ARSINOE
CLIMATE-RESILIENT REGIONS THROUGH SYSTEMIC SOLUTIONS AND INNOVATIONS

Title: Ecosystem Services, Preferences and the Design of Financial Instruments for Climate Change Adaptation

Deliverable 7.3: Financial instruments with variant maturities and carrying an acceptable level of risk

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LIST OF ABBREVIATIONS

AUEB	Athens University of Economics and Business
ESG	Environmental, Social and Governance
KPIs	Key Performance Indicators
SDGs	Sustainable Development Goals
CS	Case Study
TEEB	The Economics of Ecosystems and Biodiversity
ES	Ecosystem Services
TEV	Total Economic Value
GDP	Gross Domestic Product
GEP	Gross Ecosystem Product

EXECUTIVE SUMMARY

This deliverable is linked to ARSINOE Task 7.3. It is the third of five deliverables in Work Package 7 (WP7) which aims to provide support for the development of "financing pathways," meaning portfolios of financing solutions to support the innovation and adaptation pathways developed in ARSINOE.

The main objectives are:

- To identify the current state of play in EU regions, with a focus on ARSINOE's case studies (CS), in relation to the availability of financing sources and financial instruments (Task 7.1).
- To assess the extent to which stakeholders have access to or can effectively leverage financing sources/instruments to support their adaptation projects, including identifying barriers faced by the regions involved (Task 7.2).
- To design financial instruments that support the financing of transition pathways toward the vision of the case studies (Task 7.3).
- To develop a hybrid model to quantify and measure performance at the CS level. This model integrates the Sustainable Development Goals (SDGs) into the sustainability reporting and performance model, which is based on Environmental, Social, and Governance (ESG) criteria (Task 7.4).
- Ultimately, the outcome of these tasks will culminate in a "Manual for Sustainable Finance," which will combine the results of all previous tasks into tailored portfolios of financing solutions for each ARSINOE case study.

1.0 INTRODUCTION

1.1 Scope of the Deliverable

The scope of this deliverable is to:

- Outline the methodologies used to assess the economic values of intangible benefits/costs related to climate change, such as Contingent Valuation and Choice Experiments.
- Test innovative methodologies, including the implementation of a Virtual Reality environment, to assess the impact on stakeholders' demand functions related to climate change adaptation.
- Describe the financial instruments to be designed based on choice experiments and corresponding behavioral estimates. This includes detailing the varying maturities of the financial instruments to align with the different time horizons of climate change implications, as well as the acceptable level of risk for stakeholders.

1.2 Overview

This deliverable is structured as follows:

- Section 2 introduces the theoretical framework for the valuation of economic externalities and the design of Financial Instruments.
- Section 3 discusses the implementation of a choice experiment in the ARSINOE Athens Case Study
- Section 4 presents the design of the questionnaires and the implementation of the experiment following several techniques.

A list of references is provided, followed by an annex.

2.0 Valuation of Economic Externalities and Market Failures

2.1 Introduction

The importance of natural capital is widely acknowledged. It can be viewed as a stock of natural resources that generates a flow of benefits for both people and the economy. The products and services provided by natural capital, such as food, water, shelter, and climate regulation, are known as ecosystem services, which form the foundation of healthy lives and economic activities (HM Treasury, 2020). However, growing pressures from climate change and biodiversity loss are significantly reducing the availability of these services, creating substantial challenges and risks for both individuals and businesses.

The relationship between human, produced, and natural capital highlights that natural capital, often neglected in economic evaluations, is crucial for production and human well-being through the provision, regulation, and preservation of ecosystem services. People derive economic value from natural resources and the environment, though this value is not always reflected in market transactions. The Total Economic Value (TEV) of natural resources consists of both use and non-use values. Use value can either be market-based, such as for minerals, timber, or water, or non-market, such as outdoor recreation and landscape amenities. Non-use values, like the importance people place on specific habitats or species, also contribute to TEV.

Despite the clear significance of ecosystem service values, policymakers often overlook the economic and social benefits of environmental goods and services due to market failures. Many ecosystem services are not traded in markets and therefore lack a price. TEV represents the overall well-being derived from a policy, combining individuals' willingness to pay (WTP) for ecosystem services and their willingness to accept (WTA) the policy's effects.

Valuing ecosystem services is essential as it helps both the public and policymakers make more informed decisions. By doing so, policy decisions can better account for the costs and benefits related to the natural environment, as well as the broader impacts on human well-being. Valuing ecosystem services encourages policymakers to explore alternative policies that reflect the true value of nature's contributions.

The term "ecosystem services" itself reflects the connection between natural capital and the economy, representing the utility derived from ecosystems. However, existing metrics like Gross Domestic Product (GDP) only measure economic progress without accounting for benefits such as pollination, disaster mitigation, or regulatory functions of nature. This failure to recognize the total economic value of ecosystems, combined with the cycle of overproduction and overexploitation, has led to ecosystem degradation, threatening future growth and prosperity. Therefore, integrating the economic value of ecosystem services into mainstream public and private decision-making is vital to reversing ecosystem degradation.

The valuation of natural capital plays a crucial role in addressing economic externalities and market failures by assigning a quantifiable value to the benefits derived from ecosystems. Natural capital, which encompasses resources like forests, water, biodiversity, and soils, provides essential goods and services often referred to as ecosystem services. These services, such as air purification, water filtration, and carbon sequestration, significantly contribute to human well-being and economic activity. However, many of these benefits are not traded in markets, leading to externalities where the true social costs or benefits are not reflected in market prices (Costanza et al., 1997). The absence of a clear market value for these services often results in their underappreciation and overexploitation, contributing to environmental degradation and the depletion of natural capital (TEEB, 2010).

This inability of markets to price natural capital correctly is a classic case of market failure. Externalities arise when the environmental costs, such as pollution or loss of biodiversity, are not accounted for in economic transactions. For example, industries that emit greenhouse gases contribute to climate change, but the associated costs—such as rising sea levels and more frequent natural disasters—are borne by society rather than the polluters (Stern, 2007). Valuing natural capital helps internalize these externalities by making the invisible costs of environmental degradation visible to policymakers and businesses. This approach can lead to more sustainable economic decision-making, where the environmental and social costs of exploiting natural capital are weighed against short-term economic gains (Dasgupta, 2021). By incorporating the value of ecosystem services into public and private sector decision-making, governments can design better regulations, taxes, or subsidies to mitigate market failures and protect natural capital for future generations.

2.2 Valuation of Ecosystem services

In other words, maintaining biodiversity ensures that the stock of natural capital remains stable, which allows for the continued flow of ecosystem services essential to both current and future human prosperity (TEEB, 2010). Ecosystem services (ES) are the end products or outcomes that have direct and indirect effects on human well-being, making them compatible with economic strategies. As Daily (1997) describes, ecosystem services are "the conditions and processes through which natural ecosystems, and the species within them, sustain and enhance human life." Similarly, Costanza et al. (1997) define them as the "benefits that human populations derive, directly or indirectly, from ecosystem functions."

The Millennium Ecosystem Assessment (MA, 2005) identified four main categories of ecosystem services. These categories, along with their sub-categories, are as follows:

- Provisioning services: These are products obtained from ecosystems, such as water, food, and fiber.
- Regulating services: These services provide benefits through the regulation of ecosystem processes, such as climate regulation, water regulation, and pollination.

- Cultural services: These are non-material benefits that people gain from ecosystems, including recreation, aesthetics, spirituality, religious practices, and cultural heritage.
- Supporting services: These are fundamental services required to sustain all other ecosystem services, such as nutrient cycling, soil formation, and primary production.

Valuing ecosystem services is the final stage in a comprehensive and often detailed process of assessing the impact of a policy change on these services. The selection of an appropriate valuation method depends on the type of ecosystem service in question, as well as the availability and quality of data. Ecosystem services are critically important because they provide both direct and indirect value to humans. The concept of Total Economic Value (TEV) captures the full range of ways in which ecosystem services contribute to both tangible and intangible benefits, ultimately enhancing human well-being. Figure 1 illustrates the broader categories of value, considering both the use and non-use values that individuals and society derive or lose due to changes in ecosystem services. Since many ecosystem services are not traded in conventional markets, they do not have a defined price. Therefore, non-market valuation methods are needed to estimate their worth.

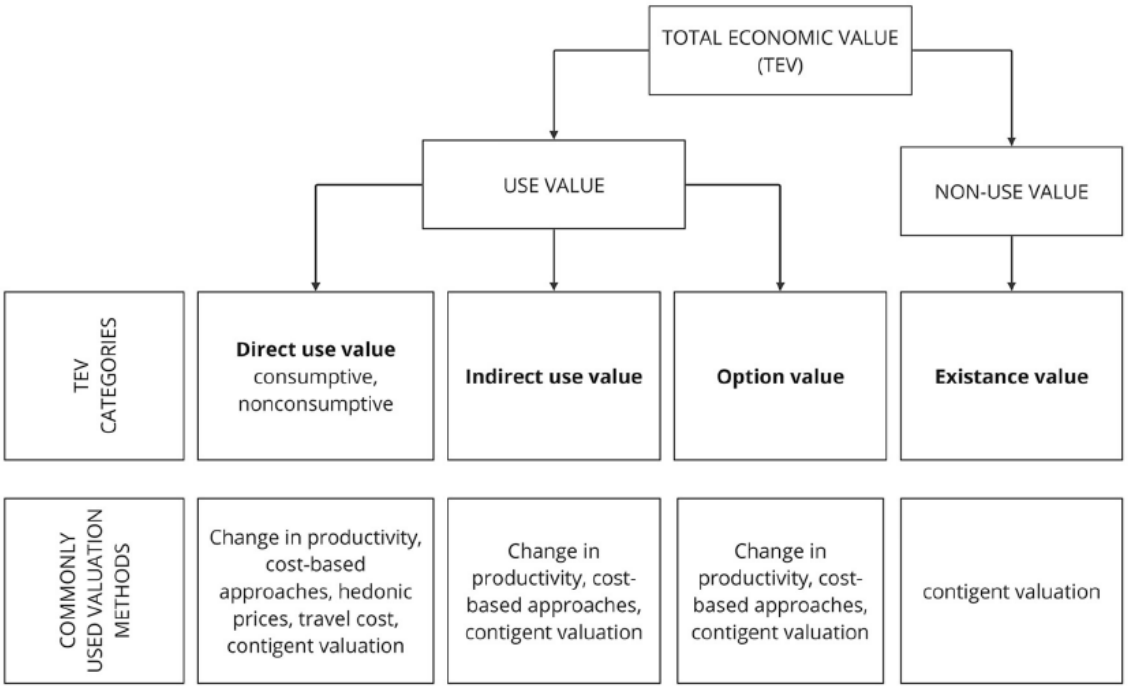


Figure 1 The total economic value framework. Source: Millennium Assessment

Use value refers to the benefits derived from direct or indirect human use of ecosystem services. This includes: (i) direct use value, where people intentionally utilize resources from ecosystems, such as for food, water, or timber; (ii) indirect use value, where benefits are enjoyed without directly using resources, like water regulation; and (iii) option value, which represents the potential future use of ecosystem services, highlighting the importance of preserving natural resources. In contrast, non-use value is based on the

appreciation of the mere existence of these ecosystem services, regardless of whether they are used.

