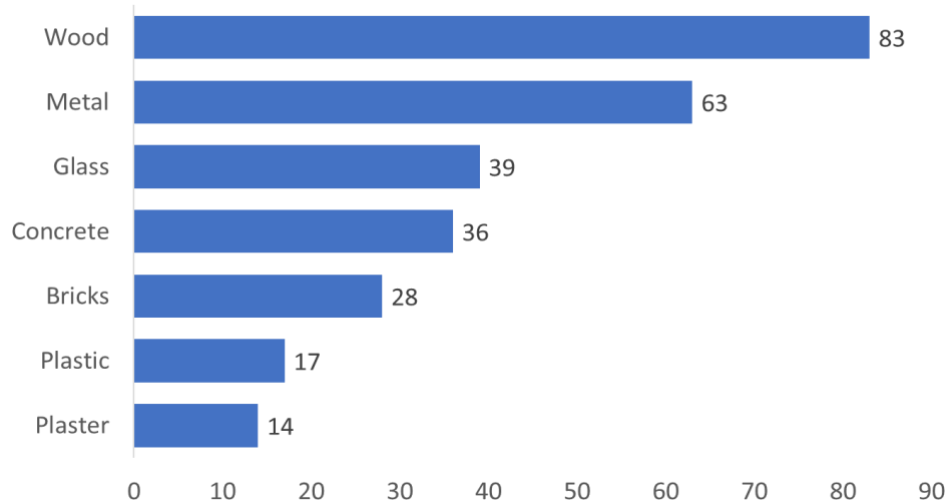


Figure 4. Frequency of material types selected by respondents that are best suited for reuse in construction. Multiple selections were allowed.

4.3. Enablers for tender process

The third research question of the study inquired which enablers can influence municipalities to include reclaimed construction material in their tender process. The survey-takers were provided sixteen statements that they scored on a 4-point Likert scale. Table 1 above lists the full statements. Each enabler belongs to one of the 4 categories: Economic, Regulation, Stakeholders, Infrastructure. Table 6 lists arithmetic mean scores of the sixteen enablers ranking them in descending order.

Table 6. Heat map illustrating the mean scores of enablers influencing municipalities to include reclaimed construction material in their tender processes (N=104). Full statement corresponding to each enabler is listed in Table 1. Note: *For the variable GHG_budget, three survey respondents selected the ‘I don’t know’ option. Therefore, the sample size for this variable is N = 101.

Category	Enabler	Mean score
Economic	<i>Grants</i>	3.500
Infrastructure	<i>Supply</i>	3.413
Economic	<i>Cheaper</i>	3.365
Infrastructure	<i>More_knowledge</i>	3.365
Infrastructure	<i>Cooperation</i>	3.260
Infrastructure	<i>Material_info</i>	3.183
Regulation	<i>GHG_budget*</i>	3.140
Regulation	<i>Guidelines</i>	3.125
Stakeholders	<i>Local_politicians</i>	3.125
Regulation	<i>Standards</i>	3.115
Regulation	<i>Municipality_target</i>	3.077
Regulation	<i>National_target</i>	2.894
Infrastructure	<i>Model_proj</i>	2.808
Stakeholders	<i>Architects</i>	2.625
Stakeholders	<i>Citizens</i>	2.481
Stakeholders	<i>Media</i>	2.298

The mean scores of the sixteen enablers reveal the following ranking of categories: Economic, Infrastructure, Regulation, Stakeholders. National grants to support material circularity is highly valued to influence tender process followed by assurance about availability and quality of material supply, whereas pressure groups from media and citizens of municipality were considered least important by the survey respondents.

5. Discussion

5.1. Future Optimism

The study findings underscore a lack of experience with reclaimed construction materials among public buyers, with most municipalities reporting little to no prior use. Municipalities with experience in using reclaimed construction materials may be considered *pioneers* similar to those with multiple Smart City projects in Belgium (Desdemoustier et al., 2019) proving to be ahead of the norm and regulations. Additionally, our findings highlight openness and optimism from public buyers regarding future use of reclaimed construction materials as evident from 84% of our sample. Similar enthusiasm was found in the case of end-consumers of recycled wood with a high proportion of innovators and early adopters in Norway (Khatri et al., 2025). The optimism from public buyers is partly attributed to the size of the municipality mirroring acceptance of used construction material by larger construction companies and developers (Ramos & Martinho, 2022; Størdal et al., 2024). Smaller municipalities often have less ambition towards circularity and lower negotiation power in comparison to their larger counterparts (Evertsen & Knotten, 2024). Additionally, our analysis shows that if the municipality is expecting an increasing population trend in their jurisdiction, they are more likely to consider using reclaimed material in the future. This may be attributed to urban and suburban municipalities, which usually anticipate population increases, are more concerned about their resource use. No evidence is found for the political ideology of the municipal mayor's party to influence openness regarding use of reclaimed materials. The debate around phasing out fossil fuels from the economy did not matter in this context. Contrary to our hypothesis, the municipality's economic condition, just as its political standing, did not influence its future outlook on circular construction materials.

