PIISA

Piloting Innovative Insurance Solutions for Adaptation

D3.3 Plan for evaluating barriers and enablers for green roof insurances in the Netherlands

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Summary

This deliverable is part of the PIISA project WP3 Pilot 1, aimed at exploring the barriers and enablers of green roofs. The focus of this pilot is to understand how green roofs can be upscaled through policy interventions, incentives, and behavioural motivations. The pilot uses a nation-wide survey to evaluate public preferences for green roofs and the effectiveness of both monetary and non-monetary incentives in the Netherlands. This deliverable presents the research framework and the methods developed for this survey.

The survey design is made of two parts. The first part is a Discrete Choice Experiment (DCE) to capture the population's Willingness to Pay (WTP) for green roof attributes. In addition, various information nudges are used to capture how WTP for green roofs can be influenced by information. The second part is a series of policy scenarios, in which we assess how different incentives affect respondents' choices. These choices are influenced by respondents' attitudes, covering environmental beliefs, altruism, time preferences, and the attitude constructs of Protection Motivation Theory (PMT). This framework allows us to assess the motivations for adopting risk-reducing behaviours like green roof implementation.

The findings from this research will help develop policy recommendations, incentives and insurance solutions for upscaling green roofs, contributing to urban climate change adaptation strategies. The results will also be applied to other climate contexts in subsequent project loops, including Boreal and Mediterranean regions, to explore the broader applicability of these solutions. Additionally, the survey work conducted in this pilot is linked to the WP1 survey, which explore attitudes and knowledge related to adaptation, Nature-Based Solutions (NBS), as well as green roofs across European countries.

Keywords

insurance, green roofs, economic valuation, nature-based solutions, ecosystem services

Abbreviations and acronyms

Acronym	Description
CBA	Cost-Benefit Analysis
CBR	Cost-Benefit Ratio
DCE	Discrete Choice Experiment
NBS	Nature-Based Solution
NPV	Net Present Value
PMT	Protection Motivation Theory
RESILIO	Resilience nEtwork of Smart Innovative cLImate-adapative rOoftops

TEV	Total Economic Value
WP	Work Package
WTP	Willingness-to-Pay

1 Introduction

Green roofs are a Nature-Based Solution (NBS) that are gaining traction in European cities. Green roofs offer numerous benefits to both their owners and cities as a whole (Shafique et al., 2018). They provide risk protection benefits, such as reduced flood risk from rainwater storage and weather damage protection, as well as thermal insulation for buildings, which contributes towards energy savings (Francis & Jensen, 2017; Langemeyer et al., 2020). Additionally, green roofs offer amenities to citizens, albeit to very varying degrees, like improved air quality and reduced noise levels inside buildings (Vijayaraghavan, 2016). They can also provide habitats for urban biodiversity (Francis & Jensen, 2017; Gonsalves et al., 2022; Netusil et al., 2022; Shafique et al., 2018; Williams et al., 2014). The relevance of green roofs for climate change adaptation in urban environments has been increasingly emphasized, particularly given the limited space available for adaptation measures in cities (Bulkeley, 2013; European Commission Directorate-General for Research and Innovation, 2015; Langemeyer et al., 2020; López-Maciel et al., 2023; Mader et al., 2011). In other words, in quite some cases green roofs present a viable opportunity to implement adaptation solutions without necessitating the use of scarce urban land (Frantzeskaki, 2019).

NBSs are strategies derived from and supported by natural ecosystems to tackle societal challenges such as climate change, food and water security, disaster risk, human health, and economic and social development (Cohen-Schacham et al., 2016). NBSs might include conserving or rehabilitating natural ecosystems, or enhancing or creating natural processes within modified or artificial ecosystems. These solutions can be implemented at various scales, from small-scale interventions - like green roofs - to large-scale efforts like the restoration of extensive floodplains (WWAP, 2018). A key feature of NBSs is their ability to provide a range of benefits and co-benefits. For instance, NBS designed to reduce water-related risks, also produce additional environmental, economic, and social benefits.

In the context of PIISA, the term “co-benefits” is used to describe these additional benefits. Evaluating the co-benefits of NBSs is deemed fundamental (Huthiff et al., 2018; Nesshöver et al., 2017). Indeed NBSs might not always prove to be as cost-effective as traditional grey solutions when only primary benefits of NBSs are considered. This statement is however to be nuanced: recent research tends to show that NBSs can more often than not turn out to be more cost-effective than grey infrastructures (Vicarelli et al., 2024). Overall, NBSs tend to present positive cost-benefit ratios, when co-benefits are taken into account (Bockarjova & Botzen, 2017; Huthiff et al., 2018; Nesshöver et al., 2017). In addition, accounting for these co-benefits may help in raising awareness about NBSs, as well as to promote less sectorial approaches in climate change adaptation (Cohen-Schacham et al., 2016).

Despite progress in their evaluation, NBSs have not been widely developed yet. The integration of NBSs into policies remains relatively low, particularly within the European Union (Davies et al., 2021). Although academics, policymakers, and practitioners have advocated for these solutions for decades, they are still not mainstreamed into urban development and climate adaptation strategies (Dorst et al., 2022; Kabisch et al., 2016). In fact, globally, the current levels of adaptation efforts are inadequate to achieve the necessary climate adaptation targets (Chen et al., 2016; Dodman et al., 2022; Mastrandrea et al., 2010).

Researchers have identified several factors and barriers limiting the development of NBSs (Giordano et al., 2020; Oijstaeijen et al., 2020; Vierikko & Niemelä, 2016; Vollmer et al., 2024), including i) a lack of clear demonstration of the effectiveness of NBS (Sarabi et al., 2019); and ii) a lack of financing mechanisms and business models tailored to NBS (Kabisch et al., 2017; Nesshöver et al., 2017). NBSs require long-term and integrated strategies, which can be hindered by factors such as the scarcity of public funds, short-term-focused strategies, and split incentives – investors only reap parts of the multiple benefits of NBS (Davies et al., 2021; Hudson et al., 2023).

In the context of green roofs, these barriers are especially relevant, because green roofs are under-studied (Joshi & Teller, 2021), and may face additional barriers in comparison with other NBSs. First, green roofs face technical limitations to implementation, generally due to the increased structural weight on buildings, or the necessity of flat roofs for implementation (López-Maciel et al., 2023; Zambrano-Prado et al., 2021). Secondly, green roofs require high initial investment costs and maintenance costs (Frantzeskaki, 2019; López-Maciel et al., 2023), which are mostly carried by households and other private actors. Indeed, unlike other types of NBSs, green roofs are private goods that incur private costs despite delivering public co-benefits. Therefore scaling-up the adoption of green roofs requires collective action, e.g. by incentivizing private actors to invest in them (Zambrano-Prado et al., 2021). Researchers and policy-makers have yet to fully explore the appropriate incentives and policy instruments needed to achieve this up-scaling. Addressing this question is precisely the scope of this pilot of the PIISA project, with its focus on the insurance industry.

Overall, the role of the insurance sector in climate change adaptation appears still unclear and unfolding (Herweijer et al., 2009; Ward et al., 2008; Zeren et al., 2024). There is a need for more effective incentives for insurers to engage in climate adaptation, and specifically to stimulate the widespread adoption of NBS - including green roofs (Jarzabkowski et al., 2019). If insurers engaged in adaptation, it could lead to wider societal benefits, but potentially also for insurers themselves (Jarzabkowski et al., 2019). In a way, from the insurers' point of view, climate change adaptation is akin to increasing "prevention". For instance, this could lead to potentially lower claim rates from building damages and pluvial floodings (Jarzabkowski et al., 2019; With et al., 2015).

Such engagement requires a long-term vision that includes creating awareness, providing strong evidence of the risk protection benefits and economic viability of green roofs, and integrating multiple public and private stakeholders – in other words a shift in insurance practices and incentives (With et al., 2015).

In the PIISA project, we explore how green roofs can be implemented as an innovative solution, incentivized by insurance policies, for urban areas. Our research focuses on two main questions:

RQ1. How can green roofs contribute to closing the adaptation gap? This question further explores the following sub-questions:

- What are the costs and benefits of green roofs?

- Are green roofs a viable measure for urban climate change adaptation – specifically for the reduction of pluvial flood risk?
- How can sustainable business models be developed for green roofs?

RQ2. What are the barriers and enablers for green roofs?

This question delves into the following sub-questions:

- What are the specific barriers and enablers for the recognition of green roofs by the insurance sector as element of an adaptation promoting insurance product portfolio?
- What incentives can be used to scale up the implementation of green roofs?
- How effective are these incentives in promoting wider adoption of green roofs?

In this report, we present the plans to address these questions. In Section 2, we briefly present the Green Roof pilot in the Netherlands. In Section 3, we discuss our research framework for the economic assessment of green roofs. Section 4 presents the methods and experiments implemented in our green roof survey.

2 The Green Roof pilot [1]

2.1 Green roofs insurance initiatives in the Netherlands

European insurers are seeing a rise in claims linked to water damage and extreme weather events. Insurers recognize the need for climate adaptation strategies, but questions remain as to how NBSs could be integrated in the Dutch insurance sector, and further mainstreamed (Kroes & Klok, 2024).

In the Netherlands, the insurance company Interpolis has initiated a climate adaptation strategy that includes various programs to incentivize homeowners to adopt prevention measures - including NBSs and green roofs. Interpolis offers green roofs to address damage claims from homeowners experiencing roof leakages caused by extreme rainfall. Clients can purchase an installation/maintenance service for three types of green roofs through the Interpolis website, each emphasising either increased green space, biodiversity, or water storage. Additionally, Interpolis provides complementary free roof inspections to check the suitability of the roofs (Interpolis, n.d.). The website provides detailed information on the benefits of green roofs, the various types available for purchase, the inspection and installation process, and the subsidies available to clients.

Previously, a 10% discount was offered on the insurance premium to encourage homeowners to install green roofs. However, this discount has been discontinued due to its negligible effect on homeowner motivation, as disclosed in an interview with Interpolis. This Interpolis initiative is the main motivation behind this pilot.

Interpolis is the only Dutch insurance company to offer green roofs as a product. However, other Dutch insurance companies do include NBSs in various ways within their operations, by:

- including sustainable building types in their policies, including green roofs;
- offering a premium discount for homeowners who remove a percentage of their garden tiles, as part of the Dutch '*NK Tegelwippen*' initiative. However, this discount was deemed too marginal to effectively motivate homeowners and has since been discontinued; and
- providing tips on climate adaptation to clients through their websites (e.g., greening gardens and water storage). In some cases, insurers also include such tips in their advice.

[1] The Green roof Pilot is part of Task 3.2 Cities and wellbeing (M6–M33) of PIISA. This task consists of two pilots: Green Roofs, and Guide to homeowners on financial risk assessments regarding case shrinkage-swelling clay soils. The Green Roof pilot (Task 3.2.1) is itself composed of three successive loops. Loop 1 is the first main loop of the pilot, and focuses on analysing enablers and barriers to green roofs in the case of the Netherlands. Loop 2 and loop 3 aim at insights for generalization on green roof promotion in the Boreal (Loop2) and Mediterranean (Loop3) regions. Most of the present report present the plans for evaluating barriers and enablers in Loop 1.

2.2 NBS in the insurance industry

The enablers and barriers to the integration of NBSs in insurance products in the Netherlands were investigated in a first phase of desk research and interviews that led to a PIISA report by Kroes & Klok (2024). The desk research included global studies on examples of NBSs in insurance products, with a particular focus on the built environment. Following the desk research, a set of interview questions was drafted (the full survey is available in Appendix B). From March to June 2024, a total of eight interviews were conducted with Dutch insurers. These insurers are represented in the Platform on Climate of the Dutch sector association, *Verbond van Verzekeraars*. All eight insurers offer property insurance for both private homeowners and small-medium enterprises.

Overall, this preliminary analysis indicated that:

- insurance companies see limited options for NBS insurance products. The main obstacles identified include the lack of a clear business case, limited awareness, minimal cross-sectoral approaches, and uncertainty regarding the role of insurers;
- there are, however, also enablers that could incentivise the uptake of NBS insurance products, such as differentiating premiums, building information infrastructures, applying the build back better approach, and offering a broader coverage for nature-based interventions;
- beneficial interventions for insurers include sharing best practices, creating climate adaptation labels, obtaining more data on the effectiveness of NBSs, raising awareness, establishing a long-term vision on the role of insurers in nature-based adaptation, and initiating cross-sectoral collaborations.

2.3 Objectives of the research

This research aims to evaluate green roof strategies through economic analysis and provide insights for developing business models to scale up their adoption. Specifically, the objectives of Loop 1 are as follows:

1. To perform societal cost-benefit analyses (CBA) of green roofs. This objective requires the evaluation of costs and benefits – including wider societal and biodiversity benefits. This objective includes performing pluvial flood risk modelling, as well as a stated preference study.
2. To examine the effectiveness of incentive mechanisms and policy instruments – including insurance-based incentives – designed to increase the adoption of green roofs. This includes also understanding the behavioural motivation behind the adoption of green roofs.
3. To establish business cases for scaling-up the implementation of green roofs. On the basis of the two previous objectives, we will identify sustainable finance arrangements – e.g. public-private partnerships - that stimulate investments in green roofs.

This deliverable outlines the methodological framework for assessing green roofs and conducting the associated economic analysis. In particular, it details the methodology for the two economic experiments embedded within the study, which aim to evaluate the incentives that could drive the upscaling of green roofs.

3 Research framework

The research framework aims to perform an economic assessment of green roofs - including societal cost-benefit analysis - and to analyse incentives for green roof's adoption upscaling. The research framework relies on i) the Total Economic Value (TEV) framework for assessing the economic viability of green roofs; and ii) the Protection Motivation Theory (PMT) framework to analyse the incentives and enablers of green roof adoption.

Figure 1 presents this overall framework. The main benefits, costs, barriers and enablers of green roofs are captured through a series of interconnected methods, which outcome feed the main research objectives. Overall, there are two groups of methods. The costs and benefits of green roofs are captured through pluvial flood risk modelling as well as a discrete choice experiment. The effectiveness of incentives is assessed through an informational nudging experiment and a policy experiment – embedded in the framework of Protection Motivation Theory. All these methods are explained and detailed in the following sections.

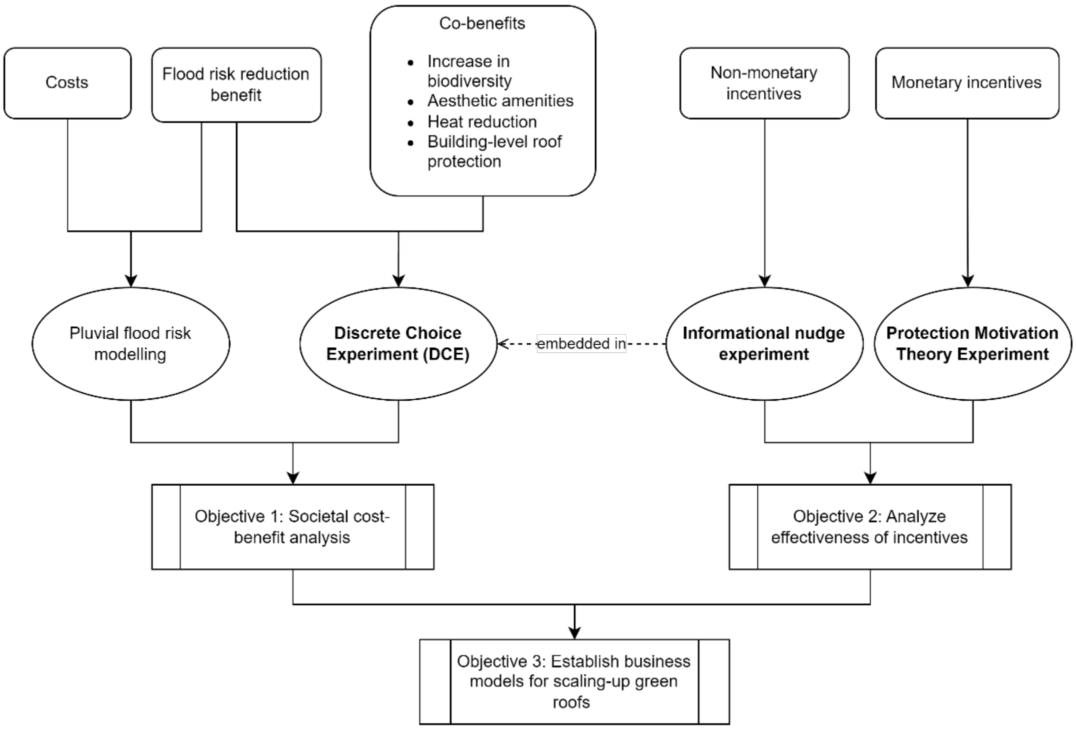


Figure 1: Research framework.

Notes. Elements in the top row (benefits, costs and incentives) are analysed using the methods in the middle row, in order to reach the main research objectives (at the bottom)

3.1 Economic valuation framework

3.1.1 The values of green roof

Green roofs are private goods that provide private benefits, but also generate public benefits – referred to in environmental economics as *positive externalities*, especially through the delivery of ecosystem services (Shafique et al., 2018). To capture the full range of potential (private and public) benefits delivered by green roofs, we rely on the Total Economic Value (TEV) framework (Lewis & Tietenberg, 2019).

The Total Economic Value, is a framework used in environmental economics to assess the full range of benefits provided by environmental goods and ecosystems to humans (Lewis & Tietenberg, 2019). This framework forms the basis to perform cost-benefit analysis of environmental goods. It divides total economic value into different categories of value that encompass both *use* and *non-use values*.

Use values include the actual use of the good or service in question. These *use values* can be *direct* use values, which are consumptive benefits, for instance, in the case of tangible products and services: the timber produced by preserved forests, or the recreational activities in urban green areas. They can also be *indirect use values*, which are values created by ecosystems without being directly consumed by humans. This category includes many Ecosystem Services, for instance the water retention services of a floodplain is an indirect use value. Finally, *non-use* values refer to the various values granted by environmental goods even though there is no direct or indirect use or benefit to be derived from them. One non-use value is the *existence value* of preserving an emblematic species in a remote place.