The concept of TEV was first introduced into ecological economics by Pearce and Turner (1991) and has since become increasingly influential. Turner et al. (2003) emphasizes the importance of assessing the economic value of environmental resources to guide the development of policies that account for sustainability. They argue that evaluating the marginal effects of changes in ecosystem services and balancing these against economic factors that people care about, is crucial for sound decision-making. However, the authors also acknowledge the limitations of the TEV approach, particularly that marginal values—rather than the total "stock" value of ecosystem services—are what influence policy decisions. Additionally, they point out potential challenges, such as the risk of misapplying results from site-specific studies, double-counting ecosystem services, and conflicts between short-term and long-term priorities among stakeholders when considering increases in TEV.

The Total Economic Value (TEV) framework, along with developments in ecosystem service valuation over the past 25 years, has made substantial contributions to both scientific research and policymaking, helping to bridge the gap between economics and ecology (Costanza et al., 2017). However, to fully appreciate the value of ecosystem services, it is essential to understand the intricate connections between natural capital and traditional economic inputs, moving beyond simplistic GDP measures (Costanza et al., 2014). To create a more comprehensive measure of well-being, Ouyang et al. (2020) introduced the concept of Gross Ecosystem Product (GEP), which translates the value of ecosystem services into monetary terms. This metric applies market prices and proxies for non-market prices to estimate the economic value of ecosystem services, allowing for a clearer understanding of ecosystems' contributions to the economy. Where direct market values are not available, non-market valuation methods are used to estimate people's Willingness to Pay (WTP) for these services.

TEV represents the total welfare benefits derived from a policy change, incorporating both people's WTP and their Willingness to Accept (WTA) compensation for ecosystem-related impacts (DEFRA, 2007). The goal is to capture the overall economic value of marginal changes in ecosystem services. The economic valuation of ecosystem services primarily focuses on understanding how changes in these services impact individual welfare. The benefits and costs associated with ecosystem services are expressed in monetary terms, based on the principles of WTP and WTA. Although the natural environment provides significant value to human well-being, its absence from market transactions often leads to its neglect in policy discussions. Assigning monetary value to ecosystem goods and services is therefore crucial to ensure they are considered in decision-making processes.

These techniques rely on understanding how changes in the quality or quantity of natural resources influence people's behavior, either through direct responses or observed actions. Among the most widely used non-market valuation approaches are revealed preference and stated preference

methods. Stated preference techniques include contingent valuation and choice modeling, while revealed preference methods, frequently employed in empirical research, include travel-cost models, random utility models, hedonic pricing, and production function models. These techniques offer policymakers tools to quantify the true value of ecosystem services, ensuring that environmental goods are recognized as crucial components of human welfare.

2.3 Non-Market Valuation Methods

Non-market valuation methods are approaches employed to assess the economic value of goods and services that are not exchanged in markets, including ecosystem services. These techniques are essential for quantifying environmental benefits that do not have a market price. Figure 2 outlines the most utilized models and econometric methods. Major techniques include contingent valuation, which involves directly asking individuals of their WTP for specific environmental services; hedonic pricing, which derives value from related market items, such as property values influenced by environmental quality; the travel cost method, which assesses the value of recreational locations based on travel expenses incurred to reach them; and benefit transfer, which uses valuation estimates from previous studies in similar contexts to apply them to new situations.

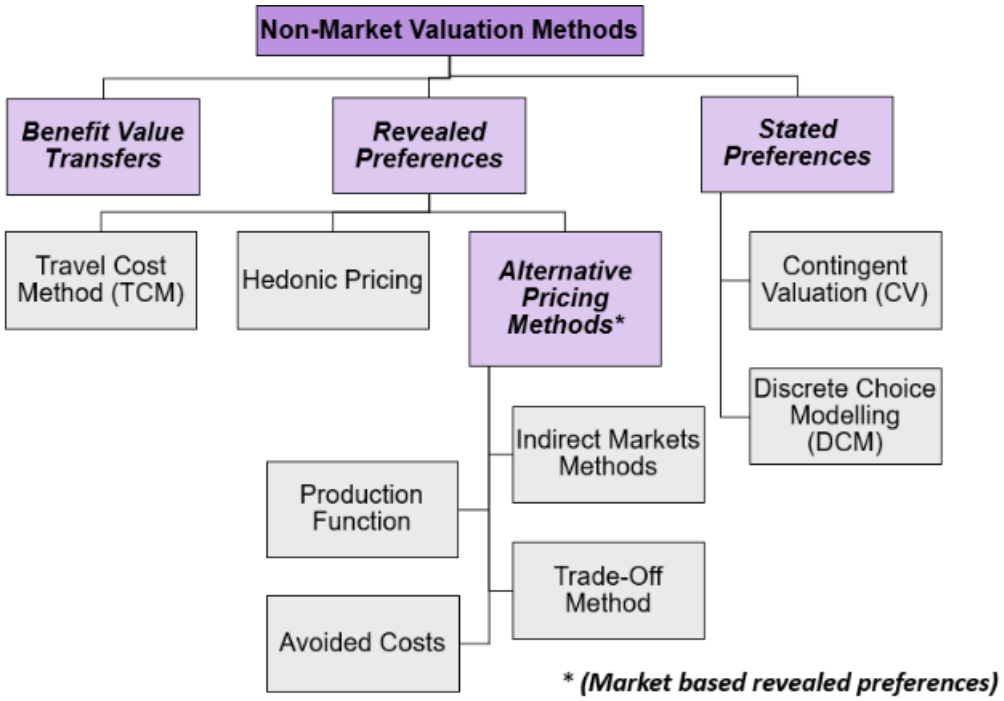


Figure 2 Econometric Techniques used in the valuation of ES. Source: University of Queensland

2.3.1 Revealed preference methods

Revealed preference methods, also referred to as indirect valuation methods, seek to identify related or surrogate markets where ecosystem services are implicitly valued (i.e., as components of a good purchased by consumers). Information obtained from observed behaviors in these surrogate markets is utilized to estimate willingness to pay (WTP), reflecting individuals'

valuation of or the benefits derived from the ecosystem service. Two common methods found in environmental economics are hedonic pricing and the travel cost method. These approaches are effective for valuing ecosystem services that are indirectly marketed, allowing for the estimation of their direct and indirect use values.

The hedonic pricing method (HPM) is founded on Lancaster's characteristics theory of value (Lancaster, 1966), which asserts that any good can be understood as a combination of characteristics and their varying levels, with the price of the good being influenced by these attributes. This method is frequently employed to examine variations in housing prices that reflect the value of local ecosystem services. The price of a home incorporates its relevant features, such as the number of bedrooms, bathrooms, size, nearby schools, and crime rates, along with local environmental factors like air quality, noise levels, and aesthetic views.

Consequently, an implicit price can be assigned to each characteristic, allowing for the statistical identification of an implicit marginal WTP, which indicates an individual's valuation of an additional unit of the ecosystem service. However, a limitation of the HPM is that it primarily captures the direct use values of ecosystem services as perceived by consumers of the goods being implicitly traded. Services such as flood control, habitat provision, and other ecological benefits may yield value for individuals who are not directly involved in the consumption of those goods, which the HPM fails to account for (Boyer and Polasky, 2004).

The travel cost method (TCM) is employed to estimate the use values linked to ecosystems or locations (such as forests, wetlands, parks, and beaches) that people visit for recreational activities like hunting, fishing, hiking, or wildlife observation. The fundamental concept of the TCM is that the time and travel expenses incurred by individuals to reach a site serve as the "price" for accessing that location. Consequently, individuals' willingness to pay (WTP) for visiting the site can be inferred from the frequency of trips made at varying travel costs. This is determining WTP for a marketed good based on the quantity demanded at different prices. The TCM includes various models, from the straightforward single-site TCM to more comprehensive regional and generalized models that incorporate quality indices and consider substitute sites (CGER, 1997).

This method can assess the economic benefits or costs arising from alterations in access expenses to a recreational area, the removal of an existing recreational site, the establishment of a new recreational site, and changes in environmental quality at a recreational location. However, there are several limitations associated with the TCM. Determining and quantifying the opportunity cost of time is challenging, as there is no strong consensus on an appropriate measure. Substitute sites are only considered in the random utility approach to TCM, which utilizes information about all potential sites a visitor might choose, their quality attributes, and the travel costs to each site. This method provides insights into the value of specific characteristics as well as the overall value of the site. However, the TCM is restricted to valuing goods consumed in situ and, like the HPM, it fails to capture the non-use values of ecosystem services. The TCM was initially proposed by

Hotelling (1931) and later refined by Clawson and Knetsch (1966).

Alongside the HPM and the TCM, there are additional revealed preference methods that are not as commonly applied in the valuation of ecosystem services; nonetheless, they can be beneficial in specific contexts, such as Avoided-Replacement Costs (Markandya et al., 2002), Production Function (Acharya and Barbier, 2002) and other Indirect Market Methods (CGER, 1997).

2.3.2 Stated preference methods

Stated preference methods (SPM), also known as direct valuation methods, have been designed to address the challenge of valuing environmental resources that are not traded in any market, including surrogate markets. Besides their capability to estimate the use values of various ecosystem services, the key advantage of these survey-based techniques is their ability to assess non-use values, allowing for the estimation of each component of Total Economic Value (TEV). Given that many outputs, functions, and services provided by ecosystems are not marketed, SPM can be employed to evaluate the economic benefits they generate.

The contingent valuation method (CVM) aims to capture individuals' preferences in monetary terms for changes in the quantity or quality of non-market environmental resources. With CVM, the valuation process is contingent on a hypothetical scenario where a sample population is surveyed and asked to express their maximum willingness to pay (WTP) or minimum willingness to accept (WTA) compensation for an increase or decrease in the level of environmental quantity or quality. Conducting a CVM requires careful attention to survey design and implementation, including the use of focus groups, expert consultations, and pre-testing the survey. Important decisions must be made regarding the method of conducting interviews (in-person, by mail, or via telephone), the most suitable payment vehicle (e.g., increased annual taxes, one-time payments, contributions to conservation funds), and the format for eliciting WTP (Champ et al.,2002). Ultimately, the mean WTP values obtained from the sample can be extrapolated to the wider population to calculate the aggregate WTP or value of the environmental resource (Mitchell and Carson, 1989).

