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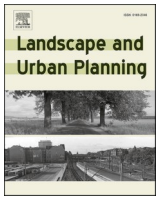

Research Paper

The right fit: Acceptance of nature-based solutions across European cities

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HIGHLIGHTS

- A discrete choice experiment on NBS was applied in 6 European countries.
- Different NBS aspects are preferred depending on the exposure to climate change.
- The willingness to pay does not depend on GDP.
- The different trade-offs in each country should be considered when planning NBS.

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ABSTRACT

European cities consistently seek to improve urban environments for their residents, yet often struggle to find solutions to address urban issues while engaging citizens. The European Union funds research and innovation projects proposing nature-based solutions to address climate change, biodiversity, human health and wellbeing in cities under the Horizon 2020 and Horizon Europe programs. The presented research from the project UPSURGE is based on a survey of 5,990 urban residents in 6 European countries. The study focuses on the planning phase of nature-based solutions in cities, in which trade-offs have to be made between different options, such as the design, effectiveness, financial contributions from residents or participatory options. Based on an innovative survey including a choice experiment, the aim is to assist public participation processes in various countries, help planning teams define priorities and design governance measures which ensure long-term dedication to development plans. The results reflect respective exposure to climate change across the continent; such as Greek respondents being more affected by high temperatures compared to those from the United Kingdom. However, the study also revealed different preferences in regard to a participatory planning process, willingness to pay and importance of biodiversity.

1. Introduction

European cities seeking to improve urban environments for their residents often struggle to find solutions to address urban issues and engage citizens. Under project calls, the European Union funding proposals for nature-based solutions to address climate change while improving health and wellbeing. Within these projects nature-based solutions are defined as "Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions." (European Commission, 2022 para. 2). The research project UPSURGE in which six city partners from Hungary, Greece, Netherlands, Poland, Slovenia and the UK are accompanied by 17 planning and research institutions from across Europe, aims to unlock the potential of nature-based solutions in cities as it addresses "the challenges faced by cities in their efforts to decrease the impacts of urban existence on climate change, mitigate air pollution and its health effects and reduce climate change stressors" (UPSURGE, 2022,

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para. 3). Despite the increasing interest in research on mapping and collecting evidence of nature-based solutions, many review papers also show that these multidimensional European goals are not easy to achieve (Kabisch et al., 2017; Lafortezza et al., 2018; Albert et al., 2019). These studies reveal, that the application of nature-based solutions in urban environments requires significant trade-offs between climate effectiveness, design and usability, biodiversity, and cost effectiveness to name a few aspects. Lafortezza et al. (2018) report that these trade-offs are influenced by enabling factors such as funding or investment models, the overall awareness of climate change and the effectiveness of nature-based solutions, the foreseen engagement and empowerment of the local population in the planning process and, last but not least the relevance of additional co-benefits such as biodiversity enhancement.

The paper contributes to the understanding of these trade-offs and to what extent these decisions are influenced by additional factors such as the respective socio-political situation or the affectedness by climate change. The findings will be considered in digital planning tools and in the five project demo cities (Budapest (Hungary), Breda (Netherlands), Katowice (Poland), Maribor (Slovenia), and Belfast (United Kingdom)). This research aims to assist public participatory processes, help planning teams define priorities and design governance concepts which ensure long-term dedication to development plans.

2. Literature review

The literature recognizes the advantages of nature-based solutions as a suitable and effective element of urban sustainability and resilience planning (Lafortezza et al., 2018), but the challenges and difficulties to mainstreaming them into local policy and planning are evident (Frantzeskaki, 2019, Dorst et al., 2022). Frantzeskaki (2019) summarizes research on case studies and offers seven lessons to guide adoption of nature-based solutions in cities: Accordingly, successful approaches should consider (1) design and appealing aesthetics, (2) development of new green commons, (3) trust between the planning partners and the process, (4) processes ensuring inclusivity and co-creation, (5) diversity to learn from social innovation, (6) knowledge transfer and interdisciplinary cooperation, and (7) replicability over time.

Nonetheless, a number of barriers continue to impede the development of urban nature-based solutions, such as limited public resources, debates about effectiveness and competition over space (Dorst et al., 2022). Despite the growing literature on the urban applications of nature-based solutions for ecosystem management, green space development, climate change adaptation and mitigation, several authors criticize an insufficient consideration of the demand side bridging science, policy, and practice (Cortinovis & Geneletti, 2018; Longato et al., 2023). Longato et al. (2023) argue that this lack of demand side consideration is likely to undermine both the effectiveness of planning decisions that involve the allocation of nature-based solutions and the ability to address specific urban challenges in different areas of the city.

Considering the opportunities nature-based solutions can provide, locals and planning institutions may be required to make trade-offs and decisions between: the type of nature-based solutions, its usability, participatory planning aspects, biodiversity effects, effectiveness for reducing the impact of climate change, improving health and well-being, reducing temperatures or improving air quality (Fig. 1). Studies have shown, that they improve health and wellbeing (Lelieveld et al., 2020; Scherer et al., 2014), reduce heat (Li & Wang, 2021; Scherer et al., 2014), reduce emissions and improve air quality (Chen et al., 2023; Klingberg et al., 2017; Kumar et al., 2022). Depending on the type, nature-based solutions are correlated to usability such as areas for urban gardening or outdoor recreation purposes (Longato et al., 2023; Maćkiewicz & Asuero, 2021; Sarabi et al., 2022) and can positively influence biodiversity in urban environments (Moreau et al., 2022).

Recent publications consider the opportunity of having inhabitants contribute to urban greening through a specific fee such as a communal, waste bin or rainwater fee (Badura et al., 2021). In communities in Germany for instance, a waste-bin charge has already been established which is paid annually by respective household(s). This fee depends on the amount of sealed surface on the property and can be reduced by greening or measures of water retention (e.g. rain gardens or water reservoirs) (Verband Wohneigentum, 2022; Khoury-Nolde & Nolde, 2020). The water retention and related stormwater management reduces communal expenses for water related infrastructure and effort for cleaning (Tasca et al., 2019; NRDC, 2018; Kertesz et al., 2014). However, implementing these new neighbourhood designs may increase the distance one must walk to parked cars or public transportation (Wiersma et al., 2021). With nature-based solutions changing the urban fabric, the development process per se might have an influence on the outcome. In Fig. 1 both the payments and the willingness to accept a different accessibility are included. Several authors highlight the relevance of participatory processes in contrast to top-down development (Mahmoud, 2022; Nóblega-Carriquiry et al., 2022; Sarabi et al., 2022; Wanner & Pröbstl-Haider, 2019) in order to develop socially just solutions and consider the needs of different user groups (Dorst et al., 2022; Lafortezza et al. 2018; Franzeskaki et al., 2017).

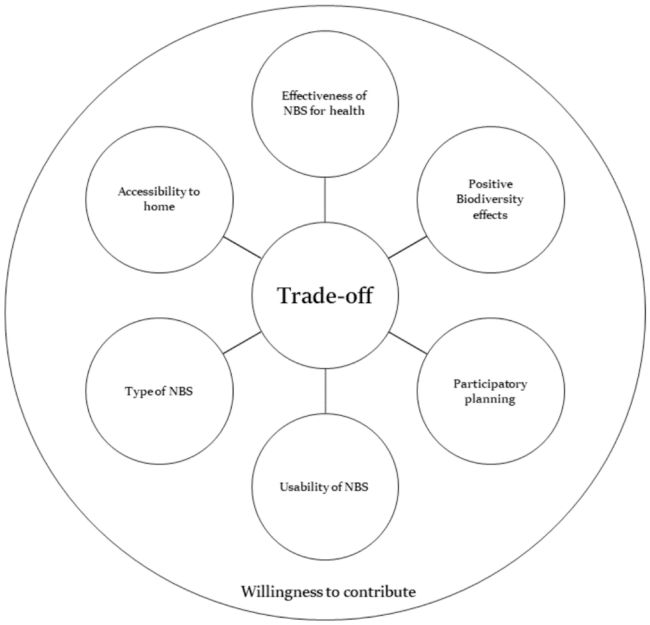

Fig. 1. Aspects influencing the trade-offs and decision making process on nature-based solutions.

For our study we assume that the most effective way to enhance nature-based solutions can be achieved if spaces for cars and related infrastructure are transformed into green areas. On one hand because this approach has been proposed by recent literature (da Schio et al., 2021; Croeser et al. 2022). And on the other because this approach is being implemented within several UPSURGE case study areas (Breda, Budapest & Katowice, UPSURGE, 2024a; b; c). Beyond UPSURGE, the tremendous potential can be illustrated with the example of the German capital city Berlin where a spatial analysis showed that parking spaces cover 13 % of the urban area (17 km^2 overall) while space for car sharing, on-demand services and taxis only surmount to 0.3 km^2 (Herrmann, 2023). Workshops with planning teams in the Austrian capital Vienna (Pröbstl-Haider & Feilhammer, 2023) and case studies (Herrmann, 2023) show a significant hesitation by political decision makers, who are uncertain and therefore often decide in favour of more "conservative" solutions in which cars are still given immense amount of space. It is therefore important to use a survey to understand local needs and prepare for political decision-making (Ritter & Tönnes, 2023).