According to this framework, green roofs deliver multiple benefits that span various categories of values (Teotónio et al., 2021). The economic assessment therefore aims at capturing the various values delivered by green roofs to include them within cost-benefit analyses. These values include direct uses values, for instance the recreational and aesthetic amenities that they provide to their owners. Green roofs would also create indirect use values, such as their capacity to mitigate flood risks at a neighbourhood level by storing rainwater, and their thermal insulation benefits, as well as their functioning as added protection to buildings against weather hazards. Finally, green roofs provide non-use values, including the habitat provided to biodiversity on green roofs.

3.1.2 Economic valuation methods

Multiple methods are used in environmental economics to identify and value environmental goods, including the co-benefits of NBSs (Bockarjova & Botzen, 2017; Tietenberg & Lewis, 2016). These methods can encompass biophysical modelling, participatory methods, and monetary methods.

When markets exist, monetary values can be directly derived from market prices and costs. In the context of valuation of ES, when those markets do not exist, biophysical indicators can be relied upon instead, such as carbon sequestration (in t-eqCO2/year), water availability (in m^3/year), nitrate concentration in water (in mg/L), or urban cooling (in °C). These methods are usually straightforward and accessible to non-economists. However, these methods tend to lead to underestimations of the associated benefits (Koetse et al., 2015).

When there are no parallel markets for direct monetary valuation, monetary valuation can be imputed through stated preference methods. Stated preferences are typically gathered through surveys where people state their willingness to pay (WTP) for environmental changes (Koetse et al., 2015). These methods can reveal individuals' preferences for different NBS scenarios and can be used to value single or multiple ecosystem services. They are essential for evaluating non-use values, which cannot be observed through market behaviour. That is, this behaviour can only be used to infer individuals' revealed preferences.

In Loop 1, we are relying on different methods to capture the values of green roofs. Namely, two main groups of method are relied upon. First flood risk modelling is performed to capture the risk protection benefits of upscaled green roofs' adoption at the scale of a Dutch city. Secondly, we use a particular stated preference method, called Discrete Choice Experiment (DCE), to monetize other benefits of green roofs, such as biodiversity and indoor cooling values, etc. The present deliverable focuses mostly on the experimental design of the DCE, which is further detailed in Section 3.

3.1.2.1 Pluvial flood risk modelling

In the Netherlands, the main climate risk that can be mitigated at a wide scale through the adoption of green roofs is pluvial flooding (López-Maciel et al., 2023). In PIISA, we estimate the reduction of pluvial flood risk associated with widespread green roof adoption by building on two previous studies conducted by IVM: the RESILIO project and a recent master's thesis (Thijssen, 2024) focused on blue-green roofs in Amsterdam. Both projects highlight the potential of green and blue-green roofs to significantly reduce urban pluvial flood risks.

- RESILIO

The RESILIO project (Resilience nEtwork of Smart Innovative cLImate-adapative rOoftops), conducted between 2018 and 2022, involved the installation of over 10,000 m² of smart blue-green roofs across multiple buildings in Amsterdam (RESILIO Final Report, 2022). These roofs, equipped with a retention layer beneath the vegetation, were designed to manage stormwater runoff by capturing rainfall. The project used a system of smart valves, linked to weather forecasts, which optimized water retention by pre-draining the blue layer ahead of predicted heavy rainfalls. This process increased the roofs' capacity to store water and reduced the amount of stormwater entering the city's drainage system during peak rainfall events. Multiple scenarios of blue-green roofs, implemented widely at the city scale were tested.

The flood risk reduction was quantified by modelling different rainfall events, such as 60 mm of rain in 1 hour, and assessing how much runoff could be retained by the blue-green roofs. The results indicated that, depending on the scenario, runoff reduction ranged between 11% and 19%, with reductions in inundation levels of up to 1.2 cm during extreme rainfall events. Although these numbers may seem small, even slight reductions in water levels can substantially decrease flood-related damage, as flood damage functions are highly sensitive to such changes.

In terms of economic assessment, the project relied on a cost-benefit analysis (CBA) to evaluate the financial viability of implementing blue-green roofs. Flood damage reduction was monetized by estimating the direct and indirect costs of flooding that are avoided through the use of blue-green roofs. These costs were calculated using models that estimate potential damage based on the depth and extent of flooding. The CBA compared the cost of installing and maintaining blue-green roofs with the projected savings from reduced flood damage. The analysis showed that in certain scenarios, particularly where roofs were renovated at the time of installation (thereby reducing initial construction costs), blue-green roofs are a cost-effective solution. However, high maintenance costs, particularly for the smart valves and the green roof upkeep, posed challenges for achieving widespread adoption.

- Master thesis

The second study, conducted by JB Thijssen as part of his 2024 master's thesis, expanded on the RESILIO project by focusing specifically on pluvial flood risk reduction in Amsterdam through blue-green roofs. This work used flood risk modelling to simulate the impact of various rainfall events (e.g., 70 mm in 1 hour) under different scenarios of roof coverage, similar to the ones of RESILIO. The study assessed three key scenarios: a "base" scenario where only modern buildings with flat roofs were fitted with blue-green roofs, and two more extensive scenarios that included older and smaller buildings. The potential for flood risk reduction was measured by the decrease in inundation depth under each scenario. In the most comprehensive scenario, where all suitable roofs were converted to blue-green roofs, inundation depths were reduced by up to 1.23 cm during extreme rainfall events.

This study also employed CBA to assess the financial feasibility of blue-green roofs. Similar to the RESILIO project, the CBA calculated the reduction in flood damage by estimating the direct financial costs of flooding (e.g., property damage) that could be avoided by installing blue-green roofs. The study further analysed the costs of installation and ongoing maintenance for the roofs and compared these to the flood damage reduction benefits. Results indicated that in 6 of the 24 scenarios modelled, blue-green roofs were cost-effective at reducing flood damage, even without factoring in additional benefits such as increased biodiversity and indoor cooling.

In our project, we will transfer the findings from these two studies into our own CBA. While both the RESILIO project and the master thesis focused on blue-green roofs, which include an additional water retention layer not present in standard green roofs, the general conclusions about flood risk reduction and economic feasibility remain relevant.

Ranges of values will be transferred to take into account the potential technical differences between green and blue-green roofs. Given the similarity in the mechanisms of water retention between blue-green and green roofs, the results can still provide valuable insights into the potential flood risk reduction benefits of widespread green roof adoption in our context. Although our analysis focuses specifically on green roofs, the methodologies and findings from these earlier studies will help inform our economic assessment and provide a robust basis for estimating the benefits of green roofs in reducing urban pluvial flooding.

3.1.2.2 The Discrete Choice Experiment method

Stated preference approaches are particularly useful in the evaluation of environmental goods and projects, because many goods and services that arise from them of an intangible nature are not traded in actual markets. Changes in their economic value due to modifications of quality or quantity cannot therefore be measured using market data. However, it does not mean they do not have an economic value.

In many stated preference methods, a random sample of respondents are asked to express their preferences for changes in the level of provision of an environmental good. In the DCE method, the environmental good being evaluated is described to respondents in terms of its inner variable components, called “attributes”. Each attribute has different levels, such as different degrees of improvement or degradation of environmental services. Respondents are then asked to choose their preferred option among a set of alternatives which are characterized by different combinations of attribute levels.

By analysing these choices, researchers can estimate the respondents' preferences for specific changes in the attributes of the good. In addition, by including price/cost as one of the attributes of the good introduces trade-offs between monetary payments and other benefits. The choices made by respondents in these trade-off situations allow analysts to estimate the maximum WTP of individuals for changes to specific attribute levels. These WTP, expressed in monetary units (€), are clear indicators for the preferences of individuals, as well as best estimates for the monetary value of the benefits of a given environmental good.

This method has been used widely in the context of environmental goods and NBS. For instance, it allowed researchers to estimate people’s WTP for the various types of Ecosystem Services provided by NBS (Doherty et al., 2014; Giergiczny & Kronenberg, 2014; Hérivaux & Le Coënt, 2021; Kunwar et al., 2020; Owuor et al., 2019; Salm et al., 2023; Shoyama et al., 2013; Soto et al., 2018; Ureta et al., 2021).

The specifics of the DCE implemented for the green roof pilot are detailed in 4 section 4.

3.1.3 Economic assessment

Economic assessment covers systematic approaches aimed at evaluating the costs and benefits of different policies, plans, or projects. It provides policymakers and stakeholders an understanding of the trade-offs and potential outcomes of various alternatives, ultimately supporting better decision-making and policy formulation (Brander & Van Beukering, 2015).

CBAs are particularly useful for decision-making and policy (Atkinson & Mourato, 2008). CBA compares multiple alternatives by (ideally) accounting for all associated costs and benefits, which can be policies, plans, or projects at various scales. In the context of NBS, it may rely on the TEV framework to structure the costs and benefits into relevant categories of value. The objective of a CBA is to aggregate all benefits and costs into simple, informational metrics. Two main metrics can be derived in this assessment: the Net Present Value (NPV) and the Cost-Benefit Ratio (CBR).

The Net Present Value is the subtraction of the present value costs and present value benefits of a given project. Present value in this case means that annual costs and benefits, which occur over a time series, are converted into a single value. This conversion is performed by discounting values that occur in the future. The NPV informs decision-makers on the overall profitability of a project. In the case of an environmental good – such as green roof – where we account for wider societal benefit, the NPV informs whether green roof projects turn out to increase overall benefits to society or not. Interestingly, the NPV can also be calculated for a subset of the costs and benefits, depending on distribution among stakeholders (Saarikoski et al., 2016). In other words, the NPV can be calculated for different groups of actors, and thus provide insights on the beneficiaries and cost-bearers of a given project.

The Cost-Benefit Ratio is a simple ratio of the sum of the total future benefits and the sum of the total future costs of a project. It is a measure of how much a project yields benefits for every invested Euro: a CBR above 1 indicates that benefits exceed costs. It shows how much a project or investment improves – or lowers - social welfare if the benefits of the project are superior – or inferior – to the costs. This approach thus informs how much society profits from a given project over another one, thus informing and legitimating decision-making (Pearce et al., 2006).

In Loop 1, we adopt both a social and public policy perspective on green roof's adoption upscaling, as well as an insurance-focused perspective. By integrating the TEV of green roof scenarios, as well as their costs, the CBA can help design optimal strategies that maximise overall benefits while addressing potential trade-offs. CBAs can help justify the overall profitability of projects and legitimize decision-making.

Conducting a CBA on green roof scenarios is one of the final objectives of the Pilot. This CBA will rely on two key sources of estimation of the benefits of green roofs: i) the stated preference survey (presented in this deliverable), and ii) flood risk modelling. The estimation of the costs of green roofs will largely be based on the approaches used for the flood risk modelling, adjusted for the specific green roofs' costs. Insights from stakeholders will be used to adjust costs estimates.

The results from this CBA on green roof will yield various results. First, it will allow the identification of socially-optimal green roof strategies in the Netherlands. Secondly, this CBA will allow the quantification of how different actors (homeowners, municipalities, insurance companies, the general population, etc.) bear the costs and benefits from green roofs. Thirdly, it will allow, in the end, us to identify and suggest potential financing arrangements and business models - e.g., monetary transfers, public-private partnerships, subsidies - to facilitate the broader adoption of green roofs.

3.2 Incentive effectiveness

In the context of PIISA, we aim to assess the effectiveness of different types of incentives that may drive demand for green roofs. These incentives can be either non-monetary or monetary. Each category is tested within our research framework using different methodologies. Non-monetary incentives are examined through an information provision experiment, while monetary incentives are assessed through a distinct financing policy experiment grounded in the theoretical framework of Protection Motivation Theory.

3.2.1 Information incentives

Efforts to mainstream green roofs can leverage various policy instruments, one of which is targeted information campaigns. Such campaigns would fall under the category of behavioural interventions, such as informational nudges. Informational nudges are subtle interventions that provide individuals with information intended to influence their decisions without restricting their choices or changing economic incentives (Thaler & Sunstein, 2009).

Behavioural interventions have regained a lot of traction in environmental policy-making recently (Schubert, 2017). They have been shown to increase demand for environmental protection and conservation (Carlsson et al., 2021; Fanghella et al., 2019), as well as for risk reduction measures, including insurance (Davidson & Goodrich, 2023; Robinson et al., 2021).

In this pilot, we aim to test the extent to which an informational nudge can drive demand for green roofs. Specifically, we test how the choices made by respondents in a DCE are affected by informational nudges. Therefore, this behavioural experiment is itself embedded within the DCE, as detailed in Section 3.3

3.2.2 Protection Motivation Theory

Protection Motivation Theory (PMT) is a psychological framework that seeks to explain how individuals are motivated to adopt risk-protection behaviours and intentions (Rogers, 1975). Originally developed in the context of health psychology, PMT has since been widely applied to understand behaviours in response to various risks, including environmental risks (Rainear & Christensen, 2017).

The theory states that individuals' protection behaviours are driven by two primary processes: *threat appraisal* and *coping appraisal*. Threat appraisal involves evaluating a risk by its *severity* and one's own *vulnerability* to it. Coping appraisal, on the other hand, involves evaluating the efficacy of protection behaviours, and one's ability to execute them. This includes considering whether the behaviours will effectively mitigate the threat (*response efficacy*), whether the individual feels capable of performing that action (*self-efficacy*), and the perceived barriers, costs and difficulties associated with performing the behaviours (*response costs*).

When applied to environmental risks, PMT suggests that the motivation to engage in protection behaviours is driven by these processes. For example, households are more likely to engage in protection behaviours and invest in home flood-proofing if i) they perceive the threat as severe, ii) believe that their actions can effectively reduce these threats, iii) believe they are capable of engaging in those behaviours, iv) do not perceive the overall costs and barriers as being too high (Botzen et al., 2019).

In PIISA, we aim to apply PMT to identify the factors that enable individuals to adopt green roofs as a protective measure for their homes. Understanding the underlying drivers of demand for green roofs can inform the development of appropriate policy instruments and financial arrangements that could incentivize the broader adoption of green roofs. The PMT framework provides the analytical framework needed to establish these connections.

In Loop 1, our focus is on the potential motivations to adopt green roofs caused by three primary risks. First, green roofs serve as protective measures for buildings, extending the lifespan of roofs by shielding their structure and upper layers from damaging weather events. Second, green roofs can help mitigate the risk of pluvial flooding, particularly when implemented collectively at the neighbourhood level, by reducing surface runoff during heavy rainfalls. Thirdly, green roofs can provide thermal insulation and protect homes against heat waves.

Consequently, the survey includes questions designed to capture the various facets of *threat appraisal* and *coping appraisal* of individuals regarding green roofs, and with respect to the risks detailed above.

4 Survey methods

4.1 Survey objectives

The primary objectives of this survey are to:

- Assess the level of knowledge that respondents have about green roofs and their associated benefits.
- Determine respondents' preferences for green roofs and their perceived advantages.
- Evaluate respondents' WTP for green roofs using a DCE.
- Measure the effectiveness of informational treatments on respondents' demand for green roofs.
- Examine the impact of monetary incentives and insurance solutions on respondents' demand for green roofs.
- Collect data on respondents' attitudes and beliefs to better understand their behaviours and demand for green roofs.
- Gather socio-demographic information to understand the influence of socio-demographic variables on preferences for green roofs; in other words, to identify what subgroups of the Dutch population value the various benefits provided by green roofs the most and least.

4.2 Sampling strategy

To ensure the external validity of results, the survey will sample a representative sample of the Dutch urban population. We target specifically the urban population of the Netherlands, because green roofs provide their main benefits in cities (Berardi et al., 2013; Wooster et al., 2022). The sample size is set at 3000 respondents, with age and gender categories representative of this urban population, according to Table 1. Respondents are recruited by a panel company.

This target sample size is a result of a power analysis: it considers the minimum sample required for the multiple statistical regressions that will be performed to analyse the data from the survey experiments.

	%	N
18 - 25	12	360
26 - 45	40	1200
46 - 65	30	900
65+	18	540
%Woman	50,1	1503
Total		3000

Table 1: Sample characteristics target. Source: CBS

The age and gender distribution is based on the characteristics of the largest Dutch municipalities (*gemeente*). We target only the most populated municipalities, because the scope of the Pilot is urban climate change adaptation. Indeed, green roofs are considered mainly as cost-efficient adaptation measures in urban areas, where space is limited. Therefore, the population characteristics are slightly different from the wider national population. Municipalities with over 90 000 inhabitants are selected for this purpose, leading to a list of 54 municipalities. The sampling strategy targets in priority respondents from the 6 most populated cities in the Netherlands (Amsterdam, Rotterdam, The Hague, Eindhoven, Utrecht, and Tilburg).

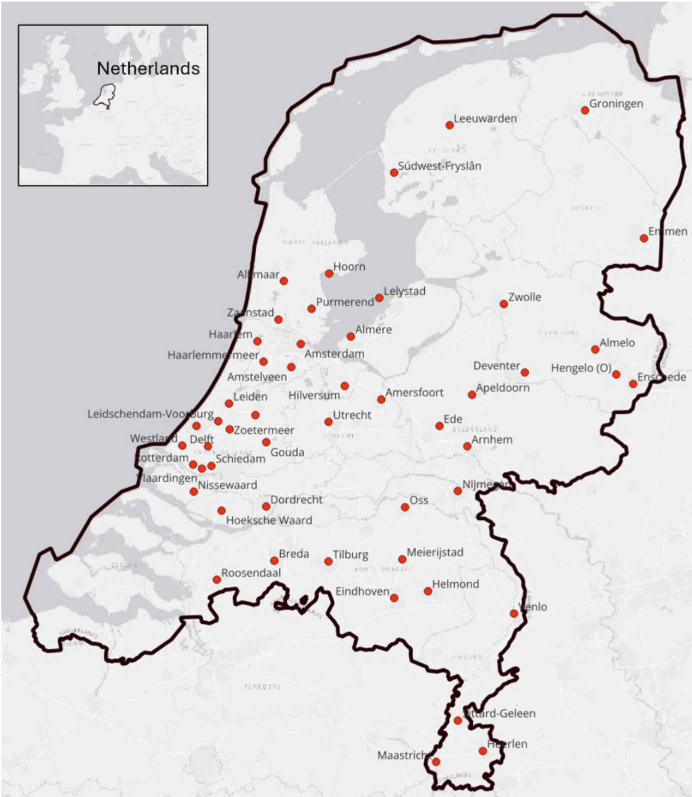


Figure 2: Sampled municipalities

The survey, translated into Dutch, was conducted online through a panel company in two phases: a pre-test phase (N=190) and the final sample phase (N=2810).