Prior experience with reclaimed construction material is found to have a statistically significant effect on future use. This implies that those public buyers who have already tried reclaimed material at least once were open to doing so again. A similar correlation has been observed between previous reuse behavior and intention to choose used wood products by housing developers (Gangsø et al., 2025). Government authorities are advised to utilize this finding and encourage one time use of reclaimed materials to prompt wider usage with time. This can be a challenge given the *path dependent* nature of the construction sector (Hemström et al., 2017; Ludwig, 2019) where stakeholders do not embrace change easily. Prior research has recognized *pilot projects* to be an enabler of material circularity in construction (Knoth et al., 2022). Such initiatives can make municipalities try reclaimed materials for the first time, potentially leading to repeat purchases. From our study results, it can be reasoned that the association with prior experience being generally *good* had an impact on their future decision-making. A UK-based study reported that construction sector representatives with favorable previous experience with reuse agreed to do so again (Densley Tingley et al., 2017). Chan et al. (2022) found similar patterns of positive experience for alternate construction materials, including reclaimed material, with a proportion of construction industry representatives agreeing to use such materials in the future.

5.2. Inclusion in Tender Process

Through this study, we wanted to assess factors that can convince municipalities to scale up the use of reclaimed construction material and not just limit it to a one-time experience. The scores assigned to sixteen enablers by the municipality representatives illustrate how this can be achieved.

Economic enablers are highly scored by municipalities implying the need for economic investment and monetary push towards reclaimed construction material. Although the probit model in our study shows that the municipalities' economic conditions do not affect their expectations for future use of reclaimed materials, survey respondents indicate that a national grant favoring reclaimed materials in the tender process is likely to influence them. Moreover, reclaimed materials would be favored in material selection if they were found to be

somehow cheaper than new construction materials according to our survey. Construction professionals have suggested that moving away from *solely price* in tender process would work in favor of low-carbon building materials (Giesekam et al., 2016). The economic costs hold ample importance in the tender process according to our results. Along the same lines, a study about green public procurement in Norway identified that half of the municipalities had “never turned down the cheapest offer in favour of environmental arguments” (Michelsen & de Boer, 2009, p.165).

Economic factors are followed by infrastructure improvements in terms of importance from the public buyers. Municipalities value reliable quality and quantity of supply of reclaimed material highlighting it as one of the top motivators in our study, as recognized by previous research (Fufa et al., 2023; Ramos & Martinho, 2022). Alongside, increased knowledge regarding reclaimed materials by suppliers and contractors is found to be a desirable aspect. Improvements in communication of product information and knowledge transfer among stakeholders have been voiced as needs to advance circular economy in the construction sector (Cohen et al., 2022; Densley Tingley et al., 2017; Nawi et al., 2017). In our study, better cooperation with construction professionals and better availability of information regarding reclaimed materials are also highly ranked by municipalities to challenge the default tender processes. Gangsø et al. (2025) discovered that easy access to used wood materials and to their information positively influenced intention of housing developers in Norway to include them in building projects.

In our survey, regulatory changes are generally scored lower than economic and infrastructure enablers, but higher than most stakeholder pressure groups. Among regulatory changes, the establishment of GHG budgets for construction projects is the highest-ranked enabler according to public buyers. Norwegian regulations currently mandate GHG accounts for construction and major renovations, allowing emissions from materials to be documented, though no emission limits are enforced (Kommunal- og distriktsdepartementet, 2022). In contrast, the Netherlands has enforced a maximum emissions limit since 2018 (Giorgi et al., 2022). Our results also indicate that explicit national guidelines in favor of reclaimed construction materials can be effective since the current public regulations do not prompt to do so. On the other hand, building standards and regulatory environmental pushes like municipality-level targets and national-level targets for GHG emission reductions are in lower half of the ranked mean scores in our study. The municipal representatives gave higher scores to municipality-level targets for GHG emission reductions versus the national-level ones. In the case of sustainable transitions, municipalities may anticipate “seldom support from national authorities” (Skill et al., 2024, p. 339) and could value their own targets to be more important. In the case of housing developers, technical standards and regulatory factors were considered to be important determinants in acceptance of used material (Gangsø et al., 2025). The listed regulations in the survey can be formulated in the next update of building regulations in Norway promoting reclaimed products alongside low-carbon options.