There is growing criticism of the dominant case study approach and its influence on the comparability of research findings weakening the

transferability and the distillation of achievable benefits (Kabisch et al., 2016, Franzeskaki et al., 2017). This applies in particular to the demand side, including the perception and awareness of citizens. There is limited research directly addressing citizens and linking their perceptions and knowledge on nature-based solutions to advance urban policy and planning. In addition, Counsins (2024) argues that processes to support just nature-based solutions for climate resilient urban development need to foster access to decision-making as well as access to, and benefits from, their implementation to facilitate equitable and just outcomes for stakeholders. To bridge this research gap, this paper aims to enhance the understanding and awareness of the demand side of citizens across Europe, to increase the comparability and to learn more about possible differences beyond a case study approach. Furthermore, the trade-offs between the multiple benefits on one hand and possible disadvantages are to be made more transparent, in order to support planning and implementation of nature-based solutions.

Looking at cities in the European Union, one must consider the different exposure to global warming effects (Iungman et al., 2023), their cultural heritage (Eckersley & Vos, 2023), and different planning traditions (Hein, 2018), which are crucial characteristics in this context. Therefore, the main hypotheses of this paper are:

- The required trade-offs are similar across European countries.
- The design and efficiency of the nature-based solution and car dependency have a significant influence on the decision making.
- The willingness to pay does not depend on the average income but the exposure to heat, heatwaves and related negative health effects.

3. Methods

To test the hypotheses a survey with an integrated discrete choice experiment was applied in six European countries. The survey included several questions on:

- City size, housing quality, surrounding urban green space,
- Local infrastructure, mobility options, preferences,
- Distance to green space, design quality of neighbourhoods
- Time spent outdoors
- Climate change, heat experience, perceived need for adaptation in urban areas
- Socio-demographics (Social, economic and demographic data including education)

In the choice experiment, respondents were provided with a scenario and asked to contemplate multiple aspects of each option and decide on a trade-off between the individual aspects according to their preferences. This intricate decision-making process requires an appropriate methodological approach which allows for the analysis of participants' preferences for and willingness to make specific trade-offs. Choice experiments (CE) are a quantitative survey technique for eliciting preferences in a systematic way, which makes them an attractive method for research on participatory planning (Pröbstl-Haider et al. 2020). Within economic literature, choice experiments have become an established valuation method (Bateman et al., 2002; Louviere et al., 2005) and have been applied in the context of climate change adaptation and related uncertainties (Pröbstl-Haider et al. 2020). Choice experiments rely on a survey-based evaluation of hypothetical alternatives, and are well suited for investigating the demand for hypothetical alternatives. They can also accommodate variables describing risk or uncertainty associated with certain situations. In choice experiments, respondents choose preferred options from various alternatives (Ben Akiva and Lerman, 1985; Train, 2009). The great advantage for this study is the opportunity of a direct examination of causal relationships in contrast to "conventional" surveys. The methodology is tailored directly to action and decision theories and a high level of external validity has been proven (Auspurg & Liebe, 2011). The application of a choice experiment within UPSURGE assists in understanding which attributes are of high relevance and which are less convincing with regards to nature-based solutions (e.g. temperature reduction vs. design vs. participation) from a citizen's perspective in different European cities.

A specific situation is introduced to the respondents (see Fig. 2) and presents two hypothetical development scenarios including future development and maintenance fees (see the attribute table in Table 1). This choice experiment asked participants to imagine that their city is promoting new green areas throughout all neighbourhoods. A citizen survey is being sent out to determine which type of green areas fits local needs. Furthermore, the city aims to understand whether residents would tolerate changes to the accessibility of your home and higher communal costs for these new green areas and improved environmental conditions. The participants' task was to select either development scenario or to opt out by choosing "neither". Each respondent was presented with six choice sets.

The presented situation first shows types of green areas. The nature-based solution options are limited to four types, representing those planned to be implemented in the UPSURGE partner countries. The next three attributes describe the effectiveness of the new green infrastructure, such as the microdust reduction, the NO_2 reduction and the temperature reduction achievable by the nature-based solutions. The levels have been defined based on r et al. (2022). Due to the UNEA 5 resolution, we also included an attribute on biodiversity (Cohen-Shacham et al., 2024). However, the levels were only split into "high" and "low" contribution. The following attribute describes the expected impact on biodiversity. The sixth and seventh attributes are likely to be a barrier for nature-based solutions' development. Then, an attribute describing the consequences on the accessibility and the impact on the required additional time was included; followed by an annual waste bin charge, describing the amount of money that is charged by the community to finance their investments in nature-based solutions across the city. To define the levels for the wastebin charge we used the experiences in Germany, where the maximum fee is about 250–300 Euro (Verband Wohneigentum, 2022; Khoury-Nolde & Nolde, 2020). Finally, participation is included as an attribute, to understand the relevance of collaborative planning. The attributes and levels are illustrated in Table 1. At a first glance the number of attributes might be perceived as overwhelming and a cognitive burden for the respondent. However, our literature review on choice experiment application in the field of land use planning and tourism revealed that well designed choice experiments may also include 8 or 9 attributes (see Kemperman, 2021, Pröbstl-Haider et al., 2020, García-Llorente et al., 2012). The current application of choice experiments and results by Hensher (2006) confirm that the careful optical design on one hand, and the relevance in the context of the decision making on the other, are crucial. Hensher (2006) analysed the feasible number of attributes used in a stated choice experiment. His empirical findings revealed that "individuals appear to adopt a range of 'coping' strategies that are consistent with how they process information in real markets, and that aligning 'choice complexity' with the amount of information to process is potentially misleading" (2006: 861). Hensher states that in this context that "*Relevancy* is what matters" (2006:861). Therefore, careful design and extensive pre-testing were crucial elements of the design process.

The choice sets were calculated using SAS software (SAS Institute Inc, 2013) and yielded 64 sets. Data collection was based on panel distribution in the UK, Hungary, Netherlands, Poland, Slovenia and Greece. Intensive pretesting was conducted in English, before professional translation into the respective languages. Using the panel provider Bilendi (Bilendi & respondi, 2024) for sampling in all of the above-mentioned countries, roughly 1,000 respondents were obtained in each country during a three-week sampling period in October 2022. Respondents were over the age of 18 and living in cities with more than 20,000 inhabitants (Table 2). Statistical analysis was conducted with SPSS. LatentGOLD was used for choice experiment analysis and part-worth utilities. Part-worth utilities are numerical scores that measure

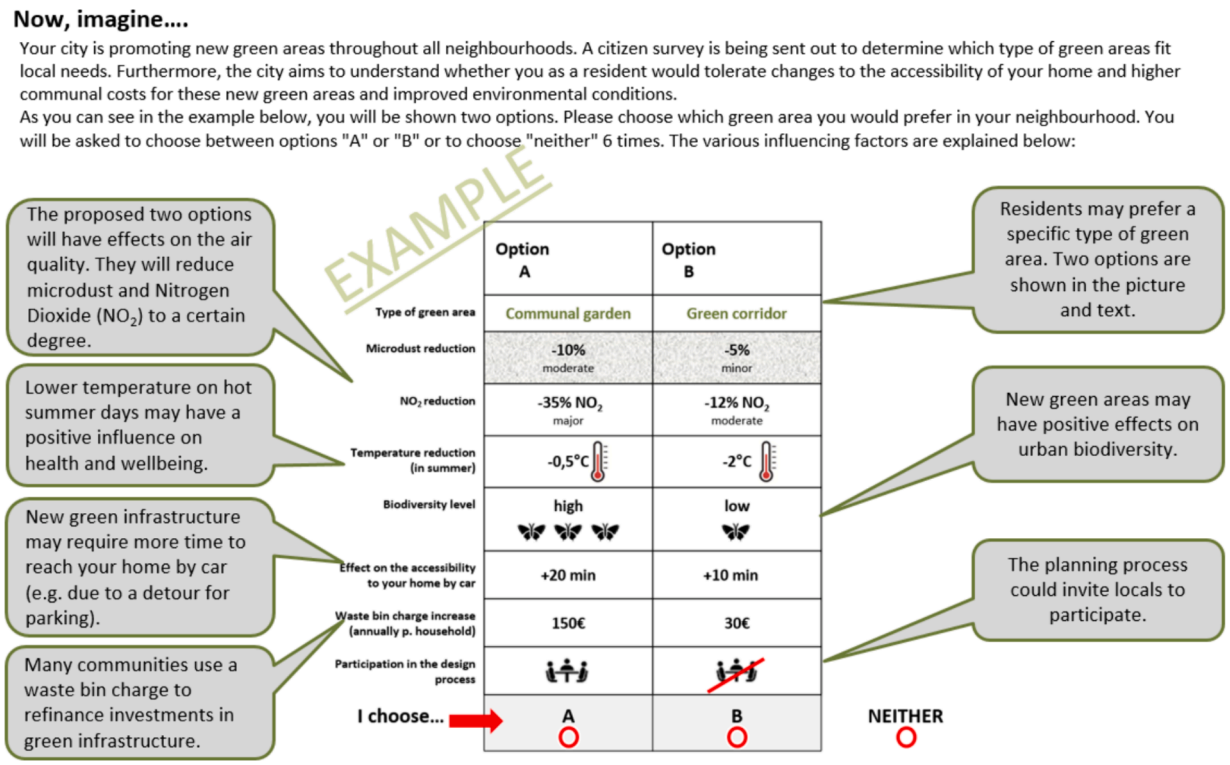

Fig. 2. Example of choice experiment (first page with instructions, followed by 6 choices).

how much each attribute influences the urban citizens' decision to select an alternative in the respective countries. To visualize main trade-offs and for discussion with project partners, an Excel-based decision support tool (DST) was developed based on the part-worth utilities of the individual country-based one-class models. The part-worth utilities presented in chapter 4.2 are effect coded, to make the differences comparable. The data sets for each of the national survey results can be found in Supplementary Material.