The pre-test phase, conducted in September 2024, had two main objectives: i) to ensure that respondents correctly understood the survey questions, and ii) to collect priors for the DCE.

During this phase, the survey was administered to the first subsample (N=190) through the panel company. The results were used to evaluate the clarity of the questions by assessing respondents' performance on attention checks and the time spent on survey questions. Additionally, priors were collected to improve the DCE.

Priors are a key element in choice modelling. In DCE, a series of choice tasks are generated based on an experimental design aimed at capturing essential trade-offs between attributes, ultimately allowing us to estimate respondents' WTP. The estimation process becomes more accurate when prior knowledge about the population’s WTP for green roof benefits is incorporated into the experimental design. By doing so, the design can be optimized to present relevant trade-offs, enhancing statistical power (Mariel et al., 2021).

For the pre-test phase, no specific priors were used in the experimental design. Instead, we assumed very generic priors, with the expectation that people tend to be averse to paying money and generally favour the benefits of green roofs - though the relative preference between different benefits was unknown. Therefore, the initial experimental design only assumed broad trade-offs between costs and benefits.

Following the pre-test phase, the collected priors were used to adjust and optimize the experimental design for the final round of respondents, allowing for a more precise WTP estimation.

4.3 Survey experiments

Economic surveys must engage respondents with a clear and logical flow as in a conversation (Johnston et al., 2017), in order to minimize the risk of respondent fatigue. In addition, we aim to reduce the risk of response bias due to the order in which information is presented (Johnston et al., 2017; Welling et al., 2022). The flowchart of the survey is presented in Figure 3.

The first section of the survey includes a general introduction, a consent form, and screen-out questions (municipality of residences, age and gender quotas). This section also includes an introduction to green roofs, their benefits and costs. The next section asks for prior knowledge of respondents on green roofs, and whether respondents live in an area with a green roof. In addition, we screen out of the survey respondents that already live in a place equipped with a green roof. The following section is the DCE, which includes also the informational nudges. After a short section of follow-up questions, respondents enter the Protection Motivation Theory experiment. Finally, respondents are asked for their attitudes and preferences, before filling in their socio-demographic characteristics.

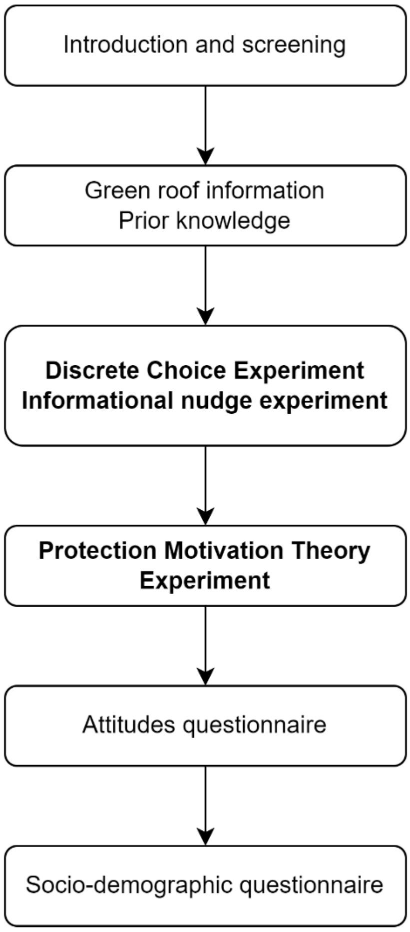


Figure 3: Survey flowchart

4.3.1 The Discrete Choice Experiment

The first main experiment of the survey is the discrete choice experiment. In this discrete choice experiment respondent are placed in a specific hypothetical situation: they are asked to choose multiple times between hypothetical houses that are already equipped different types of green roofs, or do not have one. This choice situation therefore capture a housing and relocation choice – rather than capturing directly an investment choice. This latter question is captured through the second (PMT) experiment of the survey. These points are detailed in the following sections.

We present here the methodology for this DCE. It is implemented in 6 successive steps in this survey:

1. Presentation of the attributes
2. Instructions to the choice tasks
3. Information treatment
4. DCE tasks
5. Post-experiment questionnaire

4.3.1.1 Presentation of the attributes

Firstly, we explain to the respondents how green roofs may present multiple combinations of benefits. It is indeed expected that Dutch residents have preferences for green roofs options due to: i) the co-benefits they generate (aesthetic amenity, recreational benefits, biodiversity, etc); and ii) their costs.

This initial section serves two purposes for respondents to make informed decisions in the DCE: i) it thoroughly presents the benefits of green roofs; ii) it introduces the various attributes and levels relevant to the DCE. We opted to present the attributes and levels prior to explaining the principle of the choice task in order to adopt a conversational tone in the survey and lighten the information load as much as possible. The respondents are familiarized first with the idea that green roofs can offer various combinations of levels of benefits and costs. This eases them into understanding the choice experiment that follows. Additionally, two attention checks are placed within the survey to ensure the comprehension of the survey. A fail on both attention checks exclude the respondent from the survey.

The attributes and levels introduced in the survey are motivated in the following sub-sections. The non-monetary attributes are the benefits of green roofs, selected by reviewing the state of the art on green roofs. The attributes are not the entire range of potential effects and benefits of green roofs. The number of attributes that can be included in a DCE is limited for reasons of experimental design and cognitive load (Mariel et al., 2021).

The selection process for these attributes is the result of the co-design phase of Loop 1. This co-design process was a series of interactions between IVM, CAS, and Interpolis between January and June 2024, which culminated in a work session on 16/05/2024.

The process of selection of attributes was threefold. First, we focused exclusively on the benefits of green roofs that have the most evidence from peer-reviewed literature. Secondly, we focused on green roofs benefits that appear to be the most relevant for the Dutch case study, based on the opinion of the stakeholders (Interpolis). Thirdly, the framing of the attributes, and their ranges of levels were selected after a phase of co-selection in interaction with Interpolis and CAS, during a dedicated work session.

The attributes, their levels, and the rationale behind their choice, are detailed below, and summed up in Table 2. The levels for these attributes are selected within the bounds of peer-review literature, as well as after consultation with PIISA stakeholders.

Additionally, for each attribute levels, specific pictograms were created to illustrate the levels. The pictograms were purposefully made fairly neutral, and were designed as simple visual reminders for the respondents. Visual representations can improve the estimations of WTP (Bateman et al., 2009) and help keep respondents engaged in a web survey (Mariel et al., 2021). The visual representations can be found in the DCE section of the survey (Appendix B) .

Increase in species richness

The impact of green roofs on urban biodiversity is still understudied in scientific literature, though it appears overall that green roofs tend to present a richer and more diverse species than conventional roofs, though the exact level of improvement is uncertain

(Berardi et al., 2013; Wooster et al., 2022). The impact of green roofs on local urban biodiversity also seems to depend strongly on 1) green roof characteristics, vegetation thickness, and use of local plant species; and 2) green roof location with respect to existing ecological corridors (Gonsalves et al., 2022; Wang et al., 2022; Williams et al., 2014).

The attribute in the DCE is phrased as “increase in species presence”, in order to avoid the more specific term biodiversity which all respondents may not be familiar with. To represent the variability over this benefit in literature, we include 3 potential levels for this alternative: green roof alternatives can either present no improvement in biodiversity, a small improvement or a large improvement.

Contribution to flood risk reduction

The second attribute is the impact of green roofs on pluvial flood risks, which is one the main benefits studied in literature (Berardi et al., 2013; Venter et al., 2021). It is important to note that we use the general term "green roofs" in this study, which includes also blue-green roofs. These may be specifically equipped with a system designed to capture and store rainwater, acting as a temporary buffer to prevent street flooding.

The DCE presents scenarios to respondents at the scale of a single building, not an entire neighbourhood. Therefore, it is impossible to estimate the impact of a single green roof on flood risks: the additional impact of a single green roof is minimal. It also heavily depends on the specific location of the green roof within a hydrographic basin. Overall, green roofs can affect flood risks, particularly when implemented as part of a coordinated collective action, targeted in areas where flood mitigation is feasible (RESILIO Final Report, 2022).

Given the impossibility of quantifying this benefit at the scale of a single building, we opted for a simple binary attribute. In the experiment, green roof alternatives either contribute or do not contribute to flood risk reduction. We rely on a qualitative approach for this attribute, which in fact captures respondents' WTP to participate in flood risk reduction, rather than the flood risk reduction benefit itself.

It is worth noting that the PIISA project also includes a specific flood risk reduction modelling approach at the scale of the city of Amsterdam (see Section 2.1.2.1), which will inform the flood risk reduction benefits included in the CBA. The captured WTP of the survey may include both individuals’ willingness to protect their own household and neighbourhoods from floods, as well as a *warm glow* effect (Venkataramanan et al., 2020), and is therefore potentially broader than benefits identified via flood risk modelling.

We are therefore capturing the pluvial flood risk reduction benefit of green roofs through two different lenses: through direct biophysical modelling, and through WTP. The estimates resulting from the modelling will most likely be used for the final CBA. The WTP estimates will however serve to put these results into interesting perspective.

Visibility of green roof

The third attribute is the visibility of green roofs. This attribute aims to capture the aesthetic value of green roofs. We assume that many individuals may choose to install a green roof as an aesthetic improvement to their homes, i.e. as a greening asset (Jungels et al., 2013). The aesthetic benefits of green roofs are often used as a selling point, but paradoxically, this aspect is under-studied in the literature and has only been monetarily valued through hedonic pricing approaches – through property value effects (Nurmi et al., 2016). However, urban nature holds economic value in its existence: citizens may want nature simply because it looks good (Salm et al., 2023). Therefore, including this attribute is a key innovation of this study.

The challenge with this attribute is that not all households may benefit from the visual advantages of owning a green roof. Given the great diversity of building types and architectures, a green roof may or may not be visible, even to its owners. As a result, this attribute, rather than capturing citizens' preferences for specific visual aspects of green roof landscapes, is a relatively simple binary one: green roof alternatives either have the option of being visible or not. It is explained in the attribute section of the survey that depending on the building layout, the green roof may be visible or not from the street or from the building itself, for example, through a window.

To some extent, we also anticipate interaction effects, at least for certain segments of the population, between the visibility of a green roof and its impact on biodiversity. Some respondents may want a visible green roof so as to observe nature from their home, such as diverse flower species, insects, and birds.

Indoor cooling during heatwaves

The fourth attribute of the DCE is the impact of green roofs on indoor cooling. Two alternatives for this benefit were discarded. Green roofs are often promoted for their potential to provide energy savings. However, this claim is uncertain and highly dependent on building characteristics, insulation, and household heating/cooling practices (Berardi et al., 2013; Shafique et al., 2018; Vijayaraghavan, 2016). Green roofs are often also advertised as an urban cooling solution to combat heat island effects, at the street level. However, it is important to note that the scientific evidence for this is even more uncertain, with some studies showing no effect at all (Berardi et al., 2013; Francis & Jensen, 2017). We therefore keep this cooling effect framed at the building level.

Based on these insights from literature, we rely on a more straightforward and private indicator for this attribute: indoor cooling in times of heatwaves. The range of cooling levels identified in the literature varies widely, particularly depending on climate regions. For example, green roofs in Mediterranean regions may have a much greater impact on cooling (Teotónio et al., 2020). Evidence shows that green roofs may limit heat transfers between indoor and outdoor environments, thus acting as an additional insulation layer for buildings (Berardi et al., 2013; Jamei et al., 2021; Ran & Tang, 2017).

We opted to give clear-cut levels for this attribute. Green roof alternatives can either have no impact on indoor cooling, a small impact (-1°C), or a larger impact (-2°C). These levels correspond to the upper margin of effects of green roofs (Berardi et al., 2013; Jamei et al., 2021; Ran & Tang, 2017), and can therefore cover many different situations of building characteristics that can be found in the Netherlands case study.

Increase the lifespan of roof structures

The fifth attribute of the DCE is the protection of green roofs for buildings. Green roofs provide an extra layer of protection for buildings against weather damages, such as high wind and precipitation, notably hail. This benefit is not often reported in literature, though green roofs lifecycle analyses tend to indicate that green roofs have a higher lifespan than traditional roofs (Bianchini & Hewage, 2012; Shafique et al., 2018).

This attribute is therefore presented in the survey as the increased lifespan of the roof, compared to a traditional roof. This benefit is phrased as an increase in time before the roof has to be replaced. The emphasis is not given on the avoided costs, in order to avoid conflation with the monetary attribute. Rather, the emphasis is given on the avoided hassle of replacing a roof. Again, two clear-cut levels are proposed in the DCE: the lifespan of the roof can be increased by +15 or +30 years, compared to the standard average 30 years lifespan of a traditional roof. Those levels are based on literature and expert opinion.

Annual cost

The last attribute is the monetary attribute. The inclusion of this attribute is a hard requirement for the DCE as it 1) provides a clear trade-off between green roof benefits and costs to the respondent, 2) allows to assess WTP of respondents for the benefits of green roofs. The choices made for this payment vehicle, for its levels, and for the overall choice scenario, is also the result of the co-design phase of Loop 1.

The payment vehicle in this DCE is the annual maintenance costs of a green roof. It therefore does not include the installation and initial investment costs of green roofs. The main rationale behind this choice is that the DCE is addressed to respondents that are homeowners as well as tenants. Both those profiles were included in the target sample, because green roofs may not only benefit only homeowners, but also potentially tenants. In other words, tenants may also present positive preferences and WTP for green roofs. We therefore also need to capture the potential WTP of tenants for green roofs' benefits, in order to provide a thorough economic evaluation of green roofs. Due to this, the payment vehicle needs to be consistent and relevant for both population categories. As a side note, the econometric analyses performed on the data will allow to control for this key variable. For instance, we will be able to assess solely the preferences of homeowners.

As a consequence of this choice, the framing of the choice experiment is adapted to reflect a specific hypothetical situation. The participants are placed in a choice situation where they choose hypothetical houses that already have different types of green roofs, or do not have one. This choice situation therefore does not capture directly an investment situation – such as asking respondents if they would invest or not in a green roof. Such a question would also include too much potential hypothetical bias: many potential respondents do not live in a place or at the correct floor level for installing a green roof. Instead, this question captures a housing choice for homes that include a green roof or not.

The range of values for this payment attribute corresponds roughly to the range of annual costs incurred by green roofs (replacements, maintenance, etc.). Those costs evidently vary greatly between types of green roofs, surface area, location, etc. The range of values therefore covers most situations. Furthermore, the range of values includes a purposefully high upper bound (500€), because in the DCE method, the payment vehicle should still offer trade-offs for potential respondents that have a very high WTP (Johnston et al., 2017).

This choice situation is detailed in the next section.

Attributes	Levels
Increase in species richness	No change in local fauna (baseline level) Some fauna and flora A lot of fauna and flora
Contribution to flood risk reduction	No flood risk reduction (baseline level) Flood risk reduction
Visibility of Green Roof	No green roof (baseline level) Not visible Visible
Indoor cooling during heatwaves	No indoor cooling (baseline level) - 1°C - 2°C
Roof lifespan	+ 0 yrs (30 yrs) (baseline level) +10 yrs (40 total) +30 yrs (60 total)
Annual cost	0€ per year (baseline level only) 15€ per year 30€ per year 60€ per year 120€ per year 240€ per year 500€ per year

Table 2: attributes and levels of the DCE

4.3.1.2 The choice scenario

In this experiment, respondents choose between hypothetical alternatives of houses that have a green roof on it, characterized by the benefits and cost attributes. The aim of the study is to estimate the preferences for these different attributes in monetary terms.

One particular element of this choice experiment is that the same choice situation applies both to homeowners and to tenants. Therefore, we provide a slightly different versions of the experiment instructions. The following prompt is used in the survey to explain the choice situation faced by respondents.

"Please, imagine a situation where you would move and live in a new home.

- *(for owners) This new home would have the exact same characteristics (surface area, bedrooms, mortgage, etc.), and be located in the same area to your current one.*
- *(for tenants) This new home would have the exact same characteristics (surface area, bedrooms, rent, etc.), and be located in the same area to your current one.*

The only significant difference would be the presence of a flat green roof right above your home.

In the next few pages, you will have to choose between 3 new homes: two options with a green roof, and one with no green roof at all.

These options will be defined in terms of 6 characteristics: the 5 benefits detailed previously, as well as annual costs.

- *(for owners) These costs include all the maintenance costs for the green roof that your household would have to pay annually out of your pocket, after all potential helps and subsidies are accounted for.*
- *(for tenants) These costs include all the maintenance costs that your household would have to pay annually, through an increase in rent, after all potential helps and subsidies are accounted for.*

These costs would go towards the regular inspection, cleaning and replacement of the various layers of the roof."

This prompt is followed by an instructional choice task (Figure 2). This choice task is not part of the final experimental design, since it is provided before the informational treatment. Rather, this instructional choice task is placed here to instruct respondents into choosing their preferred alternative, prior to the "real" experiment. It is an example of choice task.

Instructional choice tasks can increase the ability of respondents to perform choices although they may artificially anchor respondent's WTP depending on the levels presented in the instructional choice task (Mariel et al., 2021; Meyerhoff & Glenk, 2015). To mitigate this risk, each respondent faces an instructional choice task selected randomly from the experimental design. This way, we avoid a specific priming effect.