Stakeholder pressures are found to be the least important category of enablers in our survey. However, in a survey of housing developers in Norway, subjective norms, operationalized by influences from customers and competitors, were found to positively affect premium associated with reused material (Størdal et al., 2024). On the other hand, pressure from customers was found to be limited and not influential towards intention to use reused materials in wood (Gangsø et al., 2025). In our study, municipalities do not expect to be easily persuaded by public pressure groups of citizens, architects and media regarding reclaimed products usage in the next five years.

6. Conclusion and Implications

This study aimed to understand experiences and viewpoints of public buyers towards reclaimed construction materials. Prior literature has focused on the perspectives of construction professionals and building residents, with minimal attention to public buyers. Through our survey of 104 municipalities in Norway, we found that they had limited previous experience with reclaimed construction materials; however, a large majority claimed that they were likely to use them in the next five years. An ordered probit model suggests that this positive outlook for reclaimed materials is partly influenced by the municipality's size, anticipated population growth, and previous favorable experience with such materials. The political outlook or economic standing of the municipalities did not affect their future likelihood in the model. Our results show that the likelihood of using reclaimed material was greater for highly populated municipalities with increasing population tendencies. National and county governments can utilize these findings in planning activities in favor of scaling up

circularity of construction materials by prioritizing regions with larger populations. Our findings also highlight that municipalities with prior experience are more likely to use reclaimed construction materials in the future. Therefore, governments are advised to invest in pilot projects where municipalities can try reclaimed materials for the first time and trigger subsequent uses.

Advancement in sustainability and circular economy efforts are often associated with big cities and urban planning (Guo et al., 2017; Williams, 2023). Our study gathered responses from municipalities across a range of urban-rural profiles, expanding current knowledge about openness to circularity. To our understanding, this is the first study examining future likelihood of specifically using reclaimed construction materials by public buyers, beyond generic green public procurement research.

At present, Norway's Public Procurement Regulations requires 30% weight to be assigned to environmental considerations (Nærings- og fiskeridepartementet, 2024). The study also set out to disclose enablers that would motivate the municipalities to include specifically reclaimed construction materials in the tender process, moving beyond the application of generic environmental clauses. The enablers' scores from our findings present a blueprint for policy makers on how to encourage more circular construction products in the procurement process. However, tender processes often contract suppliers for 8-12 years at a time (Fauske & Schrader, 2017), hence any real changes in purchases, such as favoring reclaimed materials, can take a long time to come into effect. Ranking of mean scores of the enablers in the survey highlights the persuasiveness of economic factors in the form of grants or lowered prices. Infrastructure improvements relating to product supply and knowledge ranked second as a category drawing attention to support the development of this value chain in order to facilitate its adoption as standard practice. National-level authorities can smoothen the market logistics with assurance of consistent supply and establishment of material banks to trigger more use of reclaimed materials, making it more economically feasible, e.g. via national grants, and developing infrastructure for their availability and knowledge dissemination among stakeholders. According to our results, regulatory changes and stakeholder pressure groups hold relatively less importance for public buyers to change their tender processes.

6.1. Study Limitations and Future Research

Our study sample of 104 municipalities has slightly lower average municipal population and its projected change implying a small overrepresentation of the less-densely populated localities of Norway. Another limitation of our study is that the sample could potentially be biased towards collecting data from those municipalities that were more likely to respond to a telephonic survey, perhaps with more staff available. Moreover, one municipality representative answered per municipality potentially reflecting their own subjectivity and not formally capturing the full *complexities* of their decision-making (Desdemoustier et al., 2019). Other governance levels, such as county, provincial or national, were not examined in this study, but could potentially reveal differing viewpoints in further research, especially in countries where local governments have less freedom in material selection. The variable of prior experience was operationalized using a single question (Table 1); however, future research could distinguish between various dimensions of buyer experience, such as familiarity, knowledge, and evidence of past purchases.

Our probit model produced pseudo- R^2 value of 20%, indicating the presence of unexplored aspects that can influence uptake of reclaimed construction materials. Future studies could examine additional factors not addressed in the present study, such as demographic variables that capture characteristics of the municipal population rather than attributes of the municipality itself. The characteristics of the municipal population can be operationalized through variables such as residents' educational attainment and income levels. As the present study did not identify any effects associated with municipalities' own financial health, other economic variables like population income levels may reveal influences. Beyond these considerations, future research could examine unexplored social and attitudinal factors, such as risk aversion and openness to innovation, that may capture variations in municipal government's attitudes and, consequently, their decision-making regarding the use of reclaimed materials. Hofstede's cultural dimensions, such as Individualism versus Collectivism and Uncertainty Avoidance, if operationalized at the municipal level (Hofstede et al., 2010), may be able to investigate these effects more systematically.