4. Results

4.1. Overview and general description of the sample

The socio-demographic structure of the six samples and additional results are shown in Table 3. It is noteworthy that Greece, Hungary and Slovenia have lower percentages of female participants. Netherlands and the UK have an older average age and age range. Differences in income, place and location of residents are also evident across the countries.

When examining citizens' experience with heatwaves, it is interesting to note that Slovenian respondents indicated the least experience, while those from the Netherlands indicated greater exposure to heatwaves. There were higher percentages of second car ownership in Greece, Poland and Slovenia.

4.2. Results of the choice experiment: Part-worth utilities

In the following section the part-worth utilities of each of the surveyed attributes are presented and the findings per country are compared.

Type of green area: As Fig. 3 shows, the more unspecific green and commonly used nature-based solutions, such as street greening and green corridors, are the most preferred. The nature-based solutions addressed to a specific target group or with a specific functionality such as the rain garden are less preferred and even characterized by negative evaluation by respondents across all countries. However, there are significant differences between the countries. Looking at the samples from the UK and Poland, it is evident that the type of area is less important than in the Greek or Hungarian sample which demonstrate clear preference for certain types of nature-based solutions. The green corridor, which requires more space, is generally viewed positively, but in Poland and Slovenia is it perceived as a more suitable solution compared to the other countries.

Improvement on temperature, microdust and NO_2 (Fig. 4, Fig. 5 & Fig. 6): Again the results show similar patterns in nearly all countries. However, it must be highlighted that in general the respondents only react to significant improvements which are difficult to achieve. Looking at the result we can see that temperature reduction is not a desired goal in the UK, compared to the Greek or Hungarian sample who are strongly interested in reduced temperatures. Across all investigated countries, the reduction of NO_2 was more relevant than the reduction of microdust.

Accessibility (Fig. 7): the respondents in all countries show the same patterns in their part-worth utilities, underlining that no or little extra time on their way home is acceptable. Respondents from Hungary, Poland and Slovenia are less sensitive in this regard. Respondents from the Netherlands, Greece and the UK are more sensitive concerning a longer walking distance.

Biodiversity enhancement (Fig. 8): The findings reveal that an enhancement of the biodiversity by nature-based solutions is generally perceived as a positive side effect. However, the relevance of this attribute is different across countries. Respondents in the UK and the Netherlands show higher part-worth utilities for an increase in biodiversity. Again, differences between the cities in western and eastern European countries are obvious.

A charge for increasing the green areas in the city (communal charge, Fig. 9): The choice experiment explained that the implementation of nature-based solutions in their city and neighbourhood would cause additional fees such as an annual waste bin charge. It is no surprise that this fee per year and household always has a negative influence within the decision-making process. It would be preferred if the nature-based solution and its positive effect on the neighbourhood would be free of charge, but this is unlikely to occur. Overall, the respondents in the

Table 1
Choice experiment attributes and levels.

Attribute	Level
Type of Green area	
	Communal garden
	Street greening
	Rain garden
	Green corridor
Microdust reduction	
	−5% minor
	−10 % moderate
	−20 % major
	−30 % extreme
NO_2 reduction	
	−3% minor
	−12 % moderate
	−35 % major
	−50 % extreme
Temperature reduction (in summer)	
	−0.5 °C
	−2°C
	−4°C
	−6°C
Biodiversity level	
	Low
	High
Effect on accessibility to your home by car	
	No extra time
	+5 min
	+10 min
	+20 min
Waste bin charge increase (annually per household)	
	10 €
	30 €
	50 €
	100 €
	100 €
	150 €
	200 €
	250 €
Participation in the design process	
	Yes
	No

Table 2
Number of respondents per country and model fit.

Countries involved:	Number of respondents (n)	Model FitL-squared (L^2)
Greece	1,004	9914.9772
Hungary	1,017	9626.3808
Netherlands	1,012	10812.8979
Poland	1,021	10495.5325
Slovenia	934	9626.3808
United Kingdom	1,002	11276.2067

Netherlands and Greece are the most price-sensitive populations. However, the range of respective willingness to pay across the countries is smaller compared to other attributes such as biodiversity or accessibility. The majority of the countries rank this relevance between −0.2 and −0.28. Differences between Eastern and Western European countries are not observable.

Participation: Fig. 10 shows the relevance of a planning process, where the negative value indicates how the lack of involving stakeholders' effects decision making. Not having an opportunity to participate in the process, is a negative attribute in all countries. Participation is especially important for citizens in Poland, Slovenia and the UK. The eastern European countries show a higher interest in participatory processes compared to the western European countries.

4.3. *Preferred solutions from a respective national perspective*

In order to illustrate the practical consequences of the differing valuations of the relevance of each attribute in a trade-off, the data set was transferred into a decision support tool. By means of the decision support tool the respective trade-offs and population shares of acceptance for alternatives can be tested. In order to make this tangible and show the high potential of this data for further planning processes and interaction with stakeholders, the trade-offs and recommendations by simulation of specific questions are presented in the following (Fig. 11):

Option "A" proposes implementation of a **Street greening** project. It is assumed that in this case with only trees and little green space only marginal environmental improvements will be achieved, such as a temperature reduction of −2 degrees Celsius, microdust reduction (10 %) and NO_2 emissions (−12 %). However, the likelihood of impacting the accessibility is rather low and the walking distance is therefore only five minutes longer. The assumed annual fee per household to be paid is 100€. The new trees will lead to a limited effect on biodiversity.

Option "B" proposes the implementation of a **Green corridor** in the neighbourhood. The green corridor is likely to be much more effective from an environmental standpoint. The environmental improvements will be characterized by a temperature reduction of −4 degrees Celsius, a reduction of microdust (20 %) and reduced NO_2 emissions (−35 %). Overall, the green corridor is more effective, however, it will be more expensive 150€ and will lead to longer walking distances for most of the people living in this area (in our case about 10 min). Since the green corridor allows the inclusion of a variety of plant species, significant positive effect on biodiversity are expected.

The following table show this constellation and the respective trade-offs by the respondents in all six European countries (Table 4). Despite the higher costs, Option "B" is preferred for the majority of urban citizens in Slovenia and Poland. The percentage of respondents selecting neither option is 3 %. The majority of Greek and Hungarian respondents would choose Option "A" and favour of street greening measures. In both countries, the Netherlands and the UK, Option "A" and Option "B" are not acceptable (under 50 % acceptance). In the Netherlands one third would opt for the "Neither". This sends a clear signal that the planning and / or refinancing concept must be adapted. Based on the decision support tool and keeping the type of nature-based solution, the environmental effectiveness and the biodiversity enhancement on the same level, acceptance for Option "B" Green corridor (54 %) can be achieved in the Netherlands by lowering the annual fees down to 40€ for the green corridor (and 10€ for the street greening) while improving the accessibility to no additional time in option "A" and "B". However, even under these conditions 14 % of the respondents would still choose "Neither". Under the same conditions in the UK (no extra time, fees down to 10€ versus 40€) acceptance for the green corridor reaches 57 % and 10 % would still decide against both options.

In a next step, the possible influence of a participatory approach on the desired solution was analysed. The outcomes of the trade-off between green corridor and street greening in Fig. 11 change significantly if we exclude participatory processes for street greening, but keep it in the green corridor development in the second example (Table 5).

As Table 5 shows that with a clear promotion of participatory development, the acceptance of the more expensive and more effective green corridor can be enhanced. In Poland, Slovenia and Hungary the acceptance of Option "B" with participation increases. However, this is not the same for all countries. The significant focus on participation is of high relevance in the post-communist countries and show little effect in

Table 3
Socio-demographic descriptions of the sample.