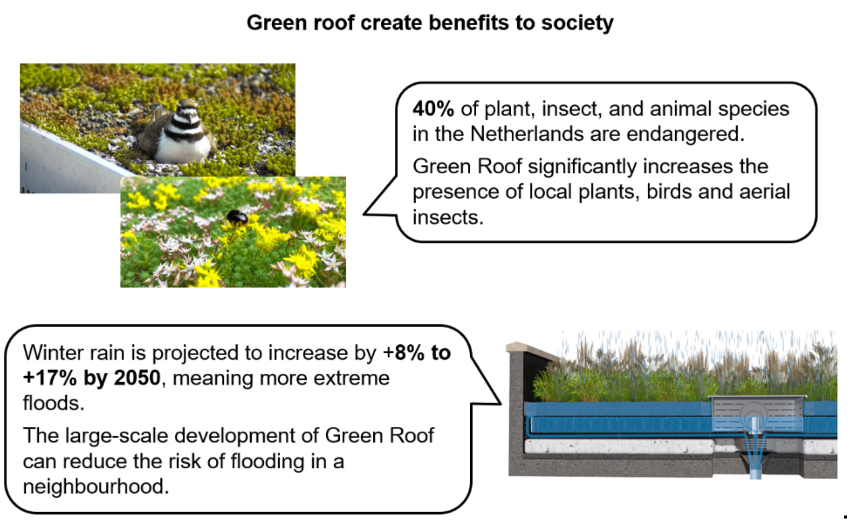
4.3.1.3 The information treatment

Prior to completing the choice tasks, some respondents are exposed to an informational nudge. These information treatments aim to test the influence of informational nudges on demand for green roofs and for their characteristics. This intervention specifically aims to provide individuals with information intended to influence their decisions without restricting their choices or changing economic incentives (Thaler & Sunstein, 2009). More specifically this behavioural intervention is akin to a *literacy boost*: respondents are presented with additional information aimed at increasing their competence in making choices for green roofs (Hertwig & Grüne-Yanoff, 2017).

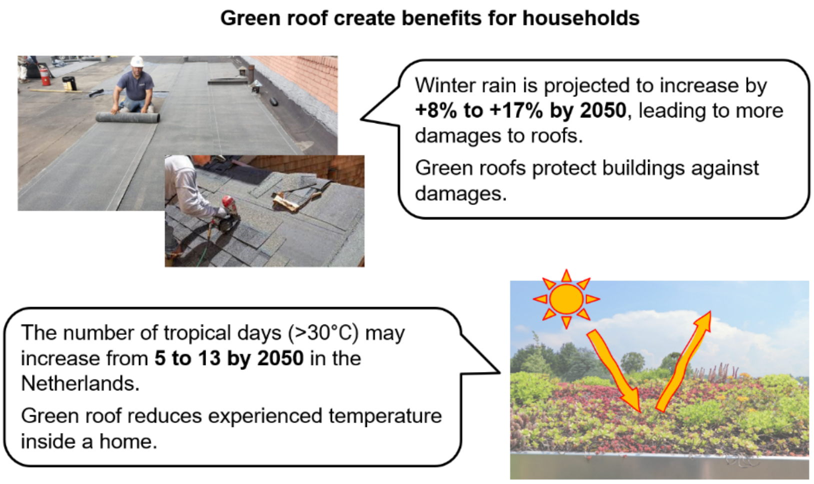
This information treatment focuses the attention of respondents on one of two categories of attributes. Our DCE is indeed designed so that some attributes are exclusively private benefits of green roofs, while other benefits are public benefit, or co-benefits. Private benefits in this case are the fourth and fifth attributes: indoor cooling and increased roof lifespan. The public benefits in this case are the first and second attributes: the contribution to flood risk reduction is a neighbourhood level benefit; and the increase in species richness is also a co-benefit. The third attribute is not given increased attention in this particular experiment: the visibility of the green roof is more ambiguous in its private vs public benefit quality.

Respondents are placed in a situation of a pro-social or a pro-self information treatment. The pro-social treatment stirs the attention of respondents on the public benefits of green roofs for society and biodiversity, while the pro-self treatment is centred on the private benefits. We therefore expect a difference in WTP between treatment arms.

In concrete terms, these information treatments are simple slides that appear on the respondents' screen prior to the choice tasks. There are two models of these information treatments (Figure 4). They follow very similar templates, and roughly the same word count, to ensure a comparable cognitive load between treatment arms.



a)



b)

Figure 4: Informational treatments used in the DCE. a) pro-social treatment b) pro-self treatment

4.3.1.4 Choice tasks

We rely on a D-efficient design to create the experiment design (Rose & Bliemer, 2009). This sort of design has become popular in choice modelling because it reduces the number of choice tasks, in contrast with orthogonal designs, where all potential alternatives are included (Mariel et al., 2021). With a D-efficient design, dominated alternatives are removed, leading to smaller standard errors in model estimation (Rose & Bliemer, 2009).

We set up the experimental design through a sequential process following standard DCE guidelines (Mariel et al., 2021). An initial efficient design is specified with no priors, and a first pilot study is performed to gather data (N=190). These data are analysed through choice modelling, *e.g*. a multinomial logit model. The resulting parameter estimates are used as priors to inform an improved design for the final survey.

The design features 5 non-monetary attributes, and a total of 10 parameters to estimate. The D-efficient design therefore leads to a theoretical total 6 minimum choice tasks to estimate the model. Following recommendations by Mariel et al., (2021) this number of choice tasks is multiplied by 3, in order to ensure sufficient data variation. We therefore end up with an experimental design of 18 choice tasks. Because 18 choice tasks is too many for each respondent, the design relies on *blocking*: choice tasks are grouped in 3 "blocks" of 6 choice tasks, and each respondent answer only one random block of 6 choice tasks. Figure 5 features an example of choice task.

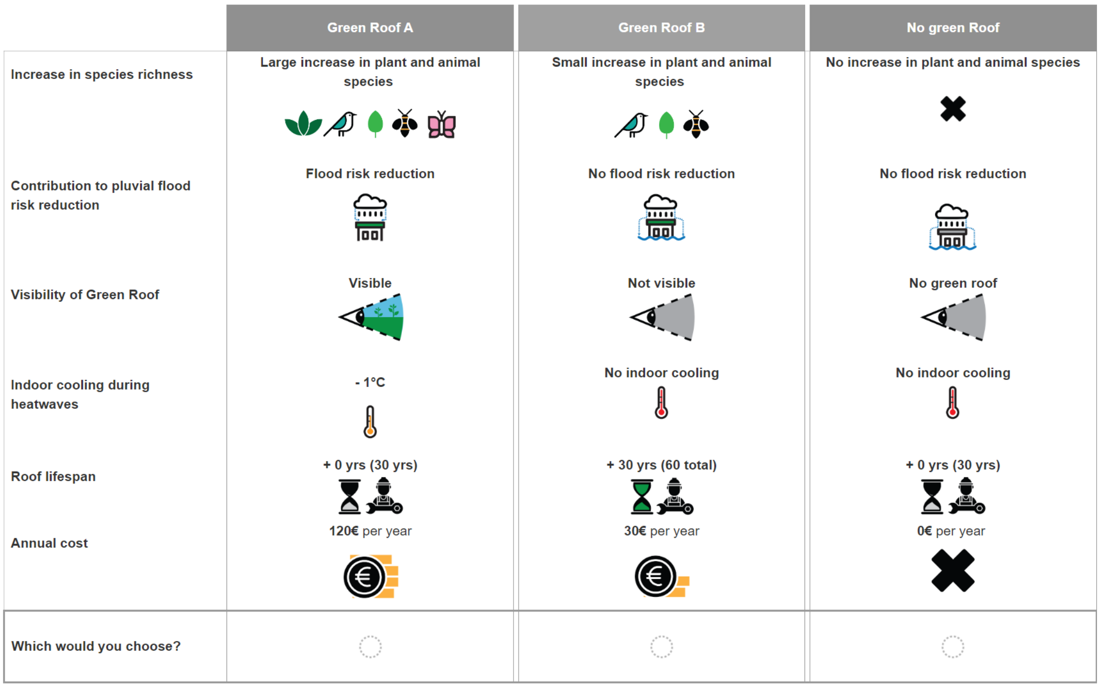


Figure 5: Example of a choice task used in the DCE. The order of attributes within the choice tasks is randomized between subjects (but kept consistent within-subject).

Finally, we add two details to the experiment design to ensure data quality. First, choice tasks are randomized within the blocks, in other words, all respondents face the choice tasks in a different order. We opt for this solution to avoid the ordering effect: evidence suggests that first choice tasks are usually performed with more attention by respondents, while successive choices tend to follow other heuristics (Mariel et al., 2021). Randomizing the order of choice tasks can control for this effect and ensure all choice tasks are addressed with the same average level of attention.

Finally, the order of presentation of attributes within the choice tasks themselves is also randomized between subjects, in order to mitigate the attribute order effect. This effect tends to happen in DCE featuring a high number of attributes: respondents tend to anchor their choices on specific attributes (either the top-most ones or the ones at the bottom of the choice tasks) and disregard others (Logar et al., 2020). Randomizing the order of attributes within the choice tasks can mitigate this effect over the overall sample. The order of attributes is however kept consistent within subjects, in order to avoid too much confusion for them.

4.3.1.5 Debriefing questions

The final part of the DCE consists in a series of follow-up questions aimed at assessing the validity of the answers, and provide extra details to the analysis. Following up the choice tasks, respondents are asked a series of questions on the DCE. This debriefing includes 4 main items to i) identify protests bids, ii) measure attribute non-attendance, iii) measure choice certainty, and, iv) measure preference consistency.

Protest bid identification

Protest responses are a common occurrence in DCE, and consist in respondents selecting systematically the status-quo option in a DCE, with the intention of rejecting the hypothetical market scenario presented to them. It is particularly important for the choice modellers to detect true protest bids, and distinguish them from simple preference for the status-quo. Indeed, protest responses are inconsistent with welfare estimation: they do not reflect a true choice of the respondent that takes into account the entirety of attributes and their trade-offs; but are rather a rejection of the choice itself (Meyerhoff & Liebe, 2010).

A conditional multiple-choice question (see Q15 in the survey in appendix A) is therefore presented to respondents that select the status-quo option throughout the experiment, that asks them to indicate the reason for this choice. A list of possible explanations as well as opened text box are given as possible answers, including both valid zero WTP and protest motives. Following the considerations of (Mariel et al., 2021), we therefore exclude protest bidders from the choice models based on answers to this question. Answers indicating a protest bid are listed in Table 3.

Protest-bid indicating answers	Non-protest
I do not believe that Green Roof delivers any benefit	I find the annual costs to be too high
I do not believe in the levels of benefits proposed in the choice situations	I cannot afford these options
I should not be the one to pay for these green roofs	I find the benefits of green roofs to be too low and/or uncertain
I did not feel capable to make a choice with the provided information	

Table 3: Protest bid answers (Q15).

Notes. When respondents select any answers from the left column, it indicates that their choices in the DCE likely reflected a protest bid – a reject of the DCE itself. In contrast, answers from the right column may indicate a true preference for the status-quo “no green roof” option.

Stated attribute non-attendance

The DCE setting is based on the assumption that respondents take into account all attributes when making their choices. However, it may not always be the case: some respondents may entirely ignore one or multiple attributes.

Attribute non-attendance is a problem for the analysis of choices: if respondents do not consider all attributes while making their choices, there is no trade-offs between attributes. The absence of trade-offs means that the marginal rates of substitutions between attribute levels is not computable, and, overall WTP cannot be estimated (Colombo et al., 2013).

Literature identifies multiple ways to detect attribute non-attendance. In this project, we rely on the approach suggested by Hensher & Greene (2010) to detect stated attribute non-attendance Hensher & Greene (2010): respondents are asked whether or not they ignored or considered each individual attributes. With this measure, we can specify in the choice models if coefficients should be kept at 0 for attributes that were ignored by respondents, thus improving the overall models.

Choice certainty

DCEs can often face the issue of hypothetical bias: respondents face a situation that is not an actual market decision, and there is no knowing if their choices actually reflect their potential behaviour in a “real” choice situation. The hypothetical bias is a sizable challenge to choice modelling, because it affects the external validity of such experiments (Rakotonarivo et al., 2016).

Multiple methods exist in literature to mitigate the risks linked to the hypothetical bias, and our survey relies on various on those. The “cheap talk” script sees success in literature (Huls et al., 2023; Morrison & Brown, 2009) and is therefore used in the survey. It describes to the respondent this very risk of hypothetical bias, and emphasizes the importance of the survey.

In addition, we rely on the methods proposed by Beck et al. (2016) to mitigate this risk, by directly asking respondents the certainty of choices. After the choice tasks, respondents self-report their level of certainty when having completed those. This certainty is reported with a simple Likert scale, and allows us to remove analysis responses that fall under too much uncertainty. It also serves as a potential covariate to use in the choice models to explain choices.

4.3.2 The Protection Motivation Theory Experiment

In this section, we detail the design of the Protection Motivation Theory experiment, aimed at understanding the drivers of individuals' motivations to adopt green roofs. Using the PMT framework, we assess how threat appraisal (e.g., perceived vulnerability and severity of risks) and coping appraisal (e.g., response efficacy, self-efficacy, and perceived barriers) influence the likelihood of green roof adoption.

We test these motivations by analysing how various monetary incentives — such as subsidies and other insurance-based arrangements — can encourage individuals to invest in green roofs. We expect that this experiment will provide valuable insights into designing more efficient, behaviourally informed policy interventions.

4.3.2.1 Policy experiments

The experiment that follows tests individual motivations for adopting green roofs under 3 varying conditions. These questions are administered to the entire sample, including both tenants and homeowners. While tenants may be less likely to invest in green roofs for rented properties, the inclusion of this group allows us to control for housing status in subsequent statistical analysis, ensuring that results can be generalized across diverse populations. Those 3 questions are detailed below.

Baseline scenario

Participants are first asked a straightforward question regarding the likelihood of installing a green roof on their property. They are asked to rate, on a probability scale, how likely they are to invest in a green roof in the future. This baseline question serves to gauge initial motivation without the influence of external incentives.

Q19 *stated_want*

How likely is it that you will buy a green roof in the future ?

- I will never install a green roof (0% chance to install a green roof)
- it is unlikely (1%-39% chance)
- it is neither likely nor unlikely (40%-60% chance)
- likely (61%-99% chance)
- I will install a green roof for certain (100% chance to install a green roof)
- I don't know / I don't want to answer

Policy scenarios

Next, participants answer the same question, but under a policy scenario where a financial incentive is provided, such as a subsidy, insurance discount, or a similar monetary benefit. This helps us understand the impact of these incentives on coping appraisal, particularly in relation to perceived response costs and barriers. By offering these varied policy interventions, we can measure their relative effectiveness in encouraging green roof adoption.

In this experiment, participants are all randomly allocated to one of three potential treatment groups. Each group receives slightly different policy scenarios. This randomization helps avoid fatigue and the priming bias that might result if all participants were exposed to every experimental condition. It also ensures that any observed effects are causally linked to the policy interventions. The three treatments are:

- A subsidy: respondents are proposed that their municipality would initiate a new program of subsidies for green roofs, with various level of coverage of the costs of green roofs. For each of the levels of the subsidy, they are then asked the same question as the initial question: the likeliness that they would implement a green roof.
- A discount on insurance premiums: respondents are proposed that their insurance company would initiate a new program of annual premium discounts for green roofs, with various levels of discounts. For each of the levels, they are then asked the same question as the initial question: the likeliness that they would implement a green roof.
- A discount on insurance deductibles: respondents are proposed that their insurance company would initiate a new program of deductible discounts for green roofs, with various levels of discounts. For each of the levels, they are then asked the same question as the initial question: the likeliness that they would implement a green roof.

For all three experiments, we also control for the prior knowledge of respondents on the existence of these types of measures. We also ask respondents if they already have a home insurance, their current premiums and deductibles.

Q21 *subsidy_WTP*

Imagine your municipality offered a new subsidy program for green roofs. You would receive a subsidy to help you cover the initial one-off cost of implementing a green roof.

Depending on the level of the subsidy, how likely is it that you would install a standard green roof on your home (3000€) ?

- No subsidy at all (0% of the cost is covered)
- The subsidy covers 25% (you pay 2250€, the subsidy covers 750€)
- The subsidy covers 50% (you pay 1500€, the subsidy covers 1500€)
- The subsidy covers 75% (you pay 750€, the subsidy covers 2250€)
- The subsidy covers 100% (you pay 0€, the subsidy covers 3000€)

Q24 *discount_WTP*

Imagine the insurance company that ensures your home started a new program of premium discounts for owners that install a green roof. This discount would lead to a lower annual premium.

Depending on the level of the discount, would you want to install a standard green roof on your home (3000€) ?

For your information, annual premiums are often around 300€.

- No discount (you would pay a standard premium)
- The premium discount is of 25%
- The premium discount is of 50%
- The premium discount is of 75%
- The premium discount is of 100%

Q25 *deductible_WTP*

Imagine the insurance company that ensures your home started a new program of deductible discounts for owners that install a green roof.

Depending on the level of the discount, would you want to install a standard green roof on your home (3000€) ?

For your information, a deductible is the sum you have to pay upfront whenever issuing an insurance claim. It is often around 300€ of the actual damages.

- No discount (you would pay a standard deductible)
- The deductible discount is of 25%
- The deductible discount is of 50%
- The deductible discount is of 75%
- The deductible discount is of 100%

Social norm scenario

Finally, we aim to investigate how some social norms can influence willingness to implement a green roof. Social norms play large role in shaping pro-environmental behaviours (Chung & Rimal, 2016). Specifically we focus on a simple descriptive social norm: a peer effect (Curtius et al., 2018; Gächter et al., 2013; Geber et al., 2021). This last part of the experiment therefore asks how peers' behaviour regarding green roof may enhance the willingness to install a green roof. The setting for this question is straightforward: participants are simply asked, within the same setting of the previous questions, what their willingness to install a green roof would be if their neighbour installed a green roof.