The choice experiment method (CEM) is theoretically based on Lancaster's characteristics theory of value (Lancaster, 1966) and utilizes random utility models (RUMs) (Luce, 1959; McFadden, 1974). RUMs are discrete choice econometric models that assume respondents possess perfect discrimination capabilities, while analysts operate with incomplete information and must account for uncertainty (see Manski, 1977 for more details). CEM is a highly structured data generation method (Hanley et al., 1998) that relies on carefully crafted tasks or “experiments” to uncover the factors influencing choices. The environmental resource is characterized by its attributes and the various levels those attributes might assume under sustainable management. For instance, an attribute could relate to the quality of ecosystem services, with levels categorized as high, medium, or low. A monetary attribute is included to facilitate the estimation of willingness to pay (WTP). Profiles of the resource are developed based on experimental design theory, which statistically

combines attribute levels into different scenarios presented to respondents. Two or three alternative profiles are grouped into choice sets, and respondents are asked to indicate their preferences (Hanley et al., 1998; Bateman et al., 2003).

Like the contingent valuation method (CVM), CEM can estimate economic values for any environmental resource and can assess both non-use and use values. However, CEM provides the capability to evaluate not only the overall value of the resource but also the implicit value of its attributes, their ranking, and the combined effects of changing multiple attributes at once (Hanley et al., 1998; Bateman et al., 2003). One advantage of CEM over CVM is that respondents are generally more comfortable with the choice approach than with the payment approach. Additionally, CEM addresses some biases inherent in CVM; for instance, strategic bias is minimized since the prices of resources are predefined within the choice sets. Moreover, "yeasaying bias" (or the warm glow effect) is mitigated because respondents cannot assign a value to the resource unless they genuinely value it. Finally, the risk of insensitivity to scope (or the embedding effect) is reduced in CEM; if the choice sets are complete and well-designed, respondents are less likely to confuse the scale of the resource or its attributes with unrelated factors (Bateman et al., 2003).

2.3.3 Benefit Value Transfer Method

The Benefit Transfer Value (BTV) method is a cost-effective approach used in environmental economics to estimate the economic value of ecosystem services or environmental resources in a specific context by transferring existing valuation estimates from studies conducted in different contexts. This method is particularly useful when primary data collection is not feasible due to time, budget, or logistical constraints. The BTV method operates on the premise that similar resources, when evaluated under comparable socio-economic and ecological conditions, will exhibit similar values. By leveraging previously published studies and their valuation estimates, researchers can approximate the value of environmental benefits in new settings without the need for extensive original research (Rosenberger & Loomis, 2000; Johnston et al., 2015).

However, the accuracy of the BTV method relies heavily on the relevance and quality of the original studies from which values are being transferred. Key considerations in this process include the similarity of the ecological, economic, and demographic contexts between the study site and the original valuation site. To improve the robustness of the estimates, researchers often apply statistical techniques and adjustments based on site-specific characteristics. Despite its advantages, the BTV method has limitations, including potential biases stemming from the differences in the context of the original studies and the site of application. Addressing these challenges is crucial for ensuring that the transferred values provide a credible basis for decision-making in environmental policy and management (Brouwer et al., 2015; Turner et al., 2010).

The objective is to statistically account for variations across the studies by analyzing specific characteristics, including the valuation method, geographic region, study factors, survey mode,

and relevant demographic variables. The meta-regression models (MRM) consist of multiple linear and non-linear Least Squares models of the form:

$$Y_i = f(X_i) + \varepsilon_i \quad \text{(eq 1)}$$

where index i corresponds to each observation gathered from the studies under consideration, Y denoted the dependent variable in our case, WTP, and X is a matrix containing the rest of explanatory variables and ε is the error term with the usual least-squares properties.

2.4 Valuation of Externalities and the design of Financial Instruments

Financial instruments designed to internalize externalities aim to align private incentives with social costs and benefits. Examples of such instruments include carbon pricing mechanisms, pollution permits, and green bonds. Carbon pricing, for instance, is implemented in various forms, including carbon taxes and cap-and-trade systems. As an example we can refer to The European Union Emissions Trading System (EU ETS), Green Bonds, REDD+ (Reducing Emissions from Deforestation and Forest Degradation) and Debt-for-Nature-Swaps.

Under ETS companies are allocated emission allowances, which can be traded, thereby creating a financial incentive to reduce their emissions. Green bonds are used to finance projects with positive environmental impacts, such asrenewable energy projects or conservation initiatives. Consequently, green bonds help redirect capital towards sustainable development. According to Flammer (2021), the issuance of green bonds has surged in recent years, driven by increasing investor demand for sustainable investments.
Debt-for-nature swaps entail buying foreign debt, exchanging it for local money, and donating the money raised to conservation efforts. The ability of commercial banks (or governments) to sell debt for less than the entire amount of the initial loan is crucial to the transaction. Another example is REDD+, where it translates to “Reducing emissions from deforestation and forest degradation in developing countries". The + denotes extra climate-protecting forest-related actions, such as sustainable forest management and the preservation and enhancement of forest carbon stores. Developing nations that reduce deforestation are eligible to earn results-based payments for their emission reductions under the framework of these REDD+ operations.

The effectiveness of these financial instruments’ hinges on accurate valuation of externalities to ensure that the costs and benefits are properly accounted for, making it essential for policymakers to integrate robust valuation methodologies into the design and implementation of such instruments.In addition, the design of these financial instruments is crucial; they must be flexible enough to adapt to changing market conditions while providing stable signals to reduce harmful externalities (Heal et al, 2013).Moreover, considerate needs to consider the potential unintended consequences of market-based approaches. For example, while pollution trading schemes can

incentivize reductions in emissions, they may inadvertently lead to "hot spots" where pollution is concentrated in certain areas, thereby exacerbating local environmental issues.

3.0 Implementation in ARSINOE project

3.1 Case Study 1 – Metropolitan Athens

Athens is the capital and largest city of Greece. Athens Metropolitan Area (AMA) has 40 municipalities, 35 of which are referred to as Greater Athens municipalities and more than 40% of the national GDP is produced therein. Moreover, due to its geographical location and the port of Piraeus in each south-western part, Athens is also an area of particular importance for the Mediterranean area as well. The ongoing infrastructure projects, such as contemporary highways connecting Athens with the rest of Greece and Northern Europe through the Balkans, underpin the special role that Athens has as a Metropolitan Region, not only for Greece but also for the wider region.

Attica, the wider region to which Athens belongs, is particularly exposed to extreme weather events. Every winter there is at least a heavy rainfall that causes damage to infrastructure, housing, businesses and crops in the suburbs, and causes problems in the traffic and the smooth functioning of the city in general. Wildfires that also occur almost annually during the summer months, in forested areas on the mountains surrounding Attica, further exacerbate the severity of the effects of rainfall and flooding.

Athens vulnerability to climate change effects will have serious negative consequence not only for the city itself but also for Greece as a whole. Therefore, the Athens region must be adequately shielded in terms of its resilience to climate change. ARSINOE project can help to this end, as the implementation of the systemic solutions and innovations developed during the project, will help the Civil Protection and Public Authorities to make timely and informed decisions, thus mitigating the effects of extreme weather events.
Athens can adopt such solutions, considering also the explicit intention of the current leadership of the Municipality of Athens to set both the improvement of green infrastructure and the support of urban biodiversity as two of its Strategic Objectives.

ARSINOE's innovation package introduces a holistic approach to materialize the Athens Resilience Strategy, which was launched in 2017, including the city's Climate Adaptation Action plan. The Municipality of Athens is currently finalizing, with the support of C40, an update of its Climate Action Plan in accordance with its commitments to the Paris Agreement and the Global Covenant of Mayors.

The Municipality of Athens has started compiling existing data and combining it with new novel observational and modelling platforms (e.g. satellite data, Copernicus Services, Citizen Science). This allows the mapping of vulnerabilities across different activity sectors of AMA and the

identification of hot spots and their respective drivers (e.g. heat, flood, soil imperviousness, inadequate housing).
Appropriate indicators are utilized, and a novel methodology is developed to move from the vulnerability indicators to realistic measures and options and means to achieve them. Additionally, financial instruments will be mapped, to provide optimal options for investment and facilitate an efficient and timely decision chain, as well as sustainability options through connection with smart and resilient city practices.
Additionally, equally important is an organized effort to increase the active participation of and to train the new generation of citizens, and ARSINOE adopts three means: citizen science, youth assemblies to simulate local Green Deal processes and curation of green practices, and innovation and science into educational curricula.

Key systems addressed: The key systems addressed in this case study are environment, health and infrastructure. In particular, the Athens municipality has a strategic focus to enhance green infrastructure and support urban biodiversity, to best shield itself from, adapt to, and build resilience to Climate Change challenges (extreme heat and flash floods). Considering that Athens faces chronic urban growth issues that amplify climate change impacts, the above key systems are addressed and are expected to deliver several benefits in terms of the resilience of the city.