		GR	HU	NL	PL	SL	UK
Gender							
	Male	58.9 %	53.5 %	51.1 %	48.3 %	56.6 %	50.4 %
	Female	40.5 %	46.2 %	48.7 %	51.6 %	42.9 %	49 %
	Diverse	0.2 %	/	0.2 %	/	0.2 %	0.2 %
	Prefer not to say	0.3 %	0.3 %	/	0.1 %	0.2 %	0.4 %
Age							
	Average	38.8	38.6	53.45	39.9	42.8	56.3
	Range	18–69	18–72	16–89	18–76	17–81	19–93
Households							
	with children under 18 years	40.1 %	39.7 %	17.2 %	49.1 %	35.5 %	23.4 %
Income (monthly household)							
	<500 €	10.2 %	23.3 %	3.2 %	10.9 %	7.9 %	2.8 %
	500–1,000 €	28.3 %	33.5 %	4.4 %	31.2 %	20.1 %	8.4 %
	1,001–2,000 €	38.2 %	15 %	20.0 %	29.8 %	44.5 %	25 %
	2,001–3,000 €	11.3 %	5.8 %	28.5 %	12 %	10.3 %	23.1 %
	3,001–4,000 €	2.2 %	12 %	17.2 %	5.5 %	2.4 %	15.7 %
	>4,000 €	2.5 %	0.8 %	9.2 %	3 %	2.7 %	12.1 %
	Prefer not to say	7.2 %	9.6 %	17.6 %	7.6 %	12.2 %	12.8 %
Place of residence (city size)							
	20,000–50,000	10 %	16.7 %	29.7 %	11.8 %	28.9 %	18 %
	50,001–100,000	14.8 %	14.2 %	24.6 %	16.5 %	15.6 %	21.4 %
	100,001–250,000	12.3 %	20.2 %	26.1 %	19.8 %	17.8 %	17.9 %
	250,001–500,000	7.2 %	49.1 %	5.1 %	18 %	37.7 %	13 %
	500,001–1,500,000	55.8 %		12.6 %	20.6 %		11.5 %
	>1,500,000				13.4 %		18.4 %
Location							
	City centre	46 %	41.1 %	16.7 %	50 %	27.8 %	16.3 %
	Urban districts	33.9 %	42.7 %	42.4 %	45.2 %	54.1 %	38 %
	Outskirts	20.1 %	16.1 %	40.9 %	4.9 %	18.1 %	45.8 %
Have experiences heatwaves		89.5 %	84.6 %	92.8 %	88.7 %	82 %	89.6 %
Car ownership							
	none	9.7 %	21.8 %	17.6 %	15.5 %	8.7 %	19 %
	1 car	53.1 %	54.4 %	59.5 %	56.6 %	47 %	56.2 %
	2 cars	32.8 %	19.1 %	19.7 %	24.2 %	35.5 %	19.9 %
	3 or more	4.2 %	4.9 %	3.2 %	3.8 %	8.7 %	5 %

western European countries. In western European countries the participation attribute had a significantly smaller influence on the overall trade-off. Option "B" with participation is more preferred against Option "A" without participation. In Greece participation changes the overall decision in favour of Option "B". However, the provided trade-off between the two development options remains unacceptable for 38 % of the respondents in the Netherlands and 26 % in the UK.

The recommendation for this case is to adapt the overall planning at least in the United Kingdom and in the Netherlands by improving the environmental outcomes to achieve a higher acceptance among citizens.

The same methodological approach using the decision support tool can also be used to study the acceptance of a new project, by comparing as Option "A" (status quo) and Option "B" (an improved nature-based solution application). From a policy point of view, the approach also allows analysis of the willingness to pay and to explore possible thresholds under different conditions. Therefore, the decision support tool is helpful for decision-making processes and may serve as a visual assistance and basis for discussions with the local population, stakeholders, practitioners and political decision makers.

5. Discussion

5.1. Contribution to the state of the art – Including the demand side

The study at hand addresses the previous insufficient consideration of the demand side within nature-based solution research and in bridging science, policy, and practice (Cortinovis & Geneletti, 2018; Longato et al., 2023). The lack of consideration of the demand side is considered to undermine effective planning decisions and is often criticized (Longato et al, 2023). The application of the choice experiment and visualisation of results in a decision sport tool as shown in Fig. 11 can aid in overcoming this criticism. By using a decision support tool when working with policy makers and practitioners, like the one introduced in the results, the trade-offs can be presented to assist public participation processes. It can be used to define long-term development plans as it gives insight into citizen's decision making and indicates which factors are of greatest importance to them when it comes to the design of the neighbourhoods they live, work and thrive in.

Applying a similar survey at the same time in six European countries is also a step beyond the case study dominated research on the acceptance of nature-based solutions in cities and the limited comparability of research findings weakening the transferability and the distillation of achievable benefits (Kabisch et al., 2016, Franzeskaki et al., 2017). One significant advantage of this survey was the ability to recognize

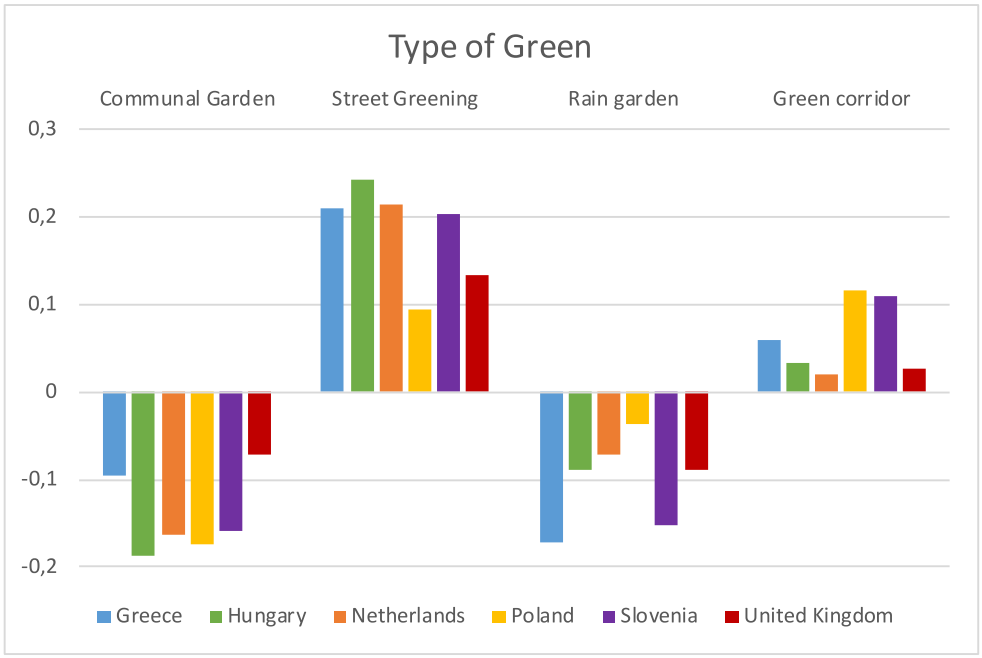

Fig. 3. Part-worth utility – types of green.

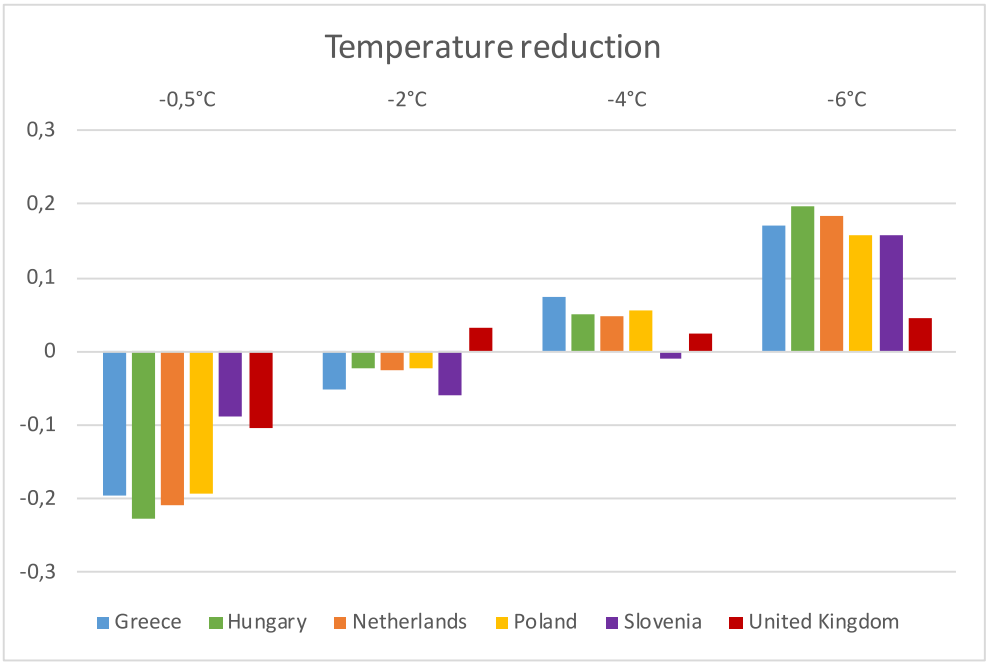

Fig. 4. Part-worth utility – temperature reduction.

differences between the countries (typically blurred through the respective case studies) and to discuss possible reasons.

In outdoor recreation research, cultural differences between European regions are well-known (Bell et al., 2009; Pröbstl et al., 2010). Nevertheless, the clear heterogeneity that the data showed was surprising. Initially, it was expected that the significant improvement of the environmental conditions for health and well-being, the enhancement of biodiversity in the cities and the overall trend to gradually ban the private car from cities are common goals reflected by more or less homogeneous trade-offs by citizens across Europe. The first hypothesis was therefore rejected, as required trade-offs differ significantly between European countries.