Q26 *peer_effect*

Imagine one or multiple of your neighbors build a green roof in the near future. How likely is it that you would also build one ?

- I will never participate in (0% chance to invest in)
- it is unlikely (1%-39% chance)
- it is neither likely nor unlikely (40%-60% chance)
- likely (61%-99% chance)
- I will participate in for certain (100% chance to invest in)
- I don't know / I don't want to answer

4.3.2.2 Attitudes questionnaire

Following the experimental policy scenarios, participants complete an attitudes questionnaire to assess their broader perceptions and motivations. A first section focuses on various general attitudes, such as environmental attitudes, time preference and altruistic behaviours. Those questions may explain the interpretation of the differences in WTP resulting from the informational nudges of the DCE. The second part of this questionnaire is designed to capture key elements of both threat appraisal and coping appraisal, in the framework of PMT.

General attitudes

To capture participants' environmental attitudes, we employ the New Environmental Paradigm (NEP), an established 15-item scale that assesses pro-environmental worldviews (Dunlap & Van Liere, 1978; Dunlap, 2008). Participants respond to these items using a Likert scale, which measures agreement or disagreement with statements related to environmental protection, ecological limits, and humanity's relationship with nature. The NEP scale has been shown to correlate strongly with WTP for environmental goods (Agimass Taye et al., 2018; Choi & Fielding, 2013; Khalili Ardali et al., 2024; Kunwar et al., 2020; Ntanos et al., 2019), making it a valuable tool in understanding motivations behind green roof adoption (Ziegler, 2021).

In addition to environmental attitudes, we also assess time preference and altruistic attitudes of respondents. Both of these are assessed using well-established survey items developed by Falk et al. (2022). Time preference surveys the willingness of individuals to give away present gains for future gains. Altruistic attitudes are measured through a question dealing with charity behaviours of respondents.

These attitude measures will help to explain various steps of the experiments. In the DCE, environmental attitudes will help explain participants' WTP for green roofs, revealing how environmental attitudes drive preferences for the various benefits of green roofs. It will also provide insights into the effectiveness of the informational nudges presented prior to the DCE. For instance, individuals with stronger pro-environmental attitudes may be more likely to respond positively to messages highlighting the environmental benefits of green roofs. Similarly, altruistic attitudes may help explain the effectiveness of the pro-social informational nudge. Time preference may help explain low/high WTP for the roof lifespan increase attribute in the DCE. Secondly, those attitudes may provide parallel explanations in the policy experiment, in addition to the PMT variables.

Protection motivation theory

The survey integrates PMT to assess respondents' threat appraisal and coping appraisal in the context of green roof implementation.

Threat appraisal is measured through a series of questions addressing perceived severity and vulnerability to environmental risks, relying on risk attitudes and perceptions established by (Dohmen et al., (2011). All those questions concern the three primary risks at play in the survey - pluvial flood risks, heatwaves and damages to one’s roof. Respondents are asked about their perception of each of these risks, i.e. the likelihood of those events happening. Respondents are also asked their attitude regarding these risks, specifically how concerned or worried they are (measured on a 5-point Likert scale). In addition to specific risk perception, the survey also examines respondents’ general attitude toward risk, because risk preference is recognized as a significant predictor for risk protection behaviours (Dohmen et al., 2011).

Coping appraisal is measured through 4 main constructs: response efficacy, self-efficacy, perceived response costs, and locus of control.

Response efficacy is measured by asking respondents to assess the overall effectiveness of green roofs in addressing each of the environmental risks (pluvial flooding, heatwaves, and roof damages). This question captures the perceived efficacy of green roofs in mitigating these risks.

Self-efficacy refers to respondents' confidence in their ability to implement and maintain a green roof. In PMT, we make the assumption that positive self-efficacy perceptions would be associated with higher protection motivations (Rainear & Christensen, 2017).

Response costs refer to the perceived barriers of implementing a green roof, including financial, logistical, and social constraints. Respondents are asked to consider whether the costs — financial costs, but also time use, effort, and other resources — are prohibitive. In the framework of PMT response costs decrease the motivation for protection behaviour (Rainear & Christensen, 2017).

Finally, this section ends by measuring respondents’ locus of control. This construct is not usually included in the framework of PMT. However, locus of control is associated positively with risk protection behaviours, for instance in the context of flood risk protection (Botzen, Kunreuther, & Michel-Kerjan, 2019). It assesses the degree of control respondents believe they have over their own lives and life outcomes (Rotter, 1966). Individuals may have an internal locus of control, i.e. the belief that outcomes are determined by their own action; or an external locus of control, which reflects the belief that outcomes are shaped by external factors.

4.3.2.3 Sociodemographic and housing characteristics

The final section of the survey gathers data on respondents' sociodemographic, housing, and environmental characteristics. The sociodemographic information includes age, gender, household composition (such as the number of children), income, and education level. These factors may serve also as covariates to explain WTP for green roof characteristics, as well as to explain behaviour toward green roof implementation.

In terms of housing characteristics, respondents are asked to describe the type of dwelling they live in, whether it is a house or an apartment, whether they own or rent it, along with specific details like the floor on which they reside, the surface area, etc. The survey also examines respondents' environmental context, particularly their access to green spaces such as private gardens, parks, or communal areas. This aspect is intended to explore how the availability of green spaces might influence the demand for green roofs, either as an alternative or complement to existing green areas.

Furthermore, participants are asked to describe their neighbourhood type — whether it is urban, rural, or peri-urban. This information can provide context for understanding how geographical and environmental factors might shape preferences for green roofs. It may ultimately also be used to identify how preferences for green roofs are clustered along certain types of land use.

The survey finally concludes with a final page thanking respondents for their time and participation, acknowledging the value of their contribution to the research.

5 Final remarks

This report describes the plan that is developed for evaluating the barriers and enablers to green roof adoption within the context of the PIISA green roof pilot (Loop 1). This plan is made of a series of economic experiments conducted through a nation-wide survey, across the main Dutch cities. These experiments aim to evaluate public preferences, the effectiveness of monetary and non-monetary incentives, and the behavioural motivations behind green roof adoption. The plan incorporates the use of insurance-based incentives alongside public policies to stimulate demand for green roofs.

In conjunction with other efforts undergoing in this pilot of PIISA — such as flood risk modelling — this approach will allow us to gather all the estimates necessary to perform extended societal cost-benefit analysis of green roofs. It will further allow the identification of the distribution of green roof costs and benefits among stakeholders, providing further insights into financial arrangements required to increase green roofs uptake. Furthermore, the findings will inform public policies and behavioural interventions to promote the uptake of green roofs.

The upcoming steps of this plan involves i) collecting the data from the DCE, ii) running the analysis of the choices and estimating WTP for green roof benefits, iii) integrating those benefits with the flood risk models, iv) performing the CBA, v) running the regressions of the PMT experiment. The survey and its results will also be revisited in Loops 2 and 3, where they will be adapted and applied to two additional climate contexts: the Boreal and Mediterranean regions.

Finally, it is important to highlight that the results from this survey, along with its further exploration in Loop 2 and Loop 3, complements the market reviews survey established in WP1 (See D1.4). Specifically, the WP1 survey focuses on gathering insights into households' opinions and attitudes towards climate adaptation, parametric insurances, Nature-Based Solutions (NBS) and green roofs across European countries (D1.4). The data from this survey will play an important supporting role in piloting Loop 2 and 3, and help to identify regional differences between European contexts. At the time of writing this deliverable, the European-wide survey is still undergoing analysis, and its findings will be the subject of a later publication within the PIISA project.

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Appendix A: Insurers survey questions

Climate change & insurers

1. In what way do climate change and extreme weather impact your organisation's portfolio?
2. In what way do your insurance products take into account the increase of extreme weather events? Does this differ between clients (i.e., private and small and medium-sized enterprises (SMEs))?
3. What types of extreme weather phenomena are most interesting to your organisation from an insurability perspective? Why?

Nature-based solutions in insurance products (awareness, discount, damage repair, …)

1. Are you currently offering any nature-based solutions within your products? If so, how? How does this differ between clients (i.e., private and SMEs)?
2. To what extent are you familiar with nature-based solution insurance products of other insurance companies? Are you familiar with Interpolis' green roof initiative? What opportunities and obstacles do you envisage for this initiative?
3. What potential do you see for including nature-based solutions in your product range? How does this differ between clients (i.e., private and SMEs)?
4. In relation to your clients, what barriers exist to offer nature-based solutions in your products? How does this differ between your clients (i.e., private and SMEs)?
5. What changes are needed to offer nature-based solutions in your products? How does this differ between your clients (i.e., private and SMEs)? To what extent does competition play a role in this?
6. To what extent could insights into the business model and cost-benefit results be an incentive for you to bet on nature-based solutions?
7. Which national or international regulations incentivise you to provide nature-based solutions to your clients (e.g., EU Taxonomy, CSRD)? If yes, how?
8. What services, insights or interventions could be of use in offering nature-based solutions products?

Nature-based solutions within the organisation of insurance companies

1. What potential do you see for including nature-based solutions within the organisation?
2. What barriers exist to act on nature-based solutions within your organisation?
3. Which KPIs exist or should be developed to act on nature-based solutions within your organisation?
4. Which changes or insights are needed within your organisation for stimulating nature-based solutions?

Possibilities of collaboration and next steps

1. Are you investing in your own (or joint) knowledge development on climate risks, climate adaptation or nature-based solutions?
2. How could insurance companies collaborate to stimulate nature-based solutions?
3. What collaboration with external entities (e.g., climate service providers) is needed to stimulate nature-based solutions?
4. To what extent do subsidies play a role in deploying nature-based solutions?

5. What products or services could be of use in stimulating nature-based solutions?
6. What would you like us to include in our research?

Appendix B: full survey (English version[2])

Welcome,

This questionnaire was developed by IVM* as part of a European research project.

The purpose of this questionnaire is to gather your opinions and preferences regarding green roofs. The results of this survey will inform policy makers in the design of action programs.

The estimated time to complete the questionnaire is about 15 to 20 minutes .

*The Institute for Environmental Studies (Instituut voor Milieuvraagstukken, IVM) is an interdisciplinary research institute at VU Amsterdam that sits within the Faculty of Science.

Toestemming

> *Het onderzoek wordt uitgevoerd door het Instituut voor Milieuvraagstukken (IVM) van de Vrije Universiteit Amsterdam (VU).*
>
> *U moet minstens 18 jaar oud zijn om deel te nemen.*
>
> *Uw deelname is vrijwillig, en u kunt op elk moment de enquête beëindigen.*
>
> *Wij houden ons aan de protocollen van de Algemene Verordening Gegevensbescherming (AVG) om de vertrouwelijkheid en veiligheid van uw gegevens te garanderen. Er zal geen persoonlijk identificeerbare informatie worden opgenomen in de uitkomsten van dit onderzoek. Alle gegevens van het onderzoek zullen worden opgeslagen op een veilige, met een wachtwoord beveiligde locatie. Alle gegevens zullen zo snel mogelijk geanonimiseerd worden. Geanonimiseerde gegevens zullen voor een periode van 10 jaar worden bewaard.*
>
> *Voor meer informatie kunt u het uitgebreide overzicht lezen via deze link.*
>
> *Bij voorbaat hartelijk bedankt voor uw reactie. Als u vragen of opmerkingen heeft, kunt u contact opnemen met dr. Georges V. Farina via e-mail: g.v.farina@vu.nl.*

[2] The Dutch version used to collect data may be made available upon request

Q1 *Consent*

Als u instemt met deelname aan dit onderzoek, betekent dit dat u de bovenstaande informatie heeft gelezen en begrepen.

- ja
- nee

Before we start, we would like to ask you a few questions.

Q2 *city*

In which of these cities do you currently live ?

This information will remain confidential.

Aa en Hunze
Aalburg
Aalsmeer
Aalten
Abcoude
Achtkarspelen
Alblasserdam
Albrandswaard
Alkemade
Alkmaar
Almelo
Almere
Alphen aan den Rijn
Alphen-Chaam
Altena
Ambt Montfort
Ameland
Amerongen
Amersfoort
Amstelveen
Amsterdam
Andijk
Angerlo
Anna Paulowna
Apeldoorn
Appingedam
Arcen en Velden
Arnhem
Assen
Asten
Axel
Baarle-Nassau
Baarn
Barendrecht
Barneveld
Bathmen
Bedum
Beek (L.)
Beekdaelen
Beemster
Beesel
Bellingwedde
Bodegraven
Bodegraven-Reeuwijk
Boekel
Bolsward
Borculo
Borger-Odoorn
Borne
Borsele
Boskoop
Boxmeer
Boxtel
Breda
Breukelen
Brielle
Bronckhorst
Brummen
Brunssum
Bunnik
Bunschoten
Buren
Bussum
De Marne
De Ronde Venen
De Wolden

Delft
Delfzijl
Den Helder
Denekamp
Deurne
Deventer
Didam
Diemen
Dijk en Waard
Dinkelland
Dinxperlo
Dirksland
Doesburg
Doetinchem
Dongen
Dongeradeel
Doorn
Dordrecht
Drechterland
Driebergen-Rijsenburg
Drimmelen
Dronten
Druten
Duiven
Echt
Echt-Susteren
Edam-Volendam
Ede
Eemnes
Eemsdelta
Eemsmond
Eersel
Eibergen
Eijsden

Eijsden-Margraten
Eindhoven
Elburg
Emmen
Enkhuizen
Enschede
Epe
Ermelo
Etten-Leur
Ferwerderadiel
Goirle
Gooise Meren
Gorinchem
Gorssel
Gouda
Graafstroom
Graft-De Rijp
Grave
Groenlo
Groesbeek
Groningen (gemeente)
Grootegast
Gulpen-Wittem
Haaksbergen
Haaren
Haarlem
Haarlemmerliede en Spaarnwoude
Haarlemmermeer
Haelen
Halderberge
Hardenberg
Harderwijk
Hardinxveld-Giessendam

Haren
Harenkarspel
Harlingen
Hattem
Heel
Heemskerk
Heemstede
Heerde
Heerenveen
Heerhugowaard
Heerjansdam
Heerlen
Heeze-Leende
Heiloo
Helden
Hellendoorn
Hellevoetsluis
Helmond
Hendrik-Ido-Ambacht
Hengelo (Gld.)
Hengelo (O.)
het Bildt
Het Hogeland
Heumen
Heusden
Heythuysen
Hillegom
Hilvarenbeek
Hilversum
Hoeksche Waard
Hof van Twente
Hollands Kroon
Hontenisse
Hoogeveen

Hoogezand-Sappemeer
Hoorn
Horst aan de Maas
Houten
Huizen
Hulst
Hummelo en Keppel
Koggenland
Kollumerland en Nieuwkruisland
Korendijk
Krimpen aan den IJssel
Krimpenerwaard
Laarbeek
Land van Cuijk
Landerd
Landgraaf
Landsmeer
Langedijk
Lansingerland
Laren (NH.)
Leek
Leerdam
Leersum
Leeuwarden
Leeuwarderadeel
Leiden
Leiderdorp
Leidschendam-Voorburg
Lelystad
Lemsterland
Leudal
Leusden
Lichtenvoorde
Liemeer
Maasdonk
Maasdriel
Maasgouw
Maashorst
Maasland
Maassluis
Maastricht
Margraten
Marum
Medemblik
Meerlo-Wanssum
Meerssen
Meierijstad
Meijel
Menaldumadeel
Menameradiel
Menterwolde
Meppel
Middelburg (Z.)
Middelharnis
Midden-Delfland
Midden-Drenthe
Midden-Groningen
Nieuw-Lekkerland
Nijefurd
Nijkerk
Nijmegen
Nissewaard
Noardeast-Fryslân
Noord-Beveland
Noordenveld
Noorder-Koggenland
Noordoostpolder
Noordwijk
Noordwijkerhout
Nuenen, Gerwen en Nederwetten
Nunspeet
Nuth
Obdam
Oosterhout
Oostflakkee
Ooststellingwerf
Oostzaan
Opmeer
Opsterland
Oss
Oud-Beijerland
Oude IJsselstreek
Ouder-Amstel
Ouderkerk
Oudewater
Overbetuwe
Papendrecht
Peel en Maas
Pekela
Pijnacker-Nootdorp
Purmerend
Putten
Raalte
Ravenstein
Reeuwijk
Rijnwaarden
Rijnwoude
Rijssen
Rijssen-Holten
Rijswijk (ZH.)

Roerdalen
Roermond
Roggel en Neer
Roosendaal
Rotterdam
Rozenburg
Rozendaal
Rucphen
Ruurlo
Sas van Gent
Sassenheim
Schagen
Scheemda
Schermer
Scherpenzeel
Schiedam
Schiermonnikoog
Schijndel
Schinnen
Schipluiden
Schoonhoven
Schouwen-Duiveland
Sevenum
's-Gravendeel
's-Gravenhage (gemeente)
's-Gravenzande
's-Hertogenbosch
Simpelveld
Sint Anthonis
Sint-Michielsgestel
Sint-Oedenrode
Sittard-Geleen
Skarsterlân
Sliedrecht
Slochteren
Sluis
Sluis-Aardenburg
Smallingerland
Steenwijkerland
Stein (L.)
Stichtse Vecht
Strijen
Súdwest-Fryslân
Susteren
Swalmen
Ten Boer
Ter Aar
Terneuzen
Terschelling
Texel
Teylingen
Tholen
Thorn
Tiel
Tilburg
Tubbergen
Twenterand
Tynaarlo
Tytsjerksteradiel
Ubbergen
Uden
Uitgeest
Uithoorn
Urk
Utrecht (gemeente)
Utrechtse Heuvelrug
Vaals
Valkenburg (ZH.)
Veldhoven
Velsen
Venhuizen
Venlo
Venray
Vianen
Vijfheerenlanden
Vlaardingen
Vlagtwedde
Vlieland
Vlissingen
Waadhoeke
Waalre
Waalwijk
West Betuwe
West Maas en Waal
Wester-Koggenland
Westerkwartier
Westerveld
Westervoort
Westerwolde
Westland
Weststellingwerf
Westvoorne
Wierden
Wieringen
Wieringermeer
Wijchen
Woudrichem
Wûnseradiel
Wymbritseradiel
Zaanstad
Zaltbommel

Zandvoort

Zederik

Zeevang

Zeewolde

Zeist

Zelhem

Zevenaar

Zevenhuizen-Moerkapelle

Zijpe

Zoetermeer

Zoeterwoude

Zuidhorn

Zuidplas

Zundert

Zutphen

Zwartewaterland

Zwijndrecht

Zwolle

My city does not appear in this list

Q3 *postcode*

What is the postcode of the place you currently live in ?