Further research can differentiate between material types, such as wood, concrete or steel; and diverse building elements such as structural, cladding or flooring purposes. Moreover, as the present study considers reclaimed materials in a broad sense, future research could differentiate between specific R-strategies (Potting

et al., 2017), such as the direct reuse of disassembled building components, the usage of recycled materials, or the incorporation of remanufactured or repaired construction products, as the market matures in the future. Since the present study focuses solely on the stated preferences of the municipal buyers, the analysis is based on expressed intentions rather than revealed preferences (Bigerna et al., 2017; McFadden, 2017). Future research could therefore examine actual purchasing behavior of municipalities once reclaimed materials become more widely available, to identify which types of municipalities actively adopt them in practice. We hope our study inspires more research into the circularity of building materials with regards to public procurement being an influential tool.

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Data Availability The data collected in this research study is available at: <https://doi.org/10.18710/OOHXF7>.

Declarations

Competing Interests The authors declare no competing interests.

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Appendix

Table A.1. Derivation of variable *Polparty* from municipality's current mayor's party affiliation and party's position on fossil fuel according to Egli et al. (2023).

<i>Polparty</i> variable	Fossil fuel stance	Political party
1	Pro-phaseout	Socialist Left Party
		Liberal Party
		Centre Party
2	Ambiguous	[no party affiliation]
		Christian Democratic Party
		Labour Party
3	Pro-petroleum	Conservative Party
		Progress Party

Table A.2. Process to compute overall ranking from individual responses (to variable Reasons) in the survey. The total score was derived by assigning a score of 10 for each rank1, 7 for each rank2 and 5 for each rank3.

Variable name	Reasons	Frequency of			Total score	Overall ranking
		Rank1	Rank2	Rank3		
<i>Prev_money</i>	Desire to save money	38	5	6	$10(38) + 7(5) + 5(6) = 445$	1 st
<i>Prev_reg</i>	Regulations	8	12	11	$10(8) + 7(12) + 5(11) = 219$	4 th
<i>Prev_admin</i>	The municipal administration's desire to take environmental considerations into account	7	23	14	$10(7) + 7(23) + 5(14) = 301$	2 nd
<i>Prev_pol</i>	The municipal politicians' desire to take environmental considerations into account	6	11	17	$10(6) + 7(11) + 5(17) = 222$	3 rd
<i>Prev_citizen</i>	Pressure from citizens	0	3	2	$10(0) + 7(3) + 5(2) = 31$	6 th
<i>Prev_egorsimple</i>	Examples from other construction projects & Simple process for obtaining such material	1	6	10	$10(1) + 7(6) + 5(10) = 102$	5 th

Table A.3. VIF and Tolerance: Collinearity tests for 5 explanatory variables. To obtain respective R² values, each explanatory variable is regressed as dependent variable and the other 4 variables as independent variables. (Note: Sources for rules of thumb: Hair et al. (2011) and O'brien (2007).)

Explanatory variable	R ² Value	VIF	Tolerance
Rule of thumb		< 5	> 0.1
<i>Size_pop</i>	0.190	1.235	0.810
<i>Pop2050</i>	0.153	1.181	0.847
<i>Polparty</i>	0.099	1.110	0.901
<i>Annualsurplus</i>	0.072	1.078	0.928
<i>Previous_exp</i>	0.010	1.010	0.990

Table A.4. Marginal effects of three statistically significant explanatory variables (*Size_pop*, *Pop2050* and *Previous_exp*) on 4 levels of *Future_use*.

Variable	Predict (<i>Future_use</i>)	Marginal effect	P> z	[95% conf. interval]	
<i>Size_pop</i>	1	-0.0000014	0.139	-0.0000032	0.0000005
	2	-0.0000021	0.081*	-0.0000051	0.0000003
	3	-0.0000010	0.179	-0.0000026	0.0000005
	4	0.0000048	0.059*	-0.0000002	0.0000098
<i>Pop2050</i>	1	-0.1881721	0.108	-0.4173572	0.0410130
	2	-0.3315465	0.059*	-0.6751876	0.0120945
	3	-0.1435817	0.193	-0.3595241	0.0723607
	4	0.6633004	0.042**	0.0231355	1.3034650
<i>Previous_exp</i>	1	-0.0626015	0.017**	-0.1140241	-0.0111790
	2	-0.1102997	0.000***	-0.1665150	-0.0540844
	3	-0.0477671	0.075*	-0.1003550	0.0048209
	4	0.2206683	0.000***	0.1632777	0.2780588

Note: *** significant at 1%, ** significant at 5%, * significant at 10%.