Figure 3, provides an identification of the primary and cascade hazards in relation to climate change for the CS1, an analysis which is documented in the previous deliverables for the case study

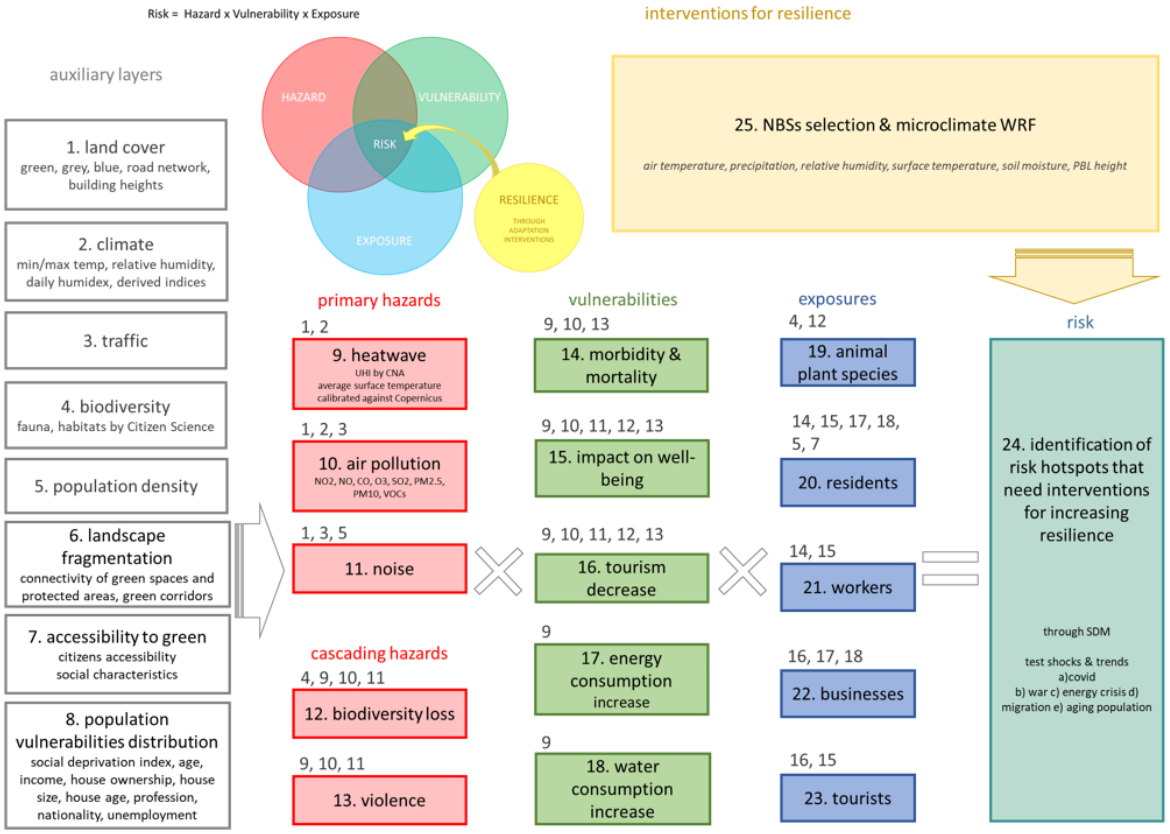


Figure 3 Case Study 1 – Hazards (primary and Cascade), Vulnerabilities and exposures.

The identification of the scope, as well as the validation of the conceptual model for CS1, was also documented in WP2 and WP6 deliverables. Heatwaves, Air pollution and Noise are identified as the main hazards, against which Athens needs to increase its resilience, with biodiversity loss and violence to be reported as cascading hazards. The main vulnerabilities refer to the impact on Wellbeing, Morbidity and Mortality, negative effects on the tourism sector and increased consumption for energy and water sectors. On the other hand, many stakeholders are exposed to the above risks, including residents, workers, businesses, tourists and animal and plant species.
AMA creates more than 40% of the national GDP and has a strategic focus on green infrastructure and urban biodiversity. Nevertheless, there are some issues that put strains on the urban biodiversity, inter alia, heatwaves (e.g., urban heat island effect), traffic and noise, health issues (e.g., morbidity and mortality), population density (e.g., violence), and air pollution. Thus, climate change adaptation is vital for the prosperity of citizens in AMA.

In essence, ways to achieve climate change adaptation is through public awareness and active participation (Falk et al., 2022; Akinsete et al., 2022; Papadaki et al., 2023). This effort will be enhanced by adopting three means: citizen science, youth assemblies to simulate local Green Deal processes and curation of green practices, and innovation and science into educational curricula.
Aiming to evaluate the negative environmental externalities, the ARSINOE project would implement the methodology of choice experiment (CE) under the scope of environmental economics evaluation. The adaptation options will be evaluated with multi-criteria analysis,

assessing effectiveness, contribution to climate change adaptation, technical and economic viability, and public acceptance. Particularly, the ARSINOE project is going to train local citizens from AMA to augment their adaptive capacity through traditional and novel methodologies from environmental economics.

The ARSINOE project would monitor the WTP of citizens' stated preferences via three ways, i.e., a meta-analysis method, a traditional Choice Experiment and a virtual reality (VR) CE. It is, arguably, the first time that VR application is utilized in CE-based study and goes beyond the typical questionnaires. The goal of this exercise, the results of which will be included in D7.5, the manual for sustainable finance, would be to explore the efficiency of the VR technology in shaping the preferences of stakeholders in relation to urban sustainability policies, which are used to finetune and design financial instruments to efficiently support the adequate funding of the adaptation pathways towards the vision of the CS.

3.2 Athens Metropolitan Area - Valuation for urban sustainability policies

3.2.1 Introduction

Urban settings, characterized by their dense populations and extensive infrastructure, are highly vulnerable to a variety of primary and secondary hazards, often referred to as "multi-hazard assessment" (Dall'Osso et al., 2014; Zhang et al., 2023). As of now, over 55% of the global population lives in urban areas, and this number is expected to rise to 68% by 2050 (WHO, 2021). Primary hazards in cities include challenges like heatwaves, air pollution, traffic, and noise, while secondary or cascading hazards such as public health crises and biodiversity loss emerge from these initial threats. The analysis of this section aims to explore individuals' WTP preferences as a tool for implementing urban sustainability policies in response to these multi-hazard scenarios.

Heat waves, the associated health risks, and the decline in biodiversity are critical concerns for urban populations, driven by their increasing intensity and frequency. Heatwaves, which are prolonged periods of extreme temperatures, pose significant threats to human well-being, infrastructure, and cultural heritage (Dasgupta, 2021; Halkos, Bampatsou, et al., 2024; Halkos, Koundouri, et al., 2024; Koundouri et al., 2024). Urban areas, covered predominantly by concrete and asphalt, absorb and retain more heat than rural areas, exacerbating the urban heat island (UHI) effect (Degirmenci et al., 2021; Mohajerani et al., 2017). This effect leads to exceptionally high urban temperatures, straining public health systems and increasing mortality, especially among vulnerable populations like the elderly (Halkos & Aslanidis, 2023a).. The interplay of heatwaves, health risks, and biodiversity decline as urban hazards highlight their interconnectedness and cumulative impacts (Lindley et al., 2019). In addition to immediate physical harm, heatwaves contribute to biodiversity loss by creating stressful environments for plant and animal species that are not adapted to such extreme conditions.

Health risks are secondary hazards that arise from initial threats such as heatwaves, air pollution, traffic, and noise. The concentration of vehicles, industrial activities, and energy consumption in

cities leads to elevated levels of air pollution (Sicard et al., 2023). During heatwaves, urban air quality worsens due to higher levels of ground-level ozone and particulate matter, exacerbating respiratory issues like asthma and chronic obstructive pulmonary disease (COPD). Poor soil conditions can also harm urban sustainability, as pollution from heavy metals (Aslanidis & Golia, 2022) can exacerbate respiratory and cardiovascular issues, leading to increased hospitalizations, reduced life expectancy, and even premature death.
According to the World Health Organization (WHO) (2022), the combination of heatwaves and poor air quality is a major cause of illness and death in urban environments, underscoring the need for adaptive strategies in public health systems. The WHO (2024) reports that air pollution causes approximately 4.2 million deaths annually, with the majority occurring in cities. Moreover, air pollution contributes to climate change by releasing greenhouse gases and short-lived climate pollutants like black carbon, which not only directly warms the atmosphere but also alters weather patterns and further degrades air quality.

Biodiversity loss in urban areas is primarily driven by the mentioned hazards. Urban sprawl often leads to the destruction or fragmentation of natural habitats, resulting in a disruption of ecosystem's carrying capacity to urban life. This decline weakens urban ecosystems' resilience to environmental changes and risks. For instance, the reduction of green spaces diminishes the cooling effects provided by plants, thereby worsening the UHI effect (Founda & Santamouris, 2017). The loss of biodiversity also impairs the ecosystem services that cities rely on, such as air and water purification, further exacerbating health risks for urban residents (Mutafoglu et al., 2017).
The aim of this task is to understand the interaction between primary and cascading hazards in urban areas, ultimately proposing a holistic approach that enhances urban sustainability by considering residents' preferences for the preservation of urban ecosystem services. Specifically, the objectives are to (i) evaluate studies that reveal individuals' mean WTP[1] in response to multi-hazard occurrences and (ii) assess valuation techniques, particularly non-market approaches like choice experiments and contingent valuation methods.

3.2.2 Primary and Cascading Effects

Several studies shed light on factors influencing WTP for environmental goods such as air quality and biodiversity conservation, as well as socioeconomic issues like the effects of traffic and noise on health, living, and working conditions. First, climate change, particularly heatwaves, can severely impact both indoor and outdoor jobs, exacerbating social exclusion and leading to energy poverty. Second, air pollution, a significant contributor to climate change, poses a substantial health threat, being linked to respiratory, cardiovascular, mental health issues, chronic diseases, and cancer. Third, higher population density worsens urban living conditions by intensifying traffic and noise pollution, negatively affecting residents' well-being. Lastly, biodiversity loss is critical, as it hampers ecosystem services, reduces recreational and cultural value, and decreases

[1] WTP is the maximum amount that a consumer is willing to spend on a good or service.

economic benefits derived from natural environments. Studies using choice experiments (CE) and contingent valuation methods (CEM) have demonstrated these impacts. Understanding public preferences is therefore essential for urban planning and conserving ecosystem services.

3.2.2.1 Heatwaves

Heatwaves, driven by climate change, have far-reaching consequences for both living and working conditions, especially for those in indoor and outdoor jobs, which face significant health risks (Barreca et al., 2016) and reduced productivity (Ciuha et al., 2019; Lowe et al., 2011; Varghese et al., 2019; Zhang et al., 2018). The business sector and local communities alike could experience economic losses due to higher absenteeism, reduced working hours, and operational shutdowns during extreme heat events.

Indoor conditions can become especially difficult during heatwaves. Employees working in warehouses, factories, or certain offices are exposed to dangerously high indoor temperatures (Ciuha et al., 2019; Xiang et al., 2014), further worsened by poor building insulation and ventilation. Urban heat island (UHI) effects also amplify this problem, as building materials retain heat during summer months, exacerbating the discomfort (Founda & Santamouris, 2017; Halkos & Aslanidis, 2023a). These adverse conditions contribute to social exclusion, particularly in energy-poor households (Halkos & Aslanidis, 2023b). Employers must prioritize improving indoor environments to protect workers' health and ensure productivity. Energy poverty also worsens conditions for vulnerable groups such as the elderly, unemployed, and students, creating cycles of social vulnerability (Gigante et al., 2024; van Steen et al., 2019). Nature-based solutions (NbS) could address UHI impacts in cities, improving well-being for indoor workers and the general public. Circular economy strategies, such as using industrial wastewater for green roofs or living walls, could further enhance sustainable economic performance (UNEP, 2023; Halkos & Aslanidis, 2024a, 2024b). Technological innovations that conserve energy could also increase resilience to climate change (Degirmenci et al., 2021).