5.2. *Relevance of nature-based solutions for health and wellbeing*

One plausible explanation for the heterogeneity between countries may be found in the link between decision making and climate change (Augusto et al., 2020; Chen et al., 2023; Orlove et al., 2020), where the exposure to negative effects such as poor air quality or heat for example, may influence the decision-making process. Thus, heat exposure, heatwaves and related experiences were analysed in the datasets. The results (see Table 2) show a very limited exposure in the United Kingdom (40 % have experienced heatwaves; average 13 days) and in the Netherlands (38 % have experienced heatwaves; average 10 days) compared to respondents in Greece (41 % have experienced heatwaves, average 16

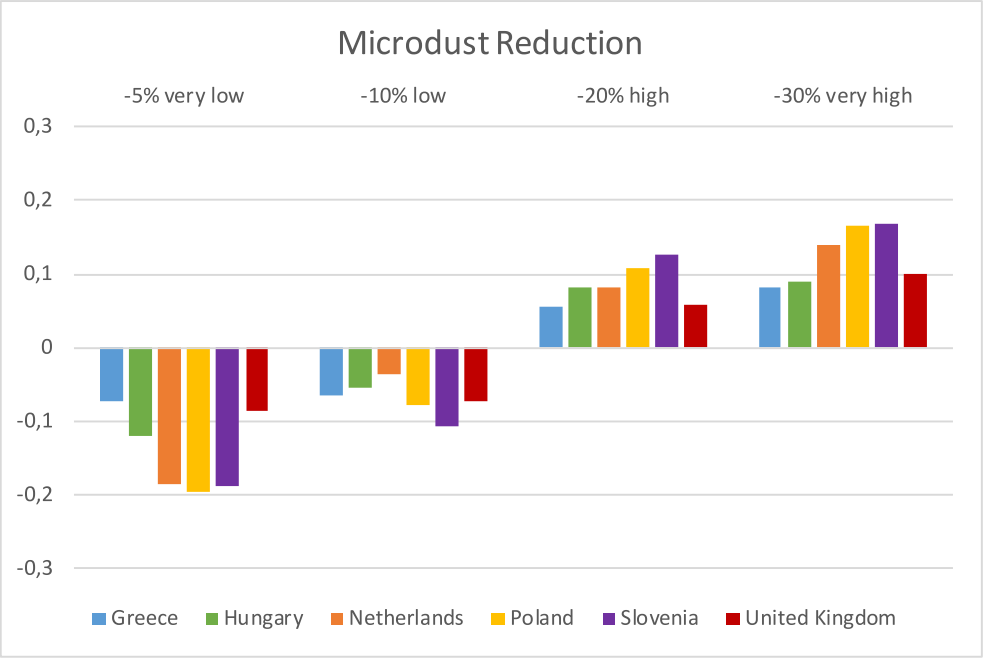

Fig. 5. Part-worth utility – microdust reduction.

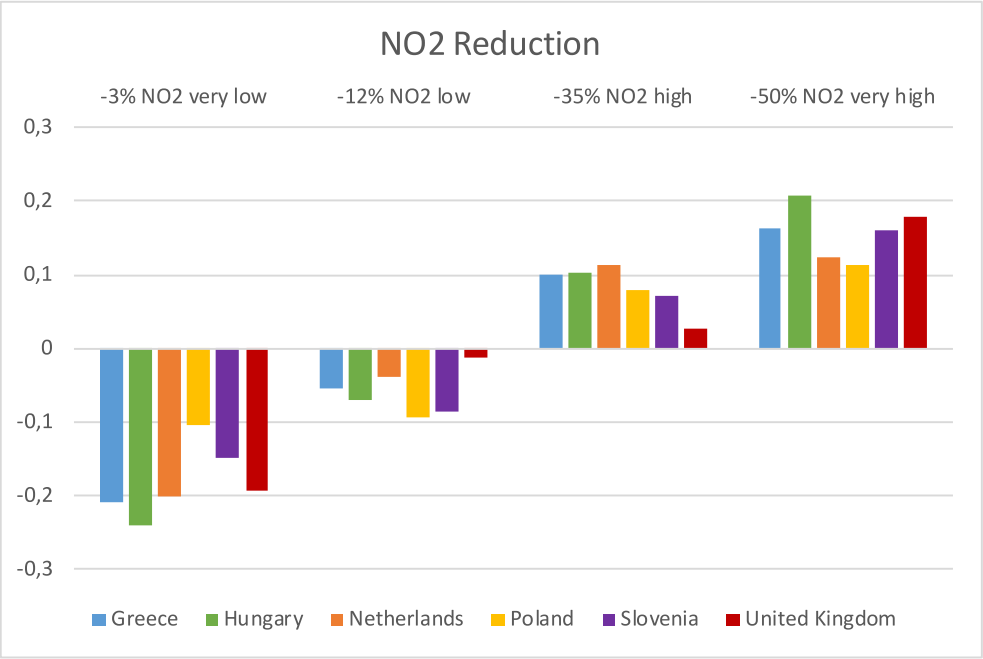

Fig. 6. Part-worth utility – NO_2 reduction.

days) and Slovenia (40 % have experienced heatwaves, average 19 days) who reported more experiences with heatwaves.

The experience with heatwaves and hot days explains the temperature reduction preferences (see Fig. 4). Comparing the results between the UK and Greece, it can be inferred that the Greek respondents have a greater interest in temperature reduction than the UK respondents because they are more exposed to heat. However, it must also be considered that proposed nature-based solutions are more likely to get accepted with higher environmental benefits including NO_2 and microdust reduction. The presented decision support system only applied moderate improvements in the given example.

When a nature-based solution addresses local needs felt by the citizens, be it heat or air quality, the citizens demonstrate greater acceptance, even if it the costs are higher or accessibility is worse. To achieve acceptance, planners and practitioners must be able to identify the urban resident's greatest health and wellbeing concerns and choose nature-based solutions which will address them. The expected effects on health and wellbeing should be communicated in the planning process, because the effectiveness has a significant positive influence on the acceptance; even though the influence differs between the countries as the results show.

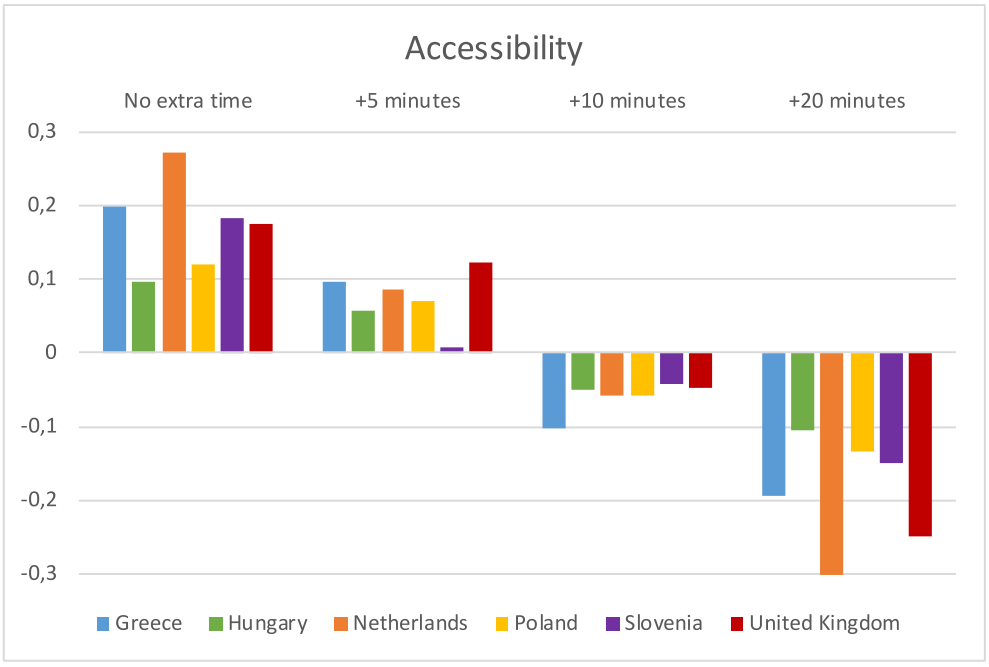

Fig. 7. Part-worth utility – accessibility.

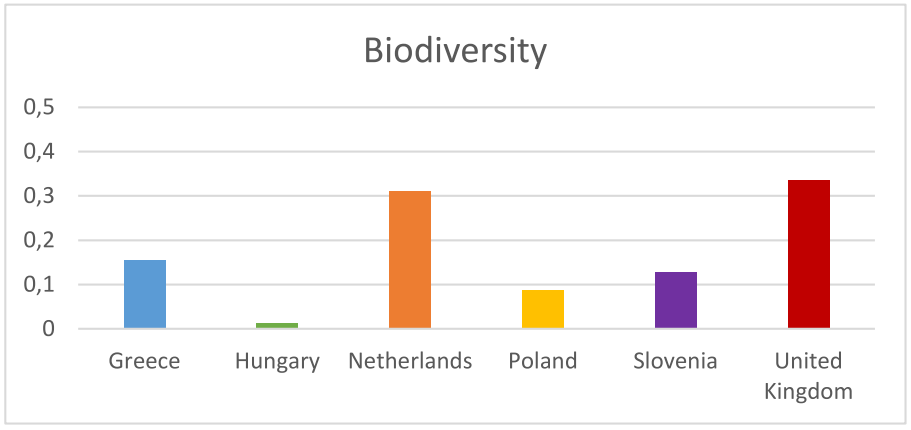

Fig. 8. Part-worth utility – biodiversity.