Please enter the full postcode

This information will only be used for scientific research purposes.

validation message: Please enter a valid Dutch postcode (4 numbers, 2 letters)

Q4 *ownrent*

Do you own or rent this place ?

- I own my current home
- I rent my current home
- Other (specify)

Q5 *age*

What is your birthyear ?

Q6 *gender*

With what gender do you identify with?

- Male
- Female
- Non-binary
- Other
- I do not want to answer

What is a green roof ?

Green Roofs are structural improvements to buildings designed for enhancing their sustainability. They are **flat roofs** partially or completely **covered by vegetation.**

They can have a **small layer of vegetation** - usually moss and/or sedum.

Funded by
the European Union

They can have a **thicker layer of vegetation**, by including local flowers and shrubs.

The installation of green roofs costs about **90€** per **square meter**. A **30m2** would cost about **2700€**.

Q7 *prior_know*

How familiar were you about Green Roof before you received this information ?

- I had never heard about it before
- I had basic knowledge about green roofs
- I was quite familiar with green roofs
- I knew already all this information

Q8 *know_neigh*

Do you know of a Green Roof in your neighborhood?

- Yes
- No
- I am not sure

Q9 *home_gr*

Do you currently live in a place equipped with a Green Roof ?

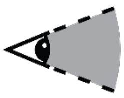
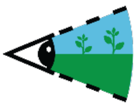
- Yes (screen-out)
- No
- I am not sure

Green roofs provide various benefits.

- Green roofs improve **thermal insulation**, leading to reduced **indoor heat** in times of heatwave. Depending how they are built, they can either lead to a
  - **-0°C** indoor cooling during heatwaves 
  - **-1°C** indoor cooling during heatwaves 
  - **-2°C** indoor cooling during heatwaves 

- Green **roofs increase the overall lifespan of roofs** by protecting them against damages. Depending on how they are built they can
  - add **+0 years** to the lifespan of a roof (total: 30 years) 
  - add **+10 years** to the lifespan of a roof (total: 40 years) 
  - add **+30 years** to the lifespan of a roof (total: 60 years) 

- Green Roofs can be designed to store rainwater, in order to **mitigate risks offlooding from rainfall** at the scale of a neighborhood.
  - Some contribute to flood risk reduction 
  - Some don't 

- Green roofs are aesthetical improvements to buildings when they are visible. Depending on the home characteristic, they can either be
  - NOT visible from the streets or from windows 
  - Visible from the streets or from windows 

- Green roofs **increase the number of species** around a building. Depending on their construction, they can have a:
    - **No** increase in wildlife ✖
    - **Small** increase in wildlife (local flora, some insects and birds)
    - **Large** increase in wildlife (local flora, various types of insects and birds,.)

Q10 *benefits_imp*

How important are each of those benefits to you ?

- Local wildlife increase
    - Not important at all
    - Not very important
    - Neutral
    - Important
    - Very important
- Visibility of green roof
    - Not important at all
    - Not very important
    - Neutral
    - Important
    - Very important
- Flood risk reduction
    - Not important at all
    - Not very important
    - Neutral
    - Important
    - Very important
- Improve roof lifespan
    - Not important at all
    - Not very important

- Neutral
- Important
- Very important

- Reduced indoor heat
    - Not important at all
    - Not very important
    - Neutral
    - Important
    - Very important

We are now reaching a very important part of this survey.

Please**, imagine a situation** where you would **move and live in a new home.**

- (*for owners)* This **new home** would have the **exact same** characteristics (surface area, bedrooms, mortgage, etc.), and be located in the **same area** to your current one.
- (*for tenants)* This **new home** would have the **exact same** characteristics (surface area, bedrooms, rent, etc.), and be located in the **same area** to your current one.

The **only significant difference** would be the **presence** of a **flat green roof** right above your home.

In the next few pages, you will have to choose between **3 new homes**: two options with a **green roof**, and one with **no green roof** at all.

These options will be defined in terms of **6 characteristics**: the **5 benefits** detailed previously, as well as **annual costs**.

- *(for owners)* These costs include all the **maintenance costs** for the green roof that your household would have to pay annually out of your pocket, after all potential helps and subsidies are accounted for.
- *(for tenants)* These costs include all the **maintenance costs** that your household would have to pay annually, *through an increase in rent,* after all potential helps and subsidies are accounted for.

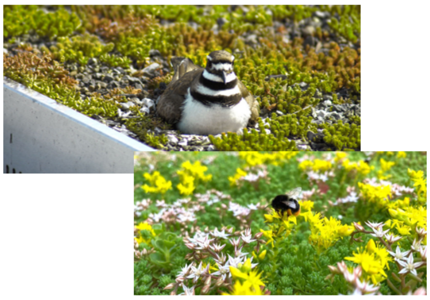
These costs would go towards the regular inspection, cleaning and replacement of the various layers of the roof.

Below is an example of the choice you will have to make, by comparing all three columns. Pick the column that you prefer most !

	Green Roof A	Green Roof B	No green Roof
Increase in species richness	No increase in plant and animal species	Large increase in plant and animal species	No increase in plant and animal species
Contribution to pluvial flood risk reduction	Flood risk reduction	No flood risk reduction	No flood risk reduction
Visibility of Green Roof	Visible	Visible	No green roof
Indoor cooling during heatwaves	No indoor cooling	- 2°C	No indoor cooling
Roof lifespan	+10 yrs (40 total)	+ 30 yrs (60 total)	+ 0 yrs (30 yrs)
Annual cost	500€ per year	500€ per year	0€ per year
Which would you choose?			

Treatments

Green roof create benefits to society

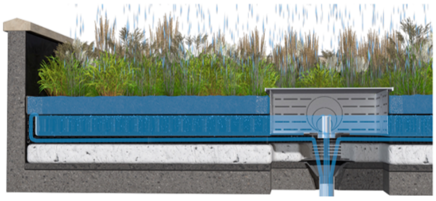


40% of plant, insect, and animal species in the Netherlands are endangered.

Green Roof significantly increases the presence of local plants, birds and aerial insects.

Winter rain is projected to increase by **+8% to +17% by 2050**, meaning more extreme floods.

The large-scale development of Green Roof can reduce the risk of flooding in a neighbourhood.



Q11 *manip_prosocial_1*

Can green roof contribute to protecting neighborhood against floods ?

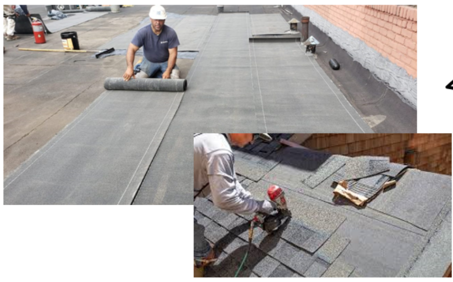
- Yes
- No
- I am not sure

Q12 *manip_prosocial_2*

Can green roof contribute to increasing wildlife ?

- Yes
- No
- I am not sure

Green roof create benefits for households



Winter rain is projected to increase by **+8% to +17% by 2050**, leading to more damages to roofs.

Green roofs protect buildings against damages.

The number of tropical days (>30°C) may increase from **5 to 13 by 2050** in the Netherlands.

Green roof reduces experienced temperature inside a home.

Q13 *manip_proself_1*

Can green roof protect buildings against excessive heat ?

- Yes
- No
- I am not sure

Q14 *manip_proself_2*

Can green roof protect buildings against damages ?

- Yes
- No
- I am not sure

Starting in the next page, **you will now make 6 choices**.

Please **consider carefully** that your household is **realistically willing to pay the costs** associated with the green roof options you choose.

Please answer those choices **honestly**, your responses are highly important to us, and will inform national policymakers.

	Green Roof A	Green Roof B	No green Roof
Increase in species richness	Small increase in plant and animal species	No increase in plant and animal species	No increase in plant and animal species
Contribution to pluvial flood risk reduction	Flood risk reduction	No flood risk reduction	No flood risk reduction
Visibility of Green Roof	Not visible	Visible	No green roof
Indoor cooling during heatwaves	- 2°C	No indoor cooling	No indoor cooling
Roof lifespan	+10 yrs (40 total)	+ 0 yrs (30 yrs)	+ 0 yrs (30 yrs)
Annual cost	15€ per year	60€ per year	0€ per year
Which would you choose?			

	Green Roof A	Green Roof B	No green Roof
Increase in species richness	No increase in plant and animal species	Large increase in plant and animal species	No increase in plant and animal species
Contribution to pluvial flood risk reduction	Flood risk reduction	No flood risk reduction	No flood risk reduction
Visibility of Green Roof	Not visible	Visible	No green roof
Indoor cooling during heatwaves	- 2°C	- 1°C	No indoor cooling
Roof lifespan	+ 30 yrs (60 total)	+ 0 yrs (30 yrs)	+ 0 yrs (30 yrs)
Annual cost	500€ per year	500€ per year	0€ per year
Which would you choose?			

	Green Roof A	Green Roof B	No green Roof
Increase in species richness	Small increase in plant and animal species	No increase in plant and animal species	No increase in plant and animal species
Contribution to pluvial flood risk reduction	No flood risk reduction	Flood risk reduction	No flood risk reduction
Visibility of Green Roof	Not visible	Visible	No green roof
Indoor cooling during heatwaves	No indoor cooling	- 1°C	No indoor cooling
Roof lifespan	+10 yrs (40 total)	+ 30 yrs (60 total)	+ 0 yrs (30 yrs)
Annual cost	60€ per year	240€ per year	0€ per year
Which would you choose?			

	Green Roof A	Green Roof B	No green Roof
Increase in species richness	No increase in plant and animal species	Large increase in plant and animal species	No increase in plant and animal species
Contribution to pluvial flood risk reduction	No flood risk reduction	Flood risk reduction	No flood risk reduction
Visibility of Green Roof	Visible	Not visible	No green roof
Indoor cooling during heatwaves	- 2°C	- 1°C	No indoor cooling
Roof lifespan	+ 0 yrs (30 yrs)	+ 30 yrs (60 total)	+ 0 yrs (30 yrs)
Annual cost	60€ per year	15€ per year	0€ per year
Which would you choose?			

	Green Roof A	Green Roof B	No green Roof
Increase in species richness	Large increase in plant and animal species	Small increase in plant and animal species	No increase in plant and animal species
Contribution to pluvial flood risk reduction	Flood risk reduction	No flood risk reduction	No flood risk reduction
Visibility of Green Roof	Visible	Not visible	No green roof
Indoor cooling during heatwaves	- 1°C	No indoor cooling	No indoor cooling
Roof lifespan	+ 0 yrs (30 yrs)	+ 30 yrs (60 total)	+ 0 yrs (30 yrs)
Annual cost	120€ per year	30€ per year	0€ per year
Which would you choose?			

	Green Roof A	Green Roof B	No green Roof
Increase in species richness	No increase in plant and animal species	Small increase in plant and animal species	No increase in plant and animal species
Contribution to pluvial flood risk reduction	No flood risk reduction	Flood risk reduction	No flood risk reduction
Visibility of Green Roof	Not visible	Visible	No green roof
Indoor cooling during heatwaves	- 1°C	- 2°C	No indoor cooling
Roof lifespan	+ 30 yrs (60 total)	+ 0 yrs (30 yrs)	+ 0 yrs (30 yrs)
Annual cost	30€ per year	15€ per year	0€ per year
Which would you choose?			

	Green Roof A	Green Roof B	No green Roof
Increase in species richness	Small increase in plant and animal species	No increase in plant and animal species	No increase in plant and animal species
Contribution to pluvial flood risk reduction	No flood risk reduction	Flood risk reduction	No flood risk reduction
Visibility of Green Roof	Visible	Not visible	No green roof
Indoor cooling during heatwaves	No indoor cooling	- 2°C	No indoor cooling
Roof lifespan	+ 30 yrs (60 total)	+ 0 yrs (30 yrs)	+ 0 yrs (30 yrs)
Annual cost	120€ per year	30€ per year	0€ per year
Which would you choose?			

	Green Roof A	Green Roof B	No green Roof
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Contribution to pluvial flood risk reduction	Flood risk reduction	No flood risk reduction	No flood risk reduction
Visibility of Green Roof	Visible	Not visible	No green roof
Indoor cooling during heatwaves	No indoor cooling	- 2°C	No indoor cooling
Roof lifespan	+ 30 yrs (60 total)	+10 yrs (40 total)	+ 0 yrs (30 yrs)
Annual cost	240€ per year	240€ per year	0€ per year
Which would you choose?			

	Green Roof A	Green Roof B	No green Roof
Increase in species richness	No increase in plant and animal species	Large increase in plant and animal species	No increase in plant and animal species
Contribution to pluvial flood risk reduction	No flood risk reduction	Flood risk reduction	No flood risk reduction
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Indoor cooling during heatwaves	- 2°C	No indoor cooling	No indoor cooling
Roof lifespan	+ 30 yrs (60 total)	+10 yrs (40 total)	+ 0 yrs (30 yrs)
Annual cost	**120€** per year	**15€** per year	**0€** per year
Which would you choose?	○	○	○

	Green Roof A	Green Roof B	No green Roof
Increase in species richness	Small increase in plant and animal species	Small increase in plant and animal species	No increase in plant and animal species
Contribution to pluvial flood risk reduction	No flood risk reduction	Flood risk reduction	No flood risk reduction
Visibility of Green Roof	Not visible	Not visible	No green roof
Indoor cooling during heatwaves	No indoor cooling	- 1°C	No indoor cooling
Roof lifespan	+ 0 yrs (30 yrs)	+10 yrs (40 total)	+ 0 yrs (30 yrs)
Annual cost	**500€** per year	**500€** per year	**0€** per year
Which would you choose?	○	○	○

	Green Roof A	Green Roof B	No green Roof
Increase in species richness	Small increase in plant and animal species	Large increase in plant and animal species	No increase in plant and animal species
Contribution to pluvial flood risk reduction	Flood risk reduction	No flood risk reduction	No flood risk reduction
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Roof lifespan	+ 0 yrs (30 yrs)	+ 30 yrs (60 total)	+ 0 yrs (30 yrs)
Annual cost	240€ per year	240€ per year	0€ per year
Which would you choose?			

	Green Roof A	Green Roof B	No green Roof
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Roof lifespan	+ 0 yrs (30 yrs)	+10 yrs (40 total)	+ 0 yrs (30 yrs)
Annual cost	30€ per year	60€ per year	0€ per year
Which would you choose?			

	Green Roof A	Green Roof B	No green Roof
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Which would you choose?			

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Annual cost	500€ per year	500€ per year	0€ per year
Which would you choose?			

	Green Roof A	Green Roof B	No green Roof
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Annual cost	240€ per year	120€ per year	0€ per year
Which would you choose?			

	Green Roof A	Green Roof B	No green Roof
Increase in species richness	Large increase in plant and animal species	No increase in plant and animal species	No increase in plant and animal species
Contribution to pluvial flood risk reduction	No flood risk reduction	Flood risk reduction	No flood risk reduction
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Annual cost	60€ per year	30€ per year	0€ per year
Which would you choose?			

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Which would you choose?			

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Visibility of Green Roof	Not visible	Visible	No green roof
Indoor cooling during heatwaves	- 1°C	No indoor cooling	No indoor cooling
Roof lifespan	+ 30 yrs (60 total)	+10 yrs (40 total)	+ 0 yrs (30 yrs)
Annual cost	30€ per year	120€ per year	0€ per year
Which would you choose?			

Q15 *protest*

You have selected the “no green roof” options every time. Could you explain why ?

- I do not believe that Green Roof deliver any benefits
- I do not believe in the levels of benefits proposed in the choice situations
- I find the annual costs to be too high
- I cannot afford these options
- I should not be the one to pay for these green roofs
- I did not feel capable to make a choice with the provided information
- Other (specify)

Q16 *certainty*

When making your choices, how certain did you feel ?

- very unsure
- unsure
- neutral
- sure
- very sure

Q17 *attribute_attendance*

When making your 6 choices, did all the characteristics weigh in you decision ?

Please indicate for all characteristics if you considered them in your decision-making or not.

- Local wildlife increase
    - I did not consider this characteristic
    - I did consider this characteristic
- Contribution to flood risk reduction
    - I did not consider this characteristic
    - I did consider this characteristic
- Visibility of Green Roof
    - I did not consider this characteristic
    - I did consider this characteristic
- Indoor cooling during heatwaves
    - I did not consider this characteristic
    - I did consider this characteristic

- Roof lifespan
    - I did not consider this characteristic
    - I did consider this characteristic
- Annual cost
    - I did not consider this characteristic
    - I did consider this characteristic

Q18 *info_ask*

Will you search for more information in the future on green roofs ?

- Absolutely not
- Probably not
- I am not sure
- Probably yes
- Absolutely

Q19 *stated_want*

How likely is it that you will buy a green roof in the future ?

- I will never install a green roof (0% chance to install a green roof)
- it is unlikely (1%-39% chance)
- it is neither likely nor unlikely (40%-60% chance)
- likely (61%-99% chance)
- I will install a green roof for certain (100% chance to install a green roof)
- i don't know / I don't want to answer

Q20 *know_subsid*

Does your municipality currently offer subsidies for the installation of green roofs ?