Outdoor workers face even greater risks during heatwaves, especially those in physically demanding jobs such as construction, hospitality, and delivery services. Direct exposure to extreme temperatures raises the risk of heat-related incidents (Varghese et al., 2019), contributing to one percent of annual work-related accidents (Drescher & Janzen, 2023; Ireland et al., 2023). To safeguard worker health, employers should implement adaptive measures like rescheduling work to cooler times, providing shaded areas, frequent breaks, and hydration. Continuous monitoring of worker conditions during extreme heat is crucial to maintaining safety.

Numerous studies have shown that NbS can help regulate temperatures and highlight the importance of urban sustainability. For example, studies on urban parks show that citizens' WTP increases for well-maintained and accessible green spaces (Andrews et al., 2017; Arabomen et al., 2019; Bertram et al., 2017; Chen, 2015). Andrews et al. (2017) found WTP values ranging from €18 for non-users to €45 for park users. Arabomen et al.

(2019) examined urban tree conservation in Nigeria, revealing a WTP of €16.58. Similarly, Bertram et al. (2017) observed WTP values in Germany ranging from €120 to €125 for maintenance and €168 to €199 for cleanliness improvements. Chen (2015) highlighted high WTP for the protection of heritage trees in urban areas, particularly rare or historically significant species.

Furthermore, water quality and availability are critical factors that influence WTP for environmental protection and conservation (Khan et al., 2019; Perez Loyola et al., 2021). Moving forward, a comprehensive approach to urban planning is required to integrate climate change adaptation and improve living and working conditions for urban populations.

3.2.2.2 Air Pollution

Air pollution is not only a leading contributor to climate change but also a significant public health hazard. Various pollutants, including particulate matter (PM2.5 and PM10), ground-level ozone (O3), carbon monoxide (CO), sulfur dioxide (SO2), and nitrogen oxides (NOx), are frequently studied due to their harmful effects (Brook et al., 2004). Extensive research shows that exposure to both fine and coarse particulate matter, whether short-term or long-term, drastically increases rates of illness and mortality (C. Liu et al., 2019; Sanyal et al., 2018). According to the World Health Organization (WHO, 2018), approximately 7 million deaths annually are attributed to fine particle pollution, making air pollution the fourth leading cause of death worldwide (Brauer, 2016). Common health conditions linked to air pollution include respiratory problems like asthma, cardiovascular diseases, mental health disorders, cancer, and chronic diseases (Dominski et al., 2021). Additionally, air pollution can lead to visibility issues, or haze, which obscures distant objects and alters the clarity and color of visible surroundings due to airborne particulates (Boyle et al., 2016).

Numerous studies have quantified the financial impact of health issues caused by air pollution, revealing a substantial economic burden. A significant share of healthcare expenditures is dedicated to treating respiratory diseases. For instance, in 2014, the cost of PM2.5 pollution in China was estimated between 17.2 and 57.0 billion yuan (Shen et al., 2017). In Shanghai, major pollutants are responsible for an annual economic loss of 197 million USD due to asthma-related medical visits (Guo & Chen, 2018). In England, between 2017 and 2025, air pollution-related health costs are projected to reach 5.56 billion euros (Pimpin et al., 2018).

Further research has explored the severity of air pollution by examining the preferences of tourists and local residents using stated preference models like choice experiments (CE) and contingent valuation methods (CVM). These studies show a strong demand for cleaner air, with respondents expressing a willingness to financially support improvements in ecosystem services in their areas. For example, in Bang Kachao, residents are willing to pay €21.16 annually for a 50% increase in clean air (Petcharat et al., 2020). In Israel, nationals would pay up to €47.68, and regional respondents up to €73.68 to preserve air quality at high levels based on local air purification

capabilities (Raviv et al., 2021). In the United States, people are willing to contribute €149.41 per year for programs that reduce the worst 20% of visibility-impaired days (Boyle et al., 2016).

Lera-López et al. (2014) found a willingness to pay (WTP) of €6.90 for reducing air pollution. The study also showed that individuals living near major roads are more motivated to reduce environmental costs. Additionally, younger, more educated, and environmentally conscious individuals are more inclined to pay for mitigating air pollution due to the influence of green values shaped by decades of environmental advocacy. Interestingly, a study focusing on tourists revealed that visitors prioritize waste reduction (€120.48) over air pollution control (Perez Loyola et al., 2021). Z. Liu et al. (2022) highlighted that in Beijing, air pollution significantly affects residents' WTP for green spaces, with WTP increasing as pollution levels rise, peaking at €272.52 under maximum pollution conditions.

3.2.2.3 Population Density, Traffic and Noise

Urban sustainability is deeply influenced by factors such as population density, commercial growth, traffic, and noise pollution, all of which shape residents' willingness to pay (WTP) for environmental improvements. Higher population density, driven by residential and commercial expansion, can place significant pressure on urban resources, leading to overcrowding and increased housing demand. Additionally, traffic and noise pollution elevate emissions, worsen air quality, and decrease the overall quality of life, posing challenges for cities aiming to meet sustainability targets.

Climate change significantly impacts both residential and commercial environments by increasing energy demand for air conditioning, potentially overloading power grids and causing outages. Rising temperatures also lead to higher cooling costs, putting financial strain on both households and businesses.

Urban planners can improve residential resilience to heatwaves through nature-based solutions (NbS). Recent studies highlight how enhancing natural environments, whether through green or blue NbS, can positively influence public attitudes. For example, Zhang et al. (2019) found that people in China are willing to pay around €20 per year for green roofs to mitigate the urban heat island effect. Similarly, Teotónio et al. (2020) revealed that residents in Portugal showed a greater WTP for accessible green roofs, and the addition of green walls as complementary NbS further boosted WTP.

Urban sustainability significantly impacts public preferences, as seen in property prices near parks. Park et al. (2017) used a hedonic pricing method to show that households near urban parks had a WTP of €388. A study in Greece estimated a WTP of €5.11 for urban park projects (Latinopoulos et al., 2016), while in China, the WTP for urban green space conservation nearly doubled to €12.97 (Song et al., 2015). For air quality improvements, the reduction of particulate matter pollution was linked to a WTP of around €1,390 (Ambrey et al., 2014). Khan et al. (2019)

also found higher WTP for better water quality in rivers, while Bennett et al. (2016) suggested that using recycled water for irrigation or domestic purposes is another viable solution.

On the commercial side, tourism is critical for well-being and sustainability, as extreme heat can reduce foot traffic, impacting retail revenue. In a study using contingent valuation methods (CVM) in Chile, the heritage value of three tourist routes led to a WTP range of €19.3 to €21.1 (Báez-Montenegro et al., 2016). In Colorado, tourists expressed a WTP range of €174 to €181 for eco-tourism activities like hiking, reflecting a strong value placed on nature-based tourism (Keske & Mayer, 2014).

Environmental noise from human activities is widespread in developed countries. According to the European Environmental Agency (EEA) (2020), nearly 20% of EU residents were exposed to road traffic noise levels exceeding 55 dB LDEN (average yearly day-evening-night noise levels). Evidence suggests that traffic noise negatively affects health, leading the WHO (2018a) to issue guidelines to protect health in Europe, based on systematic reviews assessing the impacts of road noise. Research also indicates that both the intensity and source of traffic noise can affect mental well-being (Hegewald et al., 2020), potentially causing reactions like annoyance (Beutel et al., 2016), depression (Seidler et al., 2017), anxiety (Generaal et al., 2019), and even conditions like dementia and Alzheimer's disease (Andersson et al., 2018).

Several studies have attempted to quantify the benefits of reducing traffic and noise pollution. Bravo-Moncayo et al. (2017) estimated a mean WTP of €14.60 to reduce road traffic noise in Quito, Ecuador. In Madrid's Retiro Park, Calleja et al. (2017) found a WTP of €10.36 per visitor for noise reduction. In South Korea, Kang et al. (2021) found an average WTP of €4.37 to reduce noise from construction activities. Similarly, Lera-López et al. (2014) recorded a WTP of €5.94 for reducing road noise and air pollution in Spain's Pyrenees, while Merchan (2014) reported a WTP of €438 for a noise mitigation program.

3.2.2.4 Biodiversity Loss

Biodiversity loss significantly affects ecosystem services, diminishing both their recreational and cultural values. It also undermines the economic benefits associated with natural environments, as demonstrated by studies employing choice experiments (CE) and contingent valuation methods (CVM) to assess these services. These approaches have been applied across urban forests, natural landscapes, and ecosystems, underscoring their value (Halkos, 2021).

Several studies have focused on the recreational value of urban parks. For example, Bertram et al. (2017) analyzed the WTP for enhanced maintenance and cleaning of parks in Germany, revealing a WTP of €125.10 for maintenance and €199.98 for cleaning. Andrews et al. (2017) emphasized that park location affects WTP, with the highest values being for central city parks (€34.65) and park user amenities (€40.58-€45.02). Additionally, Ratzke (2022) examined urban biodiversity's

importance, showing a significant WTP (€212.8) for preserving urban ecosystems due to their ecological, aesthetic, and recreational benefits.

Research has also explored biodiversity conservation in natural parks. Studies by Bhat and Sofi (2021) in India and Kamri et al. (2017) in Malaysia reported WTP for biodiversity conservation at €3.60 and €1.66, respectively. These values are often influenced by the rarity of species and recreational benefits. In Thailand, Petcharat et al. (2020) found a WTP of €50.77 for ecosystem services, particularly for air quality and recreation in the Bang Kachao Green Area. Similarly, Wondifraw et al. (2021) highlighted preferences for forest preservation and water conservation in Ethiopia's Mount Guna, using CE to capture these values.

In urban settings, B. Chen and Qi (2018) emphasized the role of survey design in reducing bias, especially when assessing public reactions to urban green spaces. Their findings align with Bernath and Roschewitz (2008), who used the theory of planned behavior to differentiate visitors' WTP for recreational benefits. Vojáček and Louda (2017) assessed ecosystem services in the Eastern Ore Mountains, while Blaeij et al. (2011) examined the complexities of expanding commercial wetlands, with WTP ranging between €3.56 and €5.18. These studies emphasize the importance of effective governance in ecosystem management. Rocchi et al. (2019) used cost-effectiveness analysis to evaluate stakeholder involvement in Natura 2000 sites in Umbria, Italy, revealing a WTP of €10.04 for significant ecosystem changes.

Research into urban forest recreation preferences by Japelj et al. (2016) found that residents in Ljubljana, Slovenia, prefer natural, less crowded environments with information boards and waymarks. Similarly, Khan et al. (2019) demonstrated that the public highly values river ecosystems, with a WTP of €3.22 for reducing erosion.

In Taiwan, H.-S. Chen and Chen (2019) used CE to estimate the economic value of Green Island's natural landscape and biodiversity, revealing a WTP of €74.27 for landscape preservation, €62.04 for species restoration, and €34.73 for environmental education. Dahal et al. (2018) identified a WTP of €94.14 for preserving open waterfront spaces, further supporting the integration of public preferences into environmental management policies.