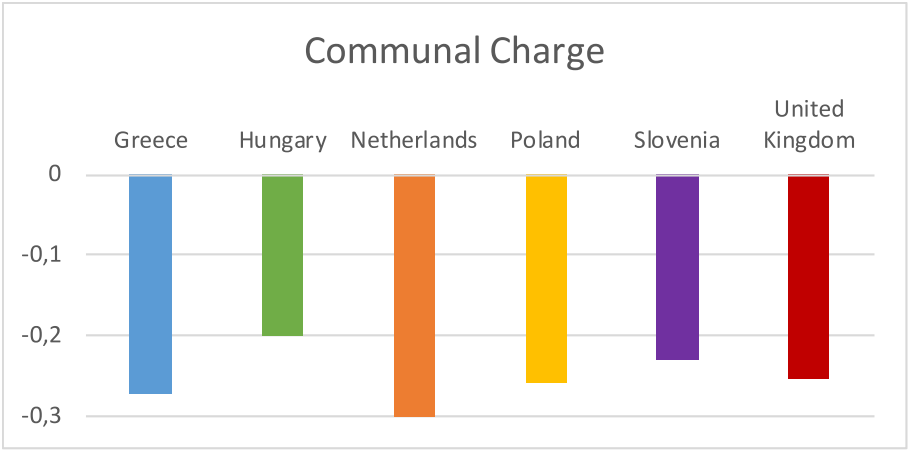

Fig. 9. Part-worth utility – communal charge.

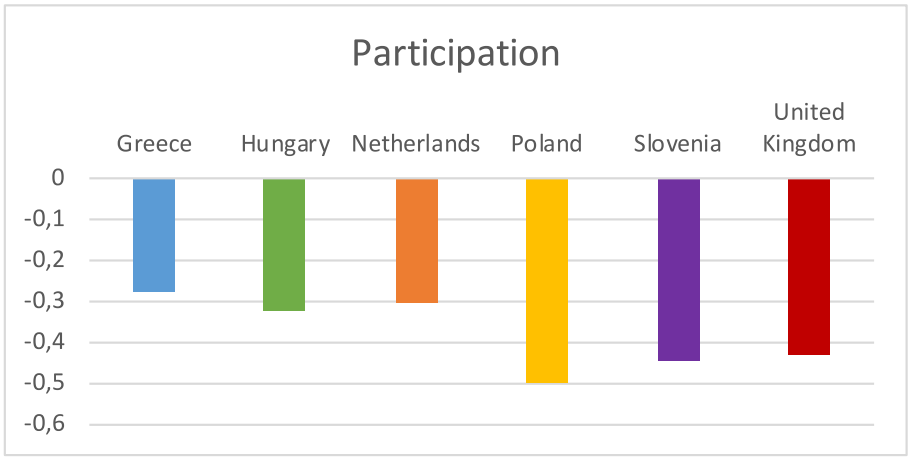

Fig. 10. Part-worth utility – participation.

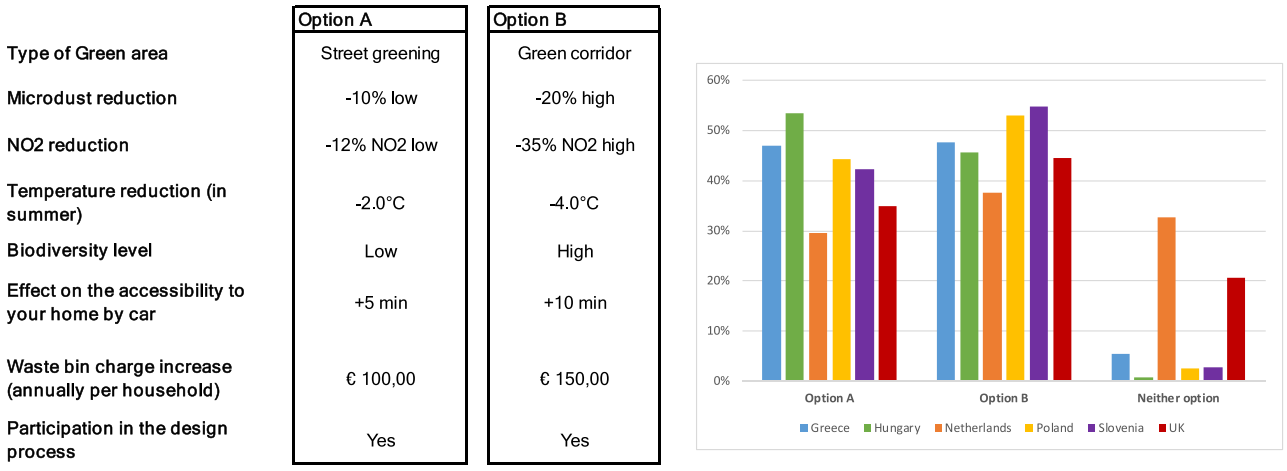

Fig. 11. Decision support tool illustrating described setting in A (street greening) and B (green corridor) and the related trade-off scenario for the respondents from different countries.

Table 4
Scenario decisions by country; different type of green area.

Choice	Option A =	Option B =	for neither
Country	Street greening with limited environmental effects, little impact on access, low biodiversity level and lower costs, participation	Green corridor with higher environmental effects, moderate effect on access, high biodiversity level, and higher costs, participation	
Greece	57 %	48 %	5 %
Hungary	54 %	46 %	1 %
The Netherlands	30 %	38 %	33 %
Poland	44 %	53 %	3 %
Slovenia	42 %	55 %	3 %
United Kingdom	35 %	44 %	21 %

5.3. Urban design and car dependency

New nature-based solutions and new urban design significantly depend on the respective mobility patterns (Gühnemann et al., 2021). Current concepts for sustainable urban development try to reduce car dependency and create new green spaces where parking lots and streets used to be. Recent research reports an increase in car-free households in cities (Zurich 52 %, Berlin 51 %, London 40 %, Vienna 42 %) offering new development options (Gühnemann et al. 2021). The car ownership per household may also reflect the presence or absence of public transportation means and current car-friendly urban design. Car ownership in this study differed, with 9–22 % of the households not owning a car at all (Table 2). Greece (32.8 %) and Slovenia (35.5 %) had especially high percentages of second car ownership per household and 8.7 % of Slovenian household even indicating 3 or more cars. This information becomes interesting, when comparing car ownership to sensitivity to accessibility as it was tested in the choice experiment.

In Greece, participants indicate a higher sensitivity to accessibility as well as higher percentage of car ownership. Slovenian respondents on the other hand do not reflect the same sensitivity although they too have

Table 5
Scenario decisions by country; different type of green area and participation aspect.

Choice	Option A	Option B	for neither
Country	Street greening with limited environmental effects, little impact on access, low biodiversity level and lower costs, **without participation**	Green corridor with higher environmental effects, moderate impact on access, high biodiversity level, and higher costs, **with participation**	
Greece	34 %	60 %	7 %
Hungary	38 %	61 %	1 %
The Netherlands	19 %	43 %	38 %
Poland	23 %	74 %	4 %
Slovenia	23 %	73 %	4 %
United Kingdom	18 %	56 %	26 %

high car ownership. A higher dependency on their vehicle can be indicated through sensitivity to accessibility – the more they need their car to get around, the less likely they are to accept poorer access to it. It is logical then that Greece has both high levels of car ownership and is sensitive to accessibility. Similarly, both the Netherlands and the UK show heightened sensitivity to accessibility. The urban fabric is car oriented in these countries and requires a car (Argyriou, 2023; Hunter et al., 2021; Wiersma et al., 2015). Dependency is found especially in regard to commuting to work and less in regard to trips for daily needs such as grocery shopping which are often undertaken by foot, bike or public transport (Tiran et al., 2022; Wiersma et al., 2021). An outlier in the international comparison between ownership and sensitivity to accessibility is Slovenia, where the ownership of a second car is highest at 35.5 %, yet they are less sensitive to accessibility then the aforementioned countries. Presumably, this is due to most of the urban population in the data living in either Maribor or Ljubljana which have good public transportation services (Tiran et al., 2022), as the survey was directed at cities with a population greater than 20,000 of which there are not many in Slovenia.

Overall, the tendencies of transportation studies which find that car dependency decreases with improved access to alternatives (Tiran et al., 2022; Wiersma et al., 2021) are recognized here as well. To reduce the negative effects of using parking or car-related areas in cities for nature-based solution implementation, the dependency on cars (especially for commuting) must be reduced and sustainable transportation close and easy to use. Considering these findings, the second hypothesis was confirmed: Car dependency and design of the nature-based solution have a significant influence on decision making.

5.4. Income level and willingness to pay

As proposed by the choice experiment scenario, investments in nature-based solutions could be partially carried by a communal charge, in which case citizen's willingness to pay must be determined. As Hagedoorn et al. (2021) found: There are instances in which a nature-based solution is valued, but the means of payment are low even if the willingness to pay in other forms (such as time) are present. Therefore, income and price sensitivity must be analysed in an integrated manner.

The median incomes obtained in the sample reflected those of the OECD statistics on household income (OECD, 2023) in all countries except Hungary, where the sample had slightly lower levels of income. The highest earners are from the United Kingdom and the Netherlands (median monthly income between 2,000 EUR and 3,000 EUR), with Greece, Poland and Slovenia falling in the mid-range (1,000–2,000 EUR), followed by Hungary (500–1,000 EUR).

The difference in income and willingness to pay may also be due to the exposure to climate change effects. In the Netherlands and the United Kingdom, exposure to heat in urban environments is not as drastic as in southern Europe. Iungman et al. (2023) also showed the varying degrees of exposure to urban heat islands followed a similar pattern. With less exposure to the issue (e.g. high temperatures or poor air quality), there is less willingness to pay for the improvement of a factor deemed irrelevant to themselves, regardless of income levels.