- Yes
- No
- I do not know

Q21 *subsidy_WTP*

Imagine your municipality offered a new subsidy program for green roofs. You would receive a subsidy to help you cover the initial one-off cost of implementing a green roof.

Depending on the level of the subsidy, how likely is it that you would install a standard green roof on your home (3000€) ?

- No subsidy at all (0% of the cost is covered)
    - I will never install a green roof (0% chance to install a green roof)
    - it is unlikely (1%-39% chance)
    - it is neither likely nor unlikely (40%-60% chance)
    - likely (61%-99% chance)
    - I will install a green roof for certain (100% chance to install a green roof)
    - i don't know / I don't want to answer
- The subsidy covers 25% (you pay 2250€, the subsidy covers 750€)
    - I will never install a green roof (0% chance to install a green roof)
    - it is unlikely (1%-39% chance)
    - it is neither likely nor unlikely (40%-60% chance)
    - likely (61%-99% chance)
    - I will install a green roof for certain (100% chance to install a green roof)
    - i don't know / I don't want to answer
- The subsidy covers 50% (you pay 1500€, the subsidy covers 1500€)
    - I will never install a green roof (0% chance to install a green roof)
    - it is unlikely (1%-39% chance)
    - it is neither likely nor unlikely (40%-60% chance)
    - likely (61%-99% chance)
    - I will install a green roof for certain (100% chance to install a green roof)
    - i don't know / I don't want to answer
- The subsidy covers 75% (you pay 750€, the subsidy covers 2250€)
    - I will never install a green roof (0% chance to install a green roof)
    - it is unlikely (1%-39% chance)
    - it is neither likely nor unlikely (40%-60% chance)
    - likely (61%-99% chance)
    - I will install a green roof for certain (100% chance to install a green roof)
    - i don't know / I don't want to answer
- The subsidy covers 100% (you pay 0€, the subsidy covers 3000€)
    - I will never install a green roof (0% chance to install a green roof)
    - it is unlikely (1%-39% chance)
    - it is neither likely nor unlikely (40%-60% chance)
    - likely (61%-99% chance)
    - I will install a green roof for certain (100% chance to install a green roof)
    - i don't know / I don't want to answer

Q22 *insured*

Do you have a home insurance ?

- Yes
- No

Q23 *premium*

Could you indicate approximately how high is your annual insurance premium ?

Q24 *discount_WTP*

Imagine the insurance company that ensures your home started a new program of premium discounts for owners that install a green roof. This discount would lead to a lower annual premium.

Depending on the level of the discount, would you want to install a standard green roof on your home (3000€) ?

For your information, annual premiums are often around 300€.

- No discount (you would pay a standard premium)
  - I will never install a green roof (0% chance to install a green roof)
  - it is unlikely (1%-39% chance)
  - it is neither likely nor unlikely (40%-60% chance)
  - likely (61%-99% chance)
  - I will install a green roof for certain (100% chance to install a green roof)
  - i don't know / I don't want to answer
- The premium discount is of 25%
  - I will never install a green roof (0% chance to install a green roof)
  - it is unlikely (1%-39% chance)
  - it is neither likely nor unlikely (40%-60% chance)
  - likely (61%-99% chance)
  - I will install a green roof for certain (100% chance to install a green roof)
  - i don't know / I don't want to answer
- The premium discount is of 50%
  - I will never install a green roof (0% chance to install a green roof)
  - it is unlikely (1%-39% chance)
  - it is neither likely nor unlikely (40%-60% chance)
  - likely (61%-99% chance)
  - I will install a green roof for certain (100% chance to install a green roof)
  - i don't know / I don't want to answer
- The premium discount is of 75%
  - I will never install a green roof (0% chance to install a green roof)
  - it is unlikely (1%-39% chance)
  - it is neither likely nor unlikely (40%-60% chance)
  - likely (61%-99% chance)
  - I will install a green roof for certain (100% chance to install a green roof)
  - i don't know / I don't want to answer
- The premium discount is of 100%
  - I will never install a green roof (0% chance to install a green roof)
  - it is unlikely (1%-39% chance)
  - it is neither likely nor unlikely (40%-60% chance)
  - likely (61%-99% chance)
  - I will install a green roof for certain (100% chance to install a green roof)

- i don't know / I don't want to answer

Q25 *deductible_WTP*

Imagine the insurance company that ensures your home started a new program of deductible discounts for owners that install a green roof.

Depending on the level of the discount, would you want to install a standard green roof on your home (3000€) ?

For your information, a deductible is the sum you have to pay upfront whenever issuing an insurance claim. It is often around 300€ of the actual damages.

- No discount (you would pay a standard deductible)
    - I will never install a green roof (0% chance to install a green roof)
    - it is unlikely (1%-39% chance)
    - it is neither likely nor unlikely (40%-60% chance)
    - likely (61%-99% chance)
    - I will install a green roof for certain (100% chance to install a green roof)
    - i don't know / I don't want to answer
- The deductible discount is of 25%
    - I will never install a green roof (0% chance to install a green roof)
    - it is unlikely (1%-39% chance)
    - it is neither likely nor unlikely (40%-60% chance)
    - likely (61%-99% chance)
    - I will install a green roof for certain (100% chance to install a green roof)
    - i don't know / I don't want to answer
- The deductible discount is of 50%
    - I will never install a green roof (0% chance to install a green roof)
    - it is unlikely (1%-39% chance)
    - it is neither likely nor unlikely (40%-60% chance)
    - likely (61%-99% chance)
    - I will install a green roof for certain (100% chance to install a green roof)
    - i don't know / I don't want to answer
- The deductible discount is of 75%
    - I will never install a green roof (0% chance to install a green roof)
    - it is unlikely (1%-39% chance)
    - it is neither likely nor unlikely (40%-60% chance)
    - likely (61%-99% chance)
    - I will install a green roof for certain (100% chance to install a green roof)
    - i don't know / I don't want to answer
- The deductible discount is of 100%
    - I will never install a green roof (0% chance to install a green roof)
    - it is unlikely (1%-39% chance)
    - it is neither likely nor unlikely (40%-60% chance)
    - likely (61%-99% chance)

- I will install a green roof for certain (100% chance to install a green roof)
- i don't know / I don't want to answer

Q26 *peer_effect*

Imagine one or multiple of your neighbors build a green roof in the near future. How likely is it that you would also build one ?

- I will never participate in (0% chance to invest in)
- it is unlikely (1%-39% chance)
- it is neither likely nor unlikely (40%-60% chance)
- likely (61%-99% chance)
- I will participate in for certain (100% chance to invest in)
- i don't know / I don't want to answer

This survey is almost over now.

Q27 *NEP*

Now we would like to know your opinions about the relationship between humans and the environment.

For each following statements, please indicate how much you agree or disagree. There are no right or wrong answers.

- We are approaching the limit of the number of people the Earth can support.
  - strongly disagree
  - disagree
  - unsure
  - agree
  - strongly agree
- Humans have the right to modify the natural environment to suit their needs.
  - strongly disagree
  - disagree
  - unsure
  - agree
  - strongly agree
- When humans interfere with nature it often produces disastrous consequences.

  - strongly disagree
  - disagree
  - unsure
  - agree
  - strongly agree
- Human ingenuity will insure that we keep the Earth livable.
  - strongly disagree
  - disagree
  - unsure
  - agree
  - strongly agree
- Humans are seriously abusing the environment.
  - strongly disagree
  - disagree
  - unsure
  - agree
  - strongly agree
- The Earth has plenty of natural resources if we just learn how to manage them.
  - strongly disagree
  - disagree
  - unsure
  - agree
  - strongly agree
- Plants and animals have as much right as humans to exist.
  - strongly disagree
  - disagree
  - unsure
  - agree
  - strongly agree
- The balance of nature is strong enough to cope with the impacts of modern industrial nations.
  - strongly disagree
  - disagree
  - unsure

- agree
- strongly agree

- Despite our special abilities, humans are still subject to the laws of nature.
    - strongly disagree
    - disagree
    - unsure
    - agree
    - strongly agree
- The so-called "ecological crisis" facing humankind has been greatly exaggerated.
    - strongly disagree
    - disagree
    - unsure
    - agree
    - strongly agree
- The Earth is like a spaceship with very limited room and resources.
    - strongly disagree
    - disagree
    - unsure
    - agree
    - strongly agree
- Humans were meant to rule over the rest of nature.
    - strongly disagree
    - disagree
    - unsure
    - agree
    - strongly agree
- The balance of nature is very delicate and easily upset.
    - strongly disagree
    - disagree
    - unsure
    - agree
    - strongly agree
- Humans will eventually learn enough about how nature works to be able to control it.
    - strongly disagree

- disagree
- unsure
- agree
- strongly agree

- If things continue on their present course, we will soon experience a major ecological catastrophe.
  - strongly disagree
  - disagree
  - unsure
  - agree
  - strongly agree
- Please click on "strongly agree"
  - strongly disagree
  - disagree
  - unsure
  - agree
  - strongly agree

Q28 *risk_pref*

Using a 10-point scale, where 0 means you are not willing to take any risks and 10 means you are very willing to take risks, what number reflects how much risk you are willing to take?

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- I do not know

Q29 *time_pref*

When it comes to financial decisions, how would you assess your willingness to give up something today in order to benefit from that in the future?

Please use a scale from 0 to 10, where 0 means you are “completely unwilling to give up something today” and a 10 means you are “very willing to give up something today”.

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- I do not know

Q30 *altruism*

How do you assess your willingness to share with others without expecting anything in return when it comes to charity ?

Please use a scale from 0 to 10, where 0 means you are “completely unwilling to share” and a 10 means you are “very willing to share.

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- I am not sure

Q31 *flood_perception*

What is your best estimate of how often a flood will occur at your home?

- Every year
- Between every year and 1 in 10 years
- Between 1 in 11 years and 1 in 100 years
- Between 1 in 101 years and 1 in 1000 years
- Between 1 in 1001 years and 1 in 10 000 years
- Less often than 1 in 10 000 years
- I am not sure

Q32 *flood_worry*

Do you agree with this statement: I am worried about the danger of a pluvial flood at my current residence.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree
- Not sure

Q33 *flood_measures*

Have you already taken measures to protect your home against floods ?

- Yes
- No

Q34 *heat_perception*

How often do you estimate heatwaves will hit your home in the future ?

- Every year
- Between every year and 1 in 10 year
- Between 1 in 11 years and 1 in 101 years
- Between 1 in 101 years and 1 in 1001 years
- Less often than 1 in 1000 years
- I am not sure

Q35 *heat_worry*

Do you agree with this statement: I am worried about the impact of heatwaves at my current residence.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree
- Not sure

Q36 *heat_measures*

Have you already taken measures to protect your home against intense heat ? (for example air conditioning, tree planting, etc.)

- Yes
- No
-

Q37 *air_con*

Do you have air conditioning at home?

- Yes
- No

Q38 *damage_perception*

How bad do you estimate the risk of damages to your roof due to weather events in the future ?

- Every year
- Between every year and 1 in 10 year
- Between 1 in 11 years and 1 in 100 years
- Between 1 in 101 years and 1 in 1000 years
- Less often than 1 in 1000 years
- I am not sure

Q39 *damage_worry*

Do you agree with this statement: I am worried about the damages to my roof at my current residence (for instance, due to storms and hail).

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree
- Not sure

Q40 *damage_measures*

Have you already taken measures to protect your home against damages ? (example: wind-resistant windows, hail-resistant roofing, etc.)

- yes
- no

Q41 *locus_control*

Using a 10-point scale, where 0 means you have no control and 10 means you have complete control, what number reflects how much control you think you have over how your life turns out?

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- I am not sure

Q42 *self_efficacy*

To what extent are you or a member of your household able to actually carry out the implementation of a green roof ?

- Definitely not able
- Possibly able
- Possibly not able
- Definitely not able
- I am not syre

Q43 *Per_rep_cost*

Please consider the entirety of costs of implementing a green roof.

Not only the initial investment, but also maintenance, contractors, as well as your time and effort. How high would you say those total costs are ?

- Very high
- High
- Somewhat high
- Not high at all
- I am not sure

Q44 *Coping_appraisal*

- How effective are green roofs according to you to address the following challenges ?
- Protect a roof against damages
    - Very effective
    - Effective
    - Somewhat effective
    - Not at all effective
    - I am not sure
- Protect a neighbourhood against flooding
    - Very effective
    - Effective
    - Somewhat effective
    - Not at all effective
    - I am not sure
- Protect your home against high indoor heat
    - Very effective
    - Effective
    - Somewhat effective

- Not at all effective
- I am not sure

- Provide habitat for willife
    - Very effective
    - Effective
    - Somewhat effective
    - Not at all effective
    - I am not sure

Q45 *edu*

What is your last completed level of education ?

- No completed education
- Primary education
- HAVO, VMBO, VWO lower secondary education, MBO1
- Bachelor's degree
- HBO, WO master, doctorate
- Other, please specify

Q46 *income*

What are the net monthly income levels of your entire household ?

- Minder dan €800
- €800 tot €1999
- €2000 tot €3999
- €4000 tot €5999
- €5000 tot €9999
- €10000 of meer
- Weet ik niet

Q47 *household_size*

What is the size of your household (including yourself) ?

- 1
- 2

- 3
- 4
- 5
- 6
- more than 6

Q48 *under18*

How many children (under 18) live in your household ?

- 0
- 1
- 2
- 3
- 4
- 5
- more than 5

Q49 *home_type*

In what type of home do you live ?

- Individual house
- Shared house
- Apartment
- Boat house
- Other (specify)

Q50 *surface*

Could you indicate (approximately) the surface area of your home ?

- less than 20m²
- Between 20m² and 40m²
- Between 40m² and 60m²
- Between 60m² and 80m²
- Between 80m² and 100m²
- Between 100m² and 120m²
- Between 120m² and 140m²

- More than 140m²

Q51 *home_age*

Approximately, when was your current residence built ?

- Prior to the 1960's
- In the 1960's
- In the 1970's
- In the 1980's
- In the 1990's
- In the 2000's
- In the 2010's
- After 2020
- I am not sure

Q52 *home_roof*

Do you live right below a roof (for instance, in a top floor apartment, or in an individual house) ?

- Yes
- No

Q53 *private_green*

Do you have access to a private green area in your home ?

ex: you own a garden or backyard

- Yes
- No

Q54 *shared_green*

Do you have access to a shared green area in your home ?

ex: you have access to a shared residential garden

- Yes
- No

Q55 *level_green*

How do you consider the availability and quality of green areas near your home ?

- Very poor
- Poor
- Neutral
- Good
- Excellent

Q56 *neigh_type*

Below are some types of neighbourhoods. Which of these neighbourhoods most closely resembles where you live ?

- Bedrijventerrein
- Bloemkoolwijk
- Historische binnenstad
- Hoogbouw
- Stedelijk bouwblok
- Naoorloogse woonwijk
- Tuindorp
- Tuinstad hoogbouw
- Tuinstad laagbouw
- Vernieuwd
- Villawijk
- Volskwijk
- Vinex Wijk
- Vooroorloogse woonwijk
- I do not know / other


Bedrijventerrein


Bloemkoolwijk


Historische binnenstad


Hoogbouw


Stedelijk bouwblok


Naoorloogse woonwijk

The survey is over. Thank you for your participation !