Agricultural landscapes also hold substantial non-market value, as shown in Aizaki et al. (2006), with WTP ranging from €3.96 to €8.86 for various landscape services in Japan. Similarly, Bateman et al. (2008) demonstrated that framing CE alternatives can influence WTP estimates, showing values between €21.45 and €44.62 for bird and plant cover increases.

In Catalonia, Soy-Massoni et al. (2016) highlighted the multifunctionality of coastal agricultural landscapes, emphasizing the need for integrated management strategies to conserve ecosystem services like erosion control and water purification. Cook et al. (2018) and Hang et al. (2023) found substantial WTP for natural site conservation in Iceland and Vietnam, with values ranging

from €46.25 to €164.55. These studies suggest that promoting awareness about the benefits of conservation can enhance funding for such efforts.

The conflict between renewable energy and environmental conservation is illustrated in Einarsdóttir et al. (2019), who found a WTP of €240.71 for preserving Iceland's natural landscapes despite the presence of wind farms. Similarly, Cong et al. (2019) identified a WTP ranging from €10.05 to €57.17 for enhancing rural landscapes in China, indicating that tailored management practices can promote sustainable rural development.

Finally, Koundouri et al. (2023) conducted a meta-analysis on marine and freshwater ecosystems across Europe, finding that over 63% of European countries showed a greater willingness to pay for marine and freshwater habitat improvements than for terrestrial ecosystems. These findings highlight the importance of aligning public preferences with sustainable policy decisions for effective environmental management.

3.2.3 Meta Analysis – Descriptive statistics

In this section, we develop a framework for analyzing primary and cascading hazards in urban areas. The analysis was based on a comprehensive review utilizing the Environmental Valuation Reference Inventory (EVRI) (2024) and the Ecosystem Services Valuation Database (ESVD) (2024). Priority was given to the EVRI database to avoid duplicate articles, particularly concerning ecosystem services and hazard-related issues. Both EVRI and ESVD are recognized as reputable databases, offering extensive empirical valuation studies that cover environmental assets and human health impacts.

For determining eligibility, 80 most recent publications were selected ensuring accuracy and relevance. The reported estimates for WTP (in April 2024 euros), the year of publication, the country or region studied, and socio-economic factors such as age, income, gender, and education, were collected from the underlying papers.. Table 1 reports the descriptive statistics for all socio economic variables used in the analysis, while Table 2 presents the descriptive statistics of the 219 WTP estimates extracted from the underlying papers, categorized by the underlying country. Table 2 reports the 80 papers and the number of WTP estimates extracted. Details for the WTP estimates and the underlying assets can be found in the Appendix I.

Table 1 Descriptive Statistics – Socio Economic Factors

	Mean	Median	Min	Max	STDEV	Skewness	Kurtosis
Age	42.508	41.700	16.900	55.500	6.383	–0.297	0.410
Income	29,303.903	27,852.340	50.835	124,173.000	21,599.581	0.942	1.453
Gender (1=Female)	0.499	0.506	0.000	0.720	0.093	–3.195	14.748
Education	0.386	0.366	0.054	0.910	0.213	0.250	–0.690

Table 2 WTP values extracted by the 80 publications considering the country level (the countries are presented in alphabetical order).

Country	Average	Min	Max	STDEV
1. Australia	192.91	0.19	1,390.21	484.43
2. Brazil	123.27	82.02	164.52	58.34
3. Chile	20.07	19.30	21.11	0.93
4. China	43.67	0.44	272.52	57.05
5. Czech Republic	1,561.56	-	-	-
6. Denmark	223.40	-	-	-
7. Ecuador	78.46	14.60	149.63	66.68
8. Ethiopia	3.24	1.90	6.10	1.97
9. France	16.37	6.36	38.62	13.85
10. Georgia	19.18	18.66	19.69	0.73
11. Germany	189.81	32.40	468.72	136.98
12. Greece	5.11	-	-	-
13. Iceland	172.79	113.10	240.71	64.20
14. India	31.84	3.60	66.84	33.06
15. Ireland	413.32	0.14	1,211.80	501.24
16. Israel	43.11	24.92	73.68	19.16
17. Italy	9.55	1.07	14.62	5.08
18. Japan	31.13	3.96	223.55	72.18
19. Lebanon	45.72	43.51	47.92	3.12
20. Lithuania	2,906.49	1,676.49	4,136.49	1739.48
21. Malaysia	1.66	-	-	-
22. Netherlands	4.37	3.56	5.18	1.15
23. Nigeria	16.58	-	-	-
24. Portugal	478.08	288.72	721.80	168.13
25. Slovakia	1,138.80	1,062.15	1,215.45	108.40
26. Slovenia	2.72	–0.62	17.61	5.17
27. South Korea	43.27	3.33	388.30	121.24
28. Spain	59.92	5.94	438.00	117.47
29. Switzerland	165.49	113.39	219.71	38.41
30. Taiwan	47.26	20.92	74.27	21.60
31. Thailand	19.49	5.88	50.77	16.23
32. United Kingdom	30.53	18.38	45.02	10.38
33. United States	129.49	0.04	1193.55	272.84
34. Vietnam	46.25	-	-	-
Total Sample	**125.14**	**–0.62**	**4,136.49**	**373.80**

The effects of both primary and cascading hazards are crucial considerations for urban planners and policymakers aiming to enhance urban sustainability and resilience against natural or human-induced events. Table 3 illustrates the impact of these hazards at a categorical level. Population

density issues were found to have the highest mean willingness to pay (MWTP), reaching nearly 300€, with the second-largest deviation and maximum value across all studies. Heatwaves followed with a MWTP of around 140€, roughly half the amount of that for population density. Other notable MWTPs include biodiversity loss at 96€, air pollution at 76€, health concerns at 63€, and traffic and noise at 42€. These values serve as an indicator of public willingness to address these issues.

Table 3 WTP values for the impact of primary and cascading hazards at a category level.

Categories	Mean	Median	Min	Max	STDEV	Skewness	Kurtosis
Air Pollution	76.10	68.88	6.90	272.45	69.37	1.41	2.28
Biodiversity Loss	96.65	18.52	–0.62	1,561.56	238.41	4.34	19.77
Health	63.29	24.78	18.58	146.52	72.14	1.71	-
Heatwaves	142.81	2.78	0.04	702.60	280.47	1.68	1.17
Population Density	298.87	19.89	0.14	4,136.49	779.13	4.08	18.61
Traffic & Noise	42.50	5.71	3.53	438.00	124.59	3.46	11.98
Total Sample	**125.14**	**18.76**	**–0.62**	**4,136.49**	**373.80**	**6.98**	**64.13**

Note: The WTP values are presented in Euro (€) in April 2024 levels.

Figure 4 outlines the effects of these hazards on citizens, flora and fauna, and both indoor and outdoor workers. From a citizen-focused perspective, population density was the most impactful, affecting 16% of public welfare, followed by air pollution (8%), and traffic and noise (6%). Interestingly, health problems and heatwaves showed a relatively smaller impact, affecting only 1.5% and 4.4% of welfare, respectively.

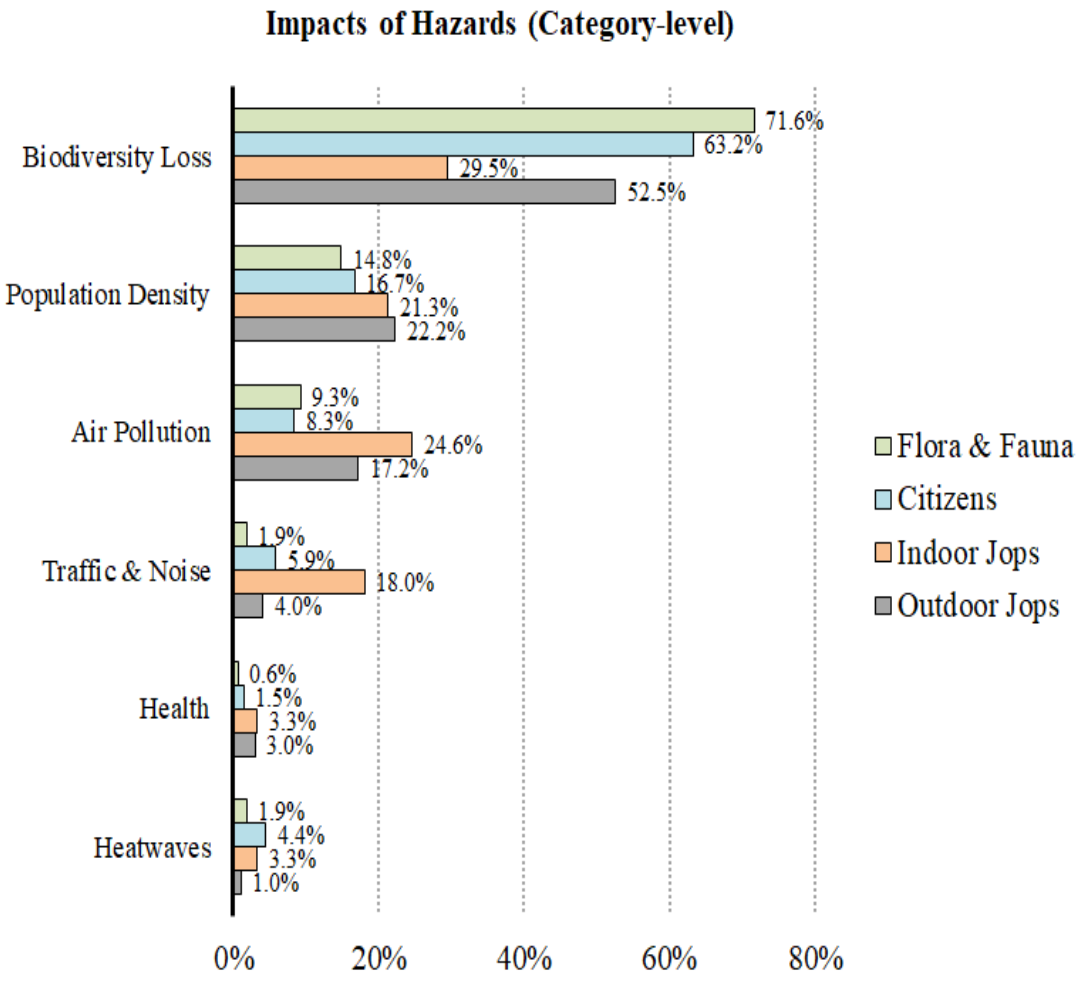


Figure 4 The impact of impact of primary and cascading hazards at people, fauna, and flora under the scope of category level

When assessing biodiversity loss, its impact on fauna and flora is overwhelming, influencing 71% of the environment, while also significantly affecting citizen well-being (63%), outdoor workers (52%), and indoor workers (29%). For workers, outdoor jobs were particularly impacted by population density (22%), air pollution (17%), and traffic and noise (4%). Health issues and heatwaves had minimal effects on outdoor workers, influencing only 3% and 1% of welfare, respectively. Indoor jobs were similarly affected, with air pollution (24%) and population density (21%) being the most significant factors, followed by traffic and noise (18%), while health and heatwaves had minimal impact at 3% each. The low impact of heatwaves on workers' welfare highlights a potential limitation of this review, possibly due to the scarcity of valuation studies specifically focused on outdoor worker welfare.