Greece demonstrates both lower income and higher price sensitivity. Following Hagedoorn et al. (2021) the lower willingness to pay is linked to lower income. Hungary, Slovenia and Poland also have lower income levels, do not show the same price sensitivity, indicating that these countries have a high willingness to pay, most likely due to their exposure to issues on air quality and high temperatures. Finally, the Netherlands and the United Kingdom have higher income but are more price sensitive, meaning that their willingness to pay is low. The reason for this is likely linked to the mild temperatures and low exposure to poor air quality (Iungman et al., 2023). Changing environmental conditions in the two countries in the future may change their perception and their willingness to contribute.

The final hypothesis is confirmed in that the willingness to pay does

not depend on average income. The results of the study at hand confirm previous findings (Hagedoorn et al., 2021; Iungman et al., 2023), since they indicate that the willingness to pay is linked to the exposure on one hand and the effectiveness of nature-based solutions on the other.

5.5. Further research steps and application of the findings

Urban citizens are not homogenous across countries and this is also true for the urban population within a country. Next research steps will concentrate on deeper analysis of the national datasets. Possible segmentation in each nation will give insight into decision making of different segments. Similar studies (Pröbstl-Haider & Feilhammer, 2023) have shown that female respondents with children living in dense urban districts prefer the establishment of communal gardens for example. The accessibility of the home is also likely to differ in urban areas and require a detailed segmentation. Additional data analysis will make it possible to tailor the findings to the specific situation within UPSURGE demo cities. Furthermore, the segmentation might help adapt the findings to other projects in Europe.

6. Conclusions

Within this conceptional approach, focus is laid on assessment tools and trade-offs as a key element of participatory planning processes in cities. This research supports the planning phase of nature-based solutions by providing a survey on trade-offs between different opportunities tailored to reflect the situation in six countries. By applying an innovative questionnaire design with a choice experiment, the aim is to assist the public participation processes by helping planning teams define priorities and design governance measures.

Understanding citizens' interest in supporting the use of nature-based solutions is crucial to proceed with this sustainable development strategy in European cities. The research has demonstrated that there is no cookie cutter solution across Europe. Not only the exposure to climate change but also the spatial concept, urban culture and availability of public means differ across the continent. Therefore, nature-based solutions need to be tailored based on social science to fit to local requirements.

CRediT authorship contribution statement

Ulrike Pröbstl-haider: Writing – original draft, Funding acquisition, Conceptualization. **Alice Wanner:** Writing – original draft, Visualization, Project administration, Methodology, Formal analysis. **Magdalena Feilhammer:** Methodology, Formal analysis. **Nina Mostegl:** Software, Methodology. **Kornelia Dabrowska:** Software, Methodology.

Data availability

Supplementary Material

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.landurbplan.2024.105189.

References

Albert, C., Schröter, B., Haase, D., Brillinger, M., Henze, J., & Herrmann, S. (2019). Addressing societal challenges through nature-based solutions: How can landscape planning and governance research contribute? *Landscape and Urban Planning, 182*, 12–21. https://doi.org/10.1016/j.landurbplan.2018.10.003

Argyriou, I. (2023). A Political economy and multi-stakeholder perspective of net-zero emission urban bus transportation in the United Kingdom. *Future Transportation, 3* (2), 429–456. https://doi.org/10.3390/futuretransp3020026

Augusto, B., Roebeling, P., Rafael, S., Ferreira, J., Ascenso, A., & Bodilis, C. (2020). Short and medium- to long-term impacts of nature-based solutions on urban heat. *Sustainable Cities and Society, 57*, Article 102122. https://doi.org/10.1016/j.scs.2020.102122

Auspurg, K., & Liebe, U. (2011). Choice-Experimente und die Messung von Handlungsentscheidungen in der Soziologie. *KZfSS Kölner Zeitschrift Für Soziologie Und Sozialpsychologie, 63*(2), 301–314. https://doi.org/10.1007/s11577-011-0136-3

Badura, T., Krkoška Lorencová, E., Ferrini, S., & Vačkářová, D. (2021). Public support for urban climate adaptation policy through nature-based solutions in Prague. In S. 215 (Ed.), *Landscape and Urban Planning* (p. 104215). https://doi.org/10.1016/j.landurbplan.2021.104215

Bateman, I., Carson, R., Day, B., Hanemann, M., Hanley, N., Hett, T., … Loomes, G. (2002). *Economic Valuation with States Preference Techniques*. Edward Elgar Publishing.

Bell, S., Simpson, M., Tyrväinen, L., Sievänen, T., & Pröbstl, U. (2009). *European forest recreation and tourism: A handbook*. Taylor & Francis.

Bilendi & respondi (2024) Homepage. Online: https://www.bilendi.de/.

Ben-Akiva, M. E., & Lerman, S. R. (1985). *Discrete choice analysis: theory and application to travel demand*. MIT press.

Chen, H.-S., Lin, Y.-C., & Chiueh, P.-T. (2023). Nexus of ecosystem service-human health-natural resources: The nature-based solutions for urban PM2.5 pollution. *Sustainable Cities and Society, 91*, Article 104441. https://doi.org/10.1016/j.scs.2023.104441

Cohen-Shacham, E., Andrade, A., Karangwa, C., & Maginnis, S. (2024) Proposing the IUCN Global Standard for NbS as the main operational framework to implement UNEA Resolutions 5/5 on NbS for supporting Sustainable Development.

Cortinovis, C., & Geneletti, D. (2018). Ecosystem services in urban plans: What is there, and what is still needed for better decisions. In: *Land Use. Policy, 70*, 298–312. https://doi.org/10.1016/j.landusepol.2017.10.017

Croeser, T., Garrard, G. E., & Visintin, C. (2022). Finding space for nature in cities: The considerable potential of redundant car parking. *NPJ Urban Sustain, 2*, 27. https://doi.org/10.1038/s42949-022-00073-x

Da Schio, N., Pelgrims, C., Cincinnato, S., & Vandenbroucke, A. (2021) Between Green Spaces and Mobility: Exploring diverging perspectives on the admission of motorised traffic in the Bois de la Cambre. Online: https://bsi.brussels/wp-content/uploads/sites/2/2021/05/Between-Green-Spaces-and-Mobility-2021-2-1.pdf.

Dorst, H., van der Jagt, A., Toxopeus, H., Tozer, L., Raven, R., & Runhaar, H. (2022). What's behind the barriers? Uncovering structural conditions working against urban nature-based solutions. *Landscape and Urban Planning, 220*, S. 104335. https://doi.org/10.1016/j.landurbplan.2021.104335

Eckersley, S., & Vos, C. (2023). *Diversity of belonging in Europe: Public spaces, contested places, cultural encounters*. *Critical Heritages of Europe*. Routledge. doi: 10.4324/9781003191698.

European Commission. (2022). *Nature-based solutions*. https://research-and-innovation.ec.europa.eu/research-area/environment/nature-based-solutions_en.

Frantzeskaki, N. (2019). Seven lessons for planning nature-based solutions in cities. In. *Environmental Science & Policy, 93*, 101–111. https://doi.org/10.1016/j.envsci.2018.12.033

Garcia-Llorente, M., Martín-Ĺopez, B., Nunes, P. A. L. D., Castro, A. J., & Montes, C. (2012). A choice experiment study for land-use scenarios in semi-arid watershedenvironments. *J. Arid Environ, 87*, 219–230. https://doi.org/10.1016/j.jaridenv.2012.07.015

Gühnemann, A., Kurzweil, A., & Mailer, M. (2021). Tourism mobility and climate change - A review of the situation in Austria. *Journal of Outdoor Recreation and Tourism, 34*, 100382. https://doi.org/10.1016/j.jort.2021.100382

Hagedoorn, L. C., Koetse, M. J., & van Beukering, P. J. H. (2021). Estimating benefits of nature-based solutions: Diverging values from choice experiments with time or money payments. *Frontiers in Environmental Science, 9*, Article 686077. https://doi.org/10.3389/fenvs.2021.686077

Hein, C. (2018). *The Routledge handbook of planning history*. *Routledge handbooks*. Routledge, Taylor et Francis Group. doi: 10.4324/9781315718996.

Hensher, D. A. (2006). How do respondents process stated choice experiments? Attribute consideration under varying information load. *Journal of Applied Econometrics, 21*(6), 861–878. https://doi.org/10.1002/jae.877

Herrmann, T. (2023). Freiraum und Mobilität. *Landschaftsarchitekten*(2).

Hunter, R. F., Cleland, C. L., Kee, F., Longo, A., Murtagh, B., Barry, J., McKeown, G., & Garcia, L. (2021). Developing system-oriented interventions and policies to reduce car dependency for improved population health in Belfast: Study protocol. *Systems, 9* (3), 62. https://doi.org/10.3390/systems9030062

Iungman, T., Cirach, M., Marando, F., Pereira Barboza, E., Khomenko, S., Masselot, P., Quijal-Zamorano, M., Mueller, N., Gasparrini, A., Urquiza, J., Heris, M., Thondoo, M., & Nieuwenhuijsen, M. (2023). Cooling cities through urban green infrastructure: A health impact assessment of European cities. *Lancet (London, England), 401*(10376), 577–589. https://doi.org/10.1016/S0140-6736(22)02585-5

Kabisch, N., Frantzeskaki, N., Pauleit, S., Naumann, S., Davis, M., & Artmann, M. (2016). Nature-based solutions to climate change mitigation and adaptation in urban areas: Perspectives on indicators, Knowledge gaps, barriers, and opportunities for action. *E&S, 21*(2). https://doi.org/10.5751/ES-08373-210239

Kabisch, N., Korn, H., Stadler, J., & Bonn, A. (2017). *Nature-based solutions to climate change adaptation in urban areas*. Cham: Springer International Publishing.