Appendix C: Coding

Q-nr	Variable name	Coding
ID	RID	
device	device_type	(1='Android phone', 2='iPhone', 3='other smartphone', 4='Android tablet', 5='iPad', 6='Windows tablet', 7='desktop device')
Q1	consent	(1='Ja', 2='Nee')
Q2	city	(1='Aa en Hunze', 2='Aalburg', 3='Aalsmeer', 4='Aalten', 5='Abcoude', 6='Achtkarspelen', 7='Alblasserdam', 8='Albrandswaard', 9='Alkemade', 10='Alkmaar', 11='Almelo', 12='Almere', 13='Alphen aan den Rijn', 14='Alphen-Chaam', 15='Altena', 16='Ambt Montfort', 17='Ameland', 18='Amerongen', 19='Amersfoort', 20='Amstelveen', 21='Amsterdam', 22='Andijk', 23='Angerlo', 24='Anna Paulowna', 25='Apeldoorn', 26='Appingedam', 27='Arcen en Velden', 28='Arnhem', 29='Assen', 30='Asten', 31='Axel', 32='Baarle-Nassau', 33='Baarn', 34='Barendrecht', 35='Barneveld', 36='Bathmen', 37='Bedum', 38='Beek (L.)', 39='Beekdaelen', 40='Beemster', 41='Beesel', 42='Bellingwedde', 43='Bodegraven', 44='Bodegraven-Reeuwijk', 45='Boekel', 46='Bolsward', 47='Borculo', 48='Borger-Odoorn', 49='Borne', 50='Borsele', 51='Boskoop', 52='Boxmeer', 53='Boxtel', 54='Breda', 55='Breukelen', 56='Brielle', 57='Bronckhorst', 58='Brummen', 59='Brunssum', 60='Bunnik', 61='Bunschoten', 62='Buren', 63='Bussum', 64='De Marne', 65='De Ronde Venen', 66='De Wolden', 67='Delft', 68='Delfzijl', 69='Den Helder', 70='Denekamp', 71='Deurne', 72='Deventer', 73='Didam', 74='Diemen', 75='Dijk en Waard', 76='Dinkelland', 77='Dinxperlo', 78='Dirksland', 79='Doesburg', 80='Doetinchem', 81='Dongen', 82='Dongeradeel', 83='Doorn', 84='Dordrecht', 85='Drechterland', 86='Driebergen-Rijsenburg', 87='Drimmelen', 88='Dronten', 89='Druten', 90='Duiven', 91='Echt', 92='Echt-Susteren', 93='Edam-Volendam', 94='Ede', 95='Eemnes', 96='Eemsdelta', 97='Eemsmond', 98='Eersel', 99='Eibergen', 100='Eijsden', 101='Eijsden-Margraten', 102='Eindhoven', 103='Elburg', 104='Emmen', 105='Enkhuizen', 106='Enschede', 107='Epe', 108='Ermelo', 109='Etten-Leur', 110='Ferwerderadiel', 111='Goirle', 112='Gooise Meren', 113='Gorinchem', 114='Gorssel', 115='Gouda', 116='Graafstroom', 117='Graft-De Rijp', 118='Grave', 119='Groenlo', 120='Groesbeek', 121='Groningen (gemeente)',

122='Grootegast', 123='Gulpen-Wittem', 124='Haaksbergen', 125='Haaren', 126='Haarlem', 127='Haarlemmerliede en Spaarnwoude', 128='Haarlemmermeer', 129='Haelen', 130='Halderberge', 131='Hardenberg', 132='Harderwijk', 133='Hardinxveld-Giessendam', 134='Haren', 135='Harenkarspel', 136='Harlingen', 137='Hattem', 138='Heel', 139='Heemskerk', 140='Heemstede', 141='Heerde', 142='Heerenveen', 143='Heerhugowaard', 144='Heerjansdam', 145='Heerlen', 146='Heeze-Leende', 147='Heiloo', 148='Helden', 149='Hellendoorn', 150='Hellevoetsluis', 151='Helmond', 152='Hendrik-Ido-Ambacht', 153='Hengelo (Gld.)', 154='Hengelo (O.)', 155='het Bildt', 156='Het Hogeland', 157='Heumen', 158='Heusden', 159='Heythuysen', 160='Hillegom', 161='Hilvarenbeek', 162='Hilversum', 163='Hoeksche Waard', 164='Hof van Twente', 165='Hollands Kroon', 166='Hontenisse', 167='Hoogeveen', 168='Hoogezand-Sappemeer', 169='Hoorn', 170='Horst aan de Maas', 171='Houten', 172='Huizen', 173='Hulst', 174='Hummelo en Keppel', 175='Koggenland', 176='Kollumerland en Nieuwkruisland', 177='Korendijk', 178='Krimpen aan den IJssel', 179='Krimpenerwaard', 180='Laarbeek', 181='Land van Cuijk', 182='Landerd', 183='Landgraaf', 184='Landsmeer', 185='Langedijk', 186='Lansingerland', 187='Laren (NH.)', 188='Leek', 189='Leerdam', 190='Leersum', 191='Leeuwarden', 192='Leeuwarderadeel', 193='Leiden', 194='Leiderdorp', 195='Leidschendam-Voorburg', 196='Lelystad', 197='Lemsterland', 198='Leudal', 199='Leusden', 200='Lichtenvoorde', 201='Liemeer', 202='Maasdonk', 203='Maasdriel', 204='Maasgouw', 205='Maashorst', 206='Maasland', 207='Maassluis', 208='Maastricht', 209='Margraten', 210='Marum', 211='Medemblik', 212='Meerlo-Wanssum', 213='Meerssen', 214='Meierijstad', 215='Meijel', 216='Menaldumadeel', 217='Menameradiel', 218='Menterwolde', 219='Meppel', 220='Middelburg (Z.)', 221='Middelharnis', 222='Midden-Delfland', 223='Midden-Drenthe', 224='Midden-Groningen', 225='Nieuw-Lekkerland', 226='Nijefurd', 227='Nijkerk', 228='Nijmegen', 229='Nissewaard', 230='Noardeast-Fryslân', 231='Noord-Beveland', 232='Noordenveld', 233='Noorder-Koggenland', 234='Noordoostpolder', 235='Noordwijk', 236='Noordwijkerhout', 237='Nuenen, Gerwen en Nederwetten', 238='Nunspeet', 239='Nuth', 240='Obdam', 241='Oosterhout', 242='Oostflakkee', 243='Ooststellingwerf', 244='Oostzaan', 245='Opmeer', 246='Opsterland', 247='Oss', 248='Oud-Beijerland', 249='Oude IJsselstreek', 250='Ouder-Amstel', 251='Ouderkerk', 252='Oudewater', 253='Overbetuwe', 254='Papendrecht', 255='Peel en Maas', 256='Pekela',

		257='Pijnacker-Nootdorp', 258='Purmerend', 259='Putten', 260='Raalte', 261='Ravenstein', 262='Reeuwijk', 263='Rijnwaarden', 264='Rijnwoude', 265='Rijssen', 266='Rijssen-Holten', 267='Rijswijk (ZH.)', 268='Roerdalen', 269='Roermond', 270='Roggel en Neer', 271='Roosendaal', 272='Rotterdam', 273='Rozenburg', 274='Rozendaal', 275='Rucphen', 276='Ruurlo', 277='Sas van Gent', 278='Sassenheim', 279='Schagen', 280='Scheemda', 281='Schermer', 282='Scherpenzeel', 283='Schiedam', 284='Schiermonnikoog', 285='Schijndel', 286='Schinnen', 287='Schipluiden', 288='Schoonhoven', 289='Schouwen-Duiveland', 290='Sevenum', 291=''s-Gravendeel', 292=''s-Gravenhage (gemeente)', 293=''s-Gravenzande', 294=''s-Hertogenbosch', 295='Simpelveld', 296='Sint Anthonis', 297='Sint-Michielsgestel', 298='Sint-Oedenrode', 299='Sittard-Geleen', 300='Skarsterlân', 301='Sliedrecht', 302='Slochteren', 303='Sluis', 304='Sluis-Aardenburg', 305='Smallingerland', 306='Steenwijkerland', 307='Stein (L.)', 308='Stichtse Vecht', 309='Strijen', 310='Súdwest-Fryslân', 311='Susteren', 312='Swalmen', 313='Ten Boer', 314='Ter Aar', 315='Terneuzen', 316='Terschelling', 317='Texel', 318='Teylingen', 319='Tholen', 320='Thorn', 321='Tiel', 322='Tilburg', 323='Tubbergen', 324='Twenterand', 325='Tynaarlo', 326='Tytsjerksteradiel', 327='Ubbergen', 328='Uden', 329='Uitgeest', 330='Uithoorn', 331='Urk', 332='Utrecht (gemeente)', 333='Utrechtse Heuvelrug', 334='Vaals', 335='Valkenburg (ZH.)', 336='Veldhoven', 337='Velsen', 338='Venhuizen', 339='Venlo', 340='Venray', 341='Vianen', 342='Vijfheerenlanden', 343='Vlaardingen', 344='Vlagtwedde', 345='Vlieland', 346='Vlissingen', 347='Waadhoeke', 348='Waalre', 349='Waalwijk', 350='West Betuwe', 351='West Maas en Waal', 352='Wester-Koggenland', 353='Westerkwartier', 354='Westerveld', 355='Westervoort', 356='Westerwolde', 357='Westland', 358='Weststellingwerf', 359='Westvoorne', 360='Wierden', 361='Wieringen', 362='Wieringermeer', 363='Wijchen', 364='Woudrichem', 365='Wûnseradiel', 366='Wymbritseradiel', 367='Zaanstad', 368='Zaltbommel', 369='Zandvoort', 370='Zederik', 371='Zeevang', 372='Zeewolde', 373='Zeist', 374='Zelhem', 375='Zevenaar', 376='Zevenhuizen-Moerkapelle', 377='Zijpe', 378='Zoetermeer', 379='Zoeterwoude', 380='Zuidhorn', 381='Zuidplas', 382='Zundert', 383='Zutphen', 384='Zwartewaterland', 385='Zwijndrecht', 386='Zwolle', 387=other municipality (screen-out)
Q3	postcode	text

Q4	ownrent	(1='I own my current home', 2='I rent my current home', 3='Other (specify)')
Q5	age	text
Q6	gender	(1=woman, 2='man', 3='Non-binary', 4=Other ', 5='I do not want to answer')
Q7	prior_know	(1='I had never heard about it before', 2='I had basic knowledge about green roofs', 3='I was quite familiar with green roofs', 4='I knew already all this information')
Q8	know_neigh	(1='Yes', 2='No', 3='I am not sure')
Q9	home_gr	(1='Yes', 2='No ', 3='I don't know')
Q10	benefits_imp_1	(1='Not important at all', 2='Not very important', 3='Neutral', 4='Important ', 5='Very important')
	benefits_imp_2	(1='Not important at all', 2='Not very important', 3='Neutral', 4='Important ', 5='Very important')
	benefits_imp_3	(1='Not important at all', 2='Not very important', 3='Neutral', 4='Important ', 5='Very important')
	benefits_imp_4	(1='Not important at all', 2='Not very important', 3='Neutral', 4='Important ', 5='Very important')
	benefits_imp_5	(1='Not important at all', 2='Not very important', 3='Neutral', 4='Important ', 5='Very important')
Q11	manip_prosocial_1	(1='Yes', 2='No ', 3='I am not sure')
Q12	manip_prosocial_2	(1='Yes', 2='No ', 3='I am not sure')
Q13	manip_proself_1	(1='Yes', 2='No ', 3='I am not sure')
Q14	manip_proself_2	(1='Yes', 2='No ', 3='I am not sure')
Q15	protest	(1='not selected', 2='selected')
Q16	certainty	(1='very unsure', 2='unsure', 3='neutral', 4='sure', 5='very sure')
Q17	attribute_attendance_1	(1='I did not consider this characteristic', 2='I did consider this characteristic')
	attribute_attendance_2	(1='I did not consider this characteristic', 2='I did consider this characteristic')
	attribute_attendance_3	(1='I did not consider this characteristic', 2='I did consider this characteristic')
	attribute_attendance_4	(1='I did not consider this characteristic', 2='I did consider this characteristic')
	attribute_attendance_5	(1='I did not consider this characteristic', 2='I did consider this characteristic')
	attribute_attendance_6	(1='I did not consider this characteristic', 2='I did consider this characteristic')
Q18	info_ask	(1='Absolutely not', 2='Probably not', 3='I am not sure', 4='Probably yes', 5='Absolutely')
Q19	stated_want	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')

Q20	know_subsid	(1='Yes', 2='No', 3='I do not know')
Q21	subsidy_WTP_1	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
	subsidy_WTP_2	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
	subsidy_WTP_3	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
	subsidy_WTP_4	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
	subsidy_WTP_5	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
Q22	insured	(1='Yes', 2='No', 3='I do not know')
Q23	premium	text
Q24	discount_WTP_1	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
	discount_WTP_2	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
	discount_WTP_3	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
	discount_WTP_4	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I

		will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
	discount_WTP_5	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
Q25	deductible_WTP_1	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
	deductible_WTP_2	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
	deductible_WTP_3	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
	deductible_WTP_4	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
	deductible_WTP_5	(1='I will never install a green roof (0% chance to install a green roof)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='likely (61%-99% chance)', 5='I will install a green roof for certain (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
Q26	peer_effect	(1='I would never participate (0% chance to participate)', 2='it is unlikely (1%-39% chance)', 3='it is neither likely nor unlikely (40%-60% chance)', 4='It is likely (61%-99% chance)', 5='I will participate (100% chance to install a green roof)', 6='i don't know / I don't want to answer')
Q27	NEP_1	(1='strongly disagree ', 2='disagree', 3='unsure', 4='agree', 5='strongly agree')
	NEP_2	(1='strongly disagree ', 2='disagree', 3='unsure', 4='agree', 5='strongly agree')
	NEP_3	(1='strongly disagree ', 2='disagree', 3='unsure', 4='agree', 5='strongly agree')
	NEP_4	(1='strongly disagree ', 2='disagree', 3='unsure', 4='agree', 5='strongly agree')
	NEP_5	(1='strongly disagree ', 2='disagree', 3='unsure', 4='agree', 5='strongly agree')

	NEP_6	(1='strongly disagree ', 2='disagree', 3='unsure', 4='agree', 5='strongly agree')
	NEP_7	(1='strongly disagree ', 2='disagree', 3='unsure', 4='agree', 5='strongly agree')
	NEP_8	(1='strongly disagree ', 2='disagree', 3='unsure', 4='agree', 5='strongly agree')
	NEP_9	(1='strongly disagree ', 2='disagree', 3='unsure', 4='agree', 5='strongly agree')
	NEP_10	(1='strongly disagree ', 2='disagree', 3='unsure', 4='agree', 5='strongly agree')
	NEP_11	(1='strongly disagree ', 2='disagree', 3='unsure', 4='agree', 5='strongly agree')
	NEP_12	(1='strongly disagree ', 2='disagree', 3='unsure', 4='agree', 5='strongly agree')
Q28	risk_pref	(1='0', 2='1', 3='2', 4='3', 5='4', 6='5', 7='6', 8='7', 9='8', 10='9', 11='10', 12='I do not know')
Q29	time_pref	(1='0', 2='1', 3='2', 4='3', 5='4', 6='5', 7='6', 8='7', 9='8', 10='9', 11='10', 12='I do not know')
Q30	altruism	(1='0', 2='1', 3='2', 4='3', 5='4', 6='5', 7='6', 8='7', 9='8', 10='9', 11='10', 12='I do not know')
Q31	flood_perception	(1='Every year', 2='Between every year and 1 in 10 years ', 3='Between 1 in 10 years and 1 in 100 years ', 4='Between 1 in 100 years and 1 in 1000 years', 5='Between 1 in 1000 years and 1 in 10 000 years ', 6='Less often than 1 in 10 000 years', 7='I am not sure')
Q32	flood_worry	(1='Strongly agree', 2='Agree ', 3='Neither agree nor disagree ', 4='Disagree ', 5='Strongly disagree ', 6='Not sure')
Q33	flood_measures	(1='Yes', 2='No')
Q34	heat_perception	(1='Every year', 2='Between every year and 1 in 10 year', 3='Between 1 in 10 years and 1 in 100 years ', 4='Between 1 in 100 years and 1 in 1000 years', 5='Less often than 1 in 1000 years', 6='I am not sure')
Q35	heat_worry	(1='Strongly agree', 2='Agree ', 3='Neither agree nor disagree ', 4='Disagree ', 5='Strongly disagree ', 6='Not sure')
Q36	heat_mesures	(1='Yes', 2='No')
Q37	air_con	(1='Yes', 2='No')
Q38	damage_perception	(1='Every year', 2='Between every year and 1 in 10 year', 3='Between 1 in 10 years and 1 in 100 years ', 4='Between 1 in 100 years and 1 in 1000 years', 5='Less often than 1 in 1000 years', 6='I am not sure')
Q39	damage_worry	(1='Strongly agree', 2='Agree ', 3='Neither agree nor disagree ', 4='Disagree ', 5='Strongly disagree ', 6='Not sure')
Q40	damage_measures	(1='Yes', 2='No')
Q41	locus_control	(1='0', 2='1', 3='2', 4='3', 5='4', 6='5', 7='6', 8='7', 9='8', 10='9', 11='10', 12='I am not sure')

Q42	self_efficacy	(1='Definitely not able', 2='Possibly able', 3='Possibly not able', 4='Definitely not able', 5='I am not sure')
Q43	per_rep_cost	(1='Very high', 2='High ', 3='Somewhat high', 4='Not high at all', 5='I am not sure')
Q44	coping_appraisal_1	(1='Very effective', 2='Effective', 3='Somewhat effective', 4='Not at all effective', 5='I am not sure')
	coping_appraisal_2	(1='Very effective', 2='Effective', 3='Somewhat effective', 4='Not at all effective', 5='I am not sure')
	coping_appraisal_3	(1='Very effective', 2='Effective', 3='Somewhat effective', 4='Not at all effective', 5='I am not sure')
	coping_appraisal_4	(1='Very effective', 2='Effective', 3='Somewhat effective', 4='Not at all effective', 5='I am not sure')
Q45	edu	(1=no completed education, 2='Basic education', 3='VMBO', 4='HAVO', 5='VWO / Gymnasium ', 6='MBO', 7='HBO / Hogeschool', 8='Universiteit - Bachelorsdiploma', 9='Universiteit - Masterdiploma', 10='Universiteit - PhD graad', 11=other, specificy')
Q46	income	(1=less than €999', 2='€1000 to €1999', 3='€2000 to €2999', 4='€3000 to €3999', 5='€4000 to €4999', 6='€5000 to €5999', 7='€6000 to €6999', 8='€7000 to €7999', 9='€8000 to €8999', 10='€9000 to €9999', 11='€10000 or more)
Q47	household_size	(1='1', 2='2', 3='3', 4='4', 5='5', 6='6', 7=more than 6')
Q48	under18	(1='1', 2='2', 3='3', 4='4', 5='5', 6='6', 7=more than 6')
Q49	home_type	(1='Individual house', 2='Shared house', 3='Apartment', 4='Boat house', 5='Other (specify)')
Q50	surface	(1='less than 20m^2', 2='Between 20m^2 and 40m^2', 3='Between 40m^2 and 60m^2', 4='Between 60m^2 and 80m^2', 5='Between 80m^2 and 100m^2', 6='Between 100m^2 and 120m^2', 7='Between 120m^2 and 140m^2', 8='More than 140m^2')
Q51	home_age	(1='Prior to the 1960's', 2='In the 1960's', 3='In the 1970's', 4='In the 1980's ', 5='In the 1990's', 6='In the 2000's', 7='In the 2010's', 8='After 2020', 9='I am not sure')
Q52	home_roof	(1='Yes', 2='No')
Q53	private_green	(1='Yes', 2='No')
Q54	shared_green	(1='Yes', 2='No')
Q55	level_green	(1='Very poor', 2='Poor', 3='Neutral', 4='Good', 5='Excellent')
Q56	neigh_type	(1='Bedrijventerrein', 2='Bloemkoolwijk', 3='Historische binnenstad', 4='Hoogbouw', 5='Stedelijk bouwblok', 6='Naoorloogse woonwijk', 7='Tuindorp', 8='Tuinstad hoogbouw', 9='Tuinstad laagbouw', 10='Vernieuwd', 11='Villawijk', 12='Volskwijk', 13='Vinex Wijk', 14='Vooroorloogse woonwijk', 15='I do not know / other')