At the sub-category level, notable changes were observed. For instance, air pollution's MWTP dropped from 76€ to 67€ due to overlaps with other sub-categories, such as mortality and morbidity. Table 4 further shows that urban planners should prioritize more pressing issues.

Residential sprawl, as part of population density, had the highest MWTP at 814€, while the commercial aspect of population density was less impactful with an MWTP of 83€. Other significant WTPs include worker and local citizen well-being at 92€, mortality-related health issues at 85€, air pollution at 67€, traffic and noise at 42€, and morbidity-related health concerns at 18€. These findings provide valuable insights for directing urban planning efforts.

Table 4 WTP values for the impact of primary and cascading hazards at a sub-category level.

Sub-categories	Mean	Median	Min	Max	STDEV	Skewness	Kurtosis
Air Pollution	67.67	47.68	6.90	272.45	70.06	1.83	3.69
Morbidity	18.58	-	-	-	-	-	-
Mortality	85.65	-	24.78	146.52	86.08	-	-
Living/Working Conditions	92.84	17.61	–0.62	1,561.56	232.14	4.47	21.08
Commercial	83.18	21.11	19.30	181.14	86.46	0.61	–3.31
Residential	355.27	19.98	0.14	4,136.49	814.56	3.74	16.00
Traffic & Noise	42.50	5.71	3.53	438.00	124.59	3.46	11.98

Note: The WTP values are presented in Euro (€) in April 2024 levels.

Considering the MWTP levels for addressing urban-related challenges, Figure 5 illustrates their effects on individuals, as well as flora and fauna, at a sub-category level. The most significant impact on people's lives is largely linked to their living and working conditions, which serve as a proxy for biodiversity loss, while also encompassing aspects of other hazards. Additionally, the increase in residential housing appears to significantly influence both indoor (24%) and outdoor (15%) employment. Indoor workers are particularly affected because those in densely populated neighbourhoods struggle to access open spaces during breaks, while outdoor workers may face similar challenges.

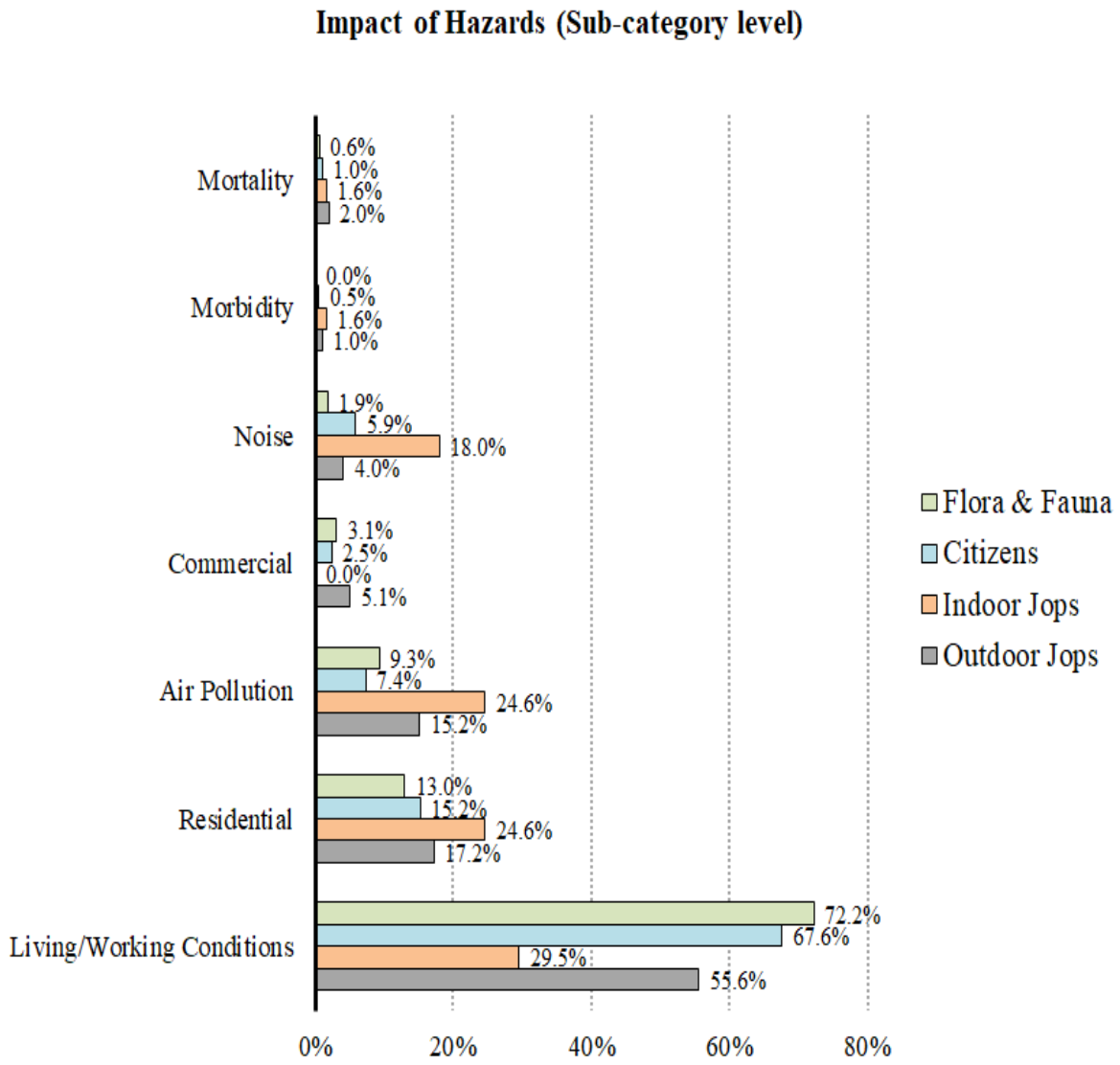


Figure 5 The impact of impact of primary and cascading hazards at people, fauna, and flora under the scope of sub-category level.

From a citizen-focused viewpoint, the well-being of citizens is predominantly influenced by factors such as residential density (15%) and air pollution (7%), followed by traffic and noise (6%) and commercial development (5%). Interestingly, health-related issues like mortality (1%) and morbidity (0%) have a minimal impact. This raises the question of whether there is a sufficient understanding of how health can be affected by both natural and human-induced phenomena, and why many people do not associate their well-being with these challenges.

Outdoor workers are influenced by residential factors (17%) and air pollution (15%). The establishment of new commercial shops or the increase of short- and long-term rentals also affects their WTP preferences by 5%. Similarly, indoor workers show the same level of influence from residential and air pollution factors, which account for 24.6% of their WTP choices. Notably,

commercial growth does not seem to impact their preferences according to the valuation studies. For both indoor and outdoor workers, issues related to noise, mortality, and morbidity do not significantly influence their WTP preferences, possibly due to limited data availability on this aspect of worker welfare.

A global analysis of MWTP, as shown in Figure 6, reveals that the lowest MWTP values, ranging from 1.66€ to 10€, are found in six countries: Malaysia, Slovenia, Ethiopia, the Netherlands, Greece, and Italy. The next category consists of moderate MWTP values, between 10€ and 100€, across 16 countries, which will be detailed in sub-samples. The first subgroup, with MWTPs between 16€ and 20€, includes France, Nigeria, Georgia, Thailand, and Chile. The second subgroup features MWTPs from 20€ to 45€ and comprises the United Kingdom, Japan, India, Israel, South Korea, and China. The third subgroup has MWTPs between 45€ and 78€, associated with Lebanon, Vietnam, Taiwan, Spain, and Ecuador.

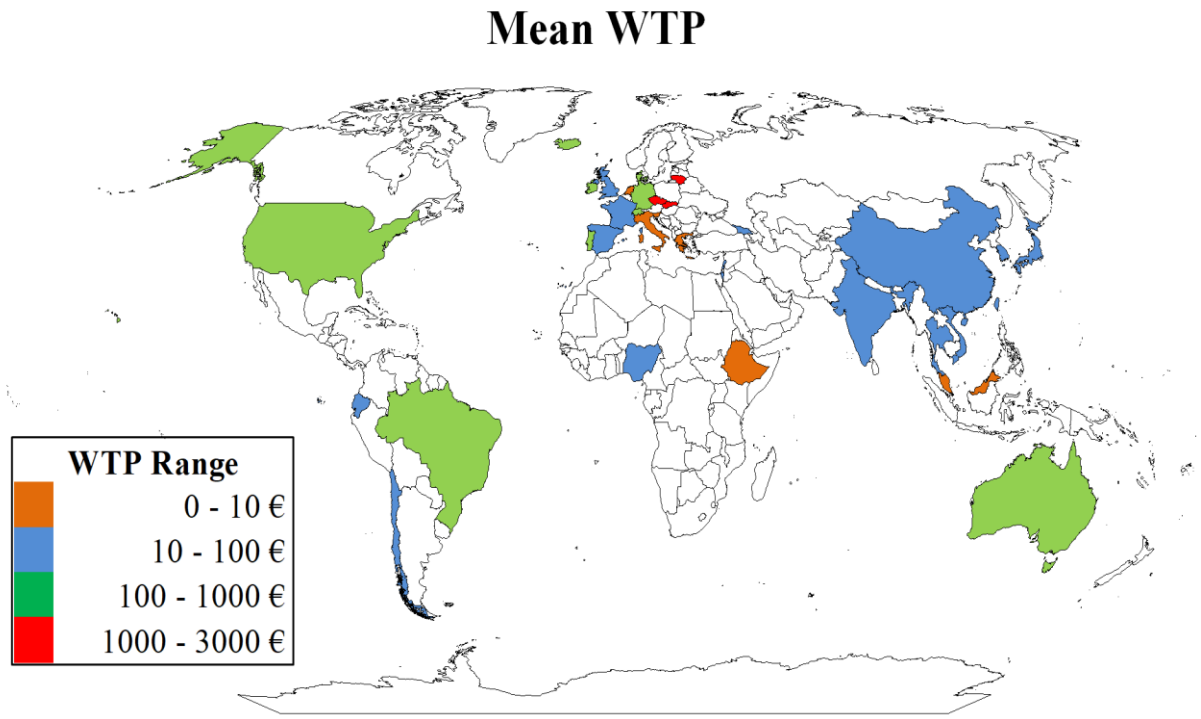


Figure 6 Mean WTP values for building urban sustainability.