Kemperman, A. (2021). A review of research into discrete choice experiments in tourism: Launching the Annals of Tourism Research Curated Collection on Discrete Choice

Experiments in Tourism. *Annals of Tourism Research, 87*, Article 103137. https://doi.org/10.1016/j.annals.2020.103137
Kertesz, R., Schuster, W., & Green, O. O. (2014). Modeling the hydrologic and economic efficacy of stormwater utility credit programs for US single family residences. *Water Science & Technology, 70*(11), 1746–1754.
Klingberg, J., Broberg, M., Strandberg, B., Thorsson, P., & Pleijel, H. (2017). Influence of urban vegetation on air pollution and noise exposure - A case study in Gothenburg, Sweden. *The Science of the Total Environment, 599–600*, 1728–1739. https://doi.org/10.1016/j.scitotenv.2017.05.051
Khoury-Nolde, N., Nolde, N. (2020), Rainwater fees for a fair and sustainable rainwater management, in: https://programme2014-20.interreg-central.eu/Content.Node/D.C.2.4-Fair-rainwater-fees-for-a-sustainable-RWM-(2)-(1).pdf.
Kumar, P., Zavala-Reyes, J. C., Tomson, M., & Kalaiarasan, G. (2022). Understanding the effects of roadside hedges on the horizontal and vertical distributions of air pollutants in street canyons. *Environment International, 158*, Article 106883. https://doi.org/10.1016/j.envint.2021.106883
Lafortezza, R., Chen, J., van den Bosch, C. K., & Randrup, T. B. (2018). Nature-based solutions for resilient landscapes and cities. *Environmental Research, 165*, 431–441. https://doi.org/10.1016/j.envres.2017.11.038
Lelieveld, J., Pozzer, A., Pöschl, U., Fnais, M., Haines, A., & Münzel, T. (2020). Loss of life expectancy from air pollution compared to other risk factors: A worldwide perspective. *Cardiovascular Research, 116*(11), 1910–1917. https://doi.org/10.1093/cvr/cvaa025
Li, P., & Wang, Z.-H. (2021). Environmental co-benefits of urban greening for mitigating heat and carbon emissions. *Journal of Environmental Management, 293*, Article 112963. https://doi.org/10.1016/j.jenvman.2021.112963
Longato, D., Cortinovis, C., Balzan, M., & Geneletti, D. (2023). A method to prioritize and allocate nature-based solutions in urban areas based on ecosystem service demand. *Landscape and Urban Planning, 235*, Article 104743. https://doi.org/10.1016/j.landurbplan.2023.104743
Louviere, J. J., Hensher, D. A., & Swait, J. D. (2005). *Stated choice analysis and applications*. Cambridge University Press.
Maćkiewicz, B., & Asuero, R. P. (2021). Public versus private: Juxtaposing urban allotment gardens as multifunctional nature-based solutions. Insights from Seville. *Urban Forestry & Urban Greening, 65*, Article 127309. https://doi.org/10.1016/j.ufug.2021.127309
Mahmoud, I. H. (2022). *Greening Cities Shaping Cities: Pinpointing Nature-Based Solutions in Cities between Shared Governance and Citizen Participation*. MDPI Books. doi: 10.3390/books978-3-0365-4704-6.
Moreau, C., Cottet, M., Rivière-Honegger, A., François, A., & Evette, A. (2022). Nature-based solutions (Nature-based solution): A management paradigm shift in practitioners' perspectives on riverbank soil bioengineering. *Journal of Environmental Management, 308*, Article 114638. https://doi.org/10.1016/j.jenvman.2022.114638
Nóblega-Carriquiry, A., March, H., & Sauri, D. (2022). Community acceptance of nature-based solutions in the delta of the Tordera River, Catalonia. *Land, 11*(4), 579. https://doi.org/10.3390/land11040579
NRDC (2018) Making it rain: Effective stormwater fees can create jobs, build infrastructure and drive investment in local communities. Natural Resources Defense Council (NRDC) Issue Brief April 2018 (IB: 18-03-A).
OECD. (2023). *Average annual wages*. https://stats.oecd.org/Index.aspx?DatasetCode=AV_AN_WAGE.
Orlove, B., Shwom, R., Markowitz, E., & Cheong, S.-M. (2020). Climate decision-making. *Annual Review of Environment and Resources, 45*(1), 271–303. https://doi.org/10.1146/annurev-environ-012320-085130
Pröbstl, U., Wirth, V., Elands, B. H. M., & Bell, S. (2010). *Management of Recreation and Nature Based Tourism in European Forests*. Springer Berlin Heidelberg. doi: 10.1007/978-3-642-03145-8.
Pröbstl-Haider, U., & Feilhammer, M. (2023). *City Green - Klimawandelanpassung durch Erhöhung des Stadtgrüns. Endbericht von StartClim2022: StartClim2022: Schlüsselmaßnahmen, Messbarkeit und Notfallszenarien*.
Ritter, C., & Tönnes, M. (2023). gemeint: Freiraum durch Mobilität statt Autos. *Landschaftsarchitekten*(2), 3–5. https://www.bdla.de/de/dokumente/bundesverband/freiraumplanung-und-staedtebau/1626-schwerpunkt-freiraum-und-mobilitaet-bdla-verbandszeitschrift-02-2023/file.
Pröbstl-Haider, U., Mostegl, N. M., & Haider, W. (2020). Small-scale private forest ownership: Understanding female and male forest owners' climate change adaptation behaviour. In: *Forest Policy and. Economics, 112*, 102111. https://doi.org/10.1016/j.forpol.2020.102111
Sarabi, S., Han, Q., de Vries, B., & Romme, A. L. (2022). The nature-based solutions planning support system: A playground for site and solution prioritization. *Sustainable Cities and Society, 78*, Article 103608. https://doi.org/10.1016/j.scs.2021.103608
SAS Institute Inc. (2013) SAS/ACCESS 9.4. Cary, NC, USA.
Scherer, D., Fehrenbach, U., & Lakes, T. (2014). Quantification of heat-stress related mortality hazard, vulnerability and risk in Berlin, Germany. *Gesellschaft für Erdkunde zu Berlin*. https://doi.org/10.12854/erde-144-17
Tasca, F. A., Finotti, A., & Goerl, R. F. (2019). A stormwater user fee model for operations and maintenance in small cities. *Water Science & Technology, 79*(2).
Tiran, J., Razpotnik Visković, N., Gabrovec, M., & Koblar, S. (2022). A spatial analysis of public transport accessibility in Slovenia. *Urbani Izziv, 33*(1), 105–121. https://doi.org/10.5379/urbani-izziv-en-2022-33-01-04
Train, K. (2009). *Discrete Choice Methods with Simulation* (2nd edition). Cambridge University Press.
UPSURGE. (2022). *The project*. https://www.upsurge-project.eu/the-project/.
UPSURGE (2024a) Demo Cases: Breda Netherlands. https://www.upsurge-project.eu/demo-cases/breda-netherlands/.
UPSURGE (2024b) Demo Cases: Budapest, Hungary. https://www.upsurge-project.eu/demo-cases/budapest-hungary/.
UPSURGE (2024c) Demo Cases: Katowice, Poland. https://www.upsurge-project.eu/demo-cases/katowice-poland/.
Verband Wohneigentum (2022) Kostenfaktor "Regensteuer": Wie sich die Abwassergebühr senken lässt. Report from 22.9.2022. Online: https://www.wohneigentum.nrw/beitrag/kostenfaktor-regensteuer-wie-sich-die-abwassergebuehr-senken-laesst.
Wanner, A., & Pröbstl-Haider, U. (2019). Barriers to stakeholder involvement in sustainable rural tourism development—Experiences from Southeast Europe. *Sustainability, 11*(12), 3372. https://doi.org/10.3390/su11123372
Wanner, A., Pröbstl-Haider, U., & Feilhammer, M. (2022). NEW GREEN INFRASTRUCTURE FOR EUROPEAN CITIES: MULTIPLE WAYS FOR IMPROVEMENT AND CLIMATE CHANGE ADAPTATION. In: S. Hernández und J. L. Miralles i Garcia (Hg.): The Sustianable City XVI. SUSTAINABLE CITY 2022. Rome, Italy, 10/10/2022 - 10/12/2022: WIT PressSouthampton UK (WIT. *Transactions on Ecology and the Environment), S*, 121–133.
Wiersma, J., Bertolin, L., & Straatemeier, T. (2015). How does the spatial context shape conditions for car dependency? An analysis of the differences between and within regions in the Netherlands. *Journal of Transport and Land Use*. https://doi.org/10.5198/jtlu.2015.583
Wiersma, J., Bertolini, L., & Harms, L. (2021). Spatial conditions for car dependency in mid-sized European city regions. *European Planning Studies, 29*(7), 1314–1330. https://doi.org/10.1080/09654313.2020.1854691