The third group, characterized by relatively high MWTPs ranging from 123€ to 478€, includes Brazil, the United States, Switzerland, Iceland, Germany, Australia, Denmark, Ireland, and Portugal. Finally, the group with the highest MWTP values, ranging from 1,138€ to 2,906€, consists of Slovakia, the Czech Republic, and Lithuania.

3.2.4 Choice Experiment Design

The ARSINOE project aims to develop climate-resilient solutions for Europe by integrating systems innovation with the unique socio-ecological and economic contexts of various regions to

tackle the risks. The literature reviewed in this discussion paper can significantly support ARSINOE's goals by providing empirical evidence on public preferences and willingness to pay (WTP) for environmental and socio-economic benefits, including air quality, biodiversity, ecosystem services, living and working conditions, and the conservation of natural parks. The above meta-analysis supported the values used in the choice cards of the experiment (as an example we provide Figure 7).

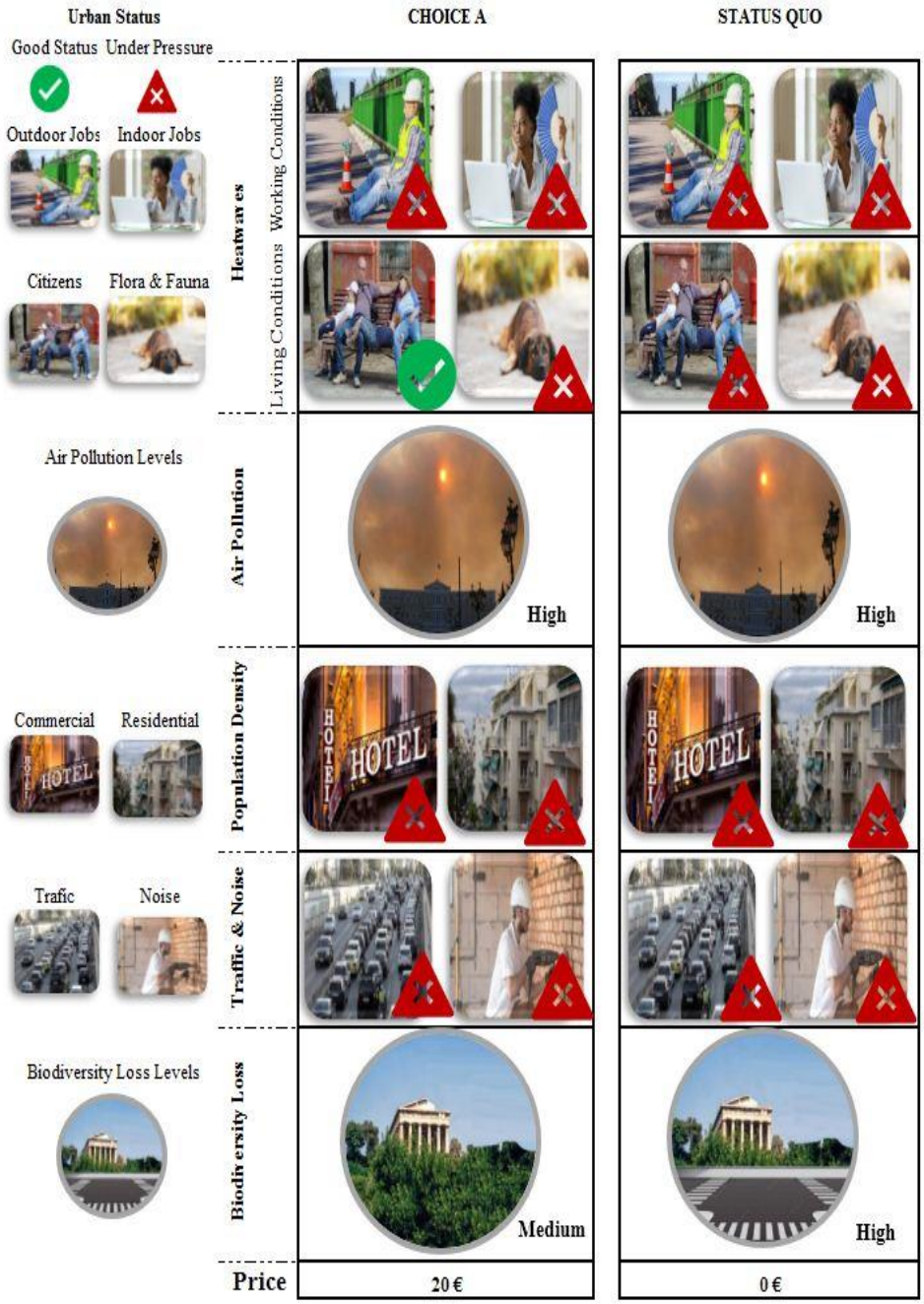


Figure 7 The structure of this questionnaire has been designed based on the consultations of the ARSINOE Project team

Notably, Ratzke (2022) explored urban biodiversity preferences, while Soy-Massoni et al. (2016) investigated ecosystem services in coastal agricultural areas, both of which align with ARSINOE's mission to tailor climate resilience strategies to specific regional characteristics. These studies deliver valuable insights into stakeholder perceptions and valuations of environmental resources, which are crucial for creating nature-based solutions (NbS) that are ecologically effective and publicly accepted. Appendix II provides the complete Questionnaire in both Greek and English version[2].

From July 15, 2024, the questionnaire was distributed in a Windows Forms format to more than 4000 stakeholders, following the synthesis of the CS1 stakeholder list, with a target to collect at least 200 responses following the below quotas in relation to the type of stakeholders:

.

Until the 25th of September 2024, there were 50 responses.Although the detailed analysis of the Choice Experiment, together with the statistical estimation of the relevant WTP for all primary and cascading effects will be included in deliverable D7.5, we do include here an analysis of this initial sample.

After a data cleaning process in which we removed those respondents with very low response time, response inconsistencies and very low variance across the various questions, a total of 42 respondents were used for the analysis. The frequency distribution of the socio-demographic characteristics of the sample shows that it is sufficiently heterogeneous. However, the sample is not completely representative of the Greece population. This can be due also to the fact that respondents were recruited not from the Greece at large, but from AE4RIA network, which may show different structures in terms of socio-demographics and preferences related characteristics compared to the national average. Thus, some caution should be used in generalizing the study's results to the entire country.

Compared to the Greek national population (reference), the study sample comprised more males (52.38% versus 48.9%), and consequently fewer females (45.27% versus 51.1%). In terms of age, the frequency distribution across the five categories is quite balanced and the sample represents the Greek population well. However, people aged between 18 and 25 and 26 and 35 were underrepresented (2.38% and 4.76% versus 7.6% and 10.5%), while the older age group was slightly underrepresented (16.67% versus 19.6%). On the other side, respondenets belonging to other age categories were overrepresented with the 21.43% (versus 13.7%) of respondents aged between 36 and 45, the 38.1% (versus 15.4%) aged between 46 and 55, and the 16.67% (versus 14%) aged between 56 and 65. Regarding the household situation, half of the sample (50%) is represented by singles and couples without children or grandchildren with less than 18 years old, and 42.9% by couples with children or grandchildren under the age of 18. Divorced couples represent only 7.14% of the sample.

The frequency distribution of annual income shows that respondents belonging to lowest income category (< €10,000) represent 2.38% of the sample, while those belonging to the highest category

[2] Greek version can be reached here: https://tinyurl.com/asxtspxs

English version: https://tinyurl.com/bdfxretm

(> €50,000) make up 30.95%. Thus, a high percentage of respondents (66.67%) earns between €10,000 and €50,000 per year. Furthermore, the majority of the respondents have a high – Doctorate - (54.76%) or middle level education – Universities and Post graduate studies - (45.24%), while no respondent has primary or other low levels of education, thus implying an underrepresentation of the lower educated people. Finally, most of the sample is employed (97.62%), while 2.38% is retired, revealing so an underrepresentation of the unemployed, students and homemaker people. Almost half of the employed people (47.62%) are working in the public sector, 23.81% in the private sector and 26.19% are delf employed (freelancers). In addition, for more than half of the respondents (52.38%), their work is related to the environment, while 21.43% are members of an environmental organization.

Table 5 presents the descriptive statistics of the respondents' socioeconomic characteristics, Table 6 displays analytically the opinions on the Athens Metropolitan Area, while Table 7 the Important cultural elements in the urban environments.

Table 5 Descriptive statistics of respondents' basic socioeconomic characteristics.

	Number of observations	Mean	Standard Deviation
Gender (%)	42	45.24% (Female)	
Age (years)	42	51.63	11.8
Education level (years)	42	20.05	2.2
Mean annual income (€)	42	37083.33	15668.79
Marital Status	42	59.52% (Married)	

Table 6 Opinions on the Athens Metropolitan Area in percentages

	Strongly Agree	**Somewhat Agree**	**Neither Agree Not Disagree**	**Somewhat Disagree**	**Strongly Disagree**
Athens Metropolitan Area is currently experiencing environmental damage/degradation due to human activities	73,8%	23,8%	2,4%	0,0%	0,0%
The quality of life in the Athens Metropolitan Area needs to be improved.	88,1%	9,5%	2,4%	0,0%	0,0%
Improving the quality of life of the Athens Metropolitan Area is the responsibility of the government	61,9%	33,3%	4,8%	0,0%	0,0%
Improving the quality of life of the Athens Metropolitan Area is the responsibility of local/regional authorities	78,6%	21,4%	0,0%	0,0%	0,0%
Improving the quality of life of the Athens Metropolitan Area is the responsibility of everyday citizens	57,1%	35,7%	7,1%	0,0%	0,0%

	Strongly Agree	Somewhat Agree	Neither Agree Not Disagree	Somewhat Disagree	Strongly Disagree
A high level of quality of life is essential for tourism development.	26,2%	26,2%	40,5%	2,4%	4,8%
Taxes are a more stable way of maintaining the funding necessary to successfully manage the urban environment than are donations and EU funds	14,3%	26,2%	28,6%	23,8%	7,1%
We should do something to significantly reduce air pollution in Athens Metropolitan Area even if the economy slows down because of this.	45,2%	38,1%	9,5%	4,8%	2,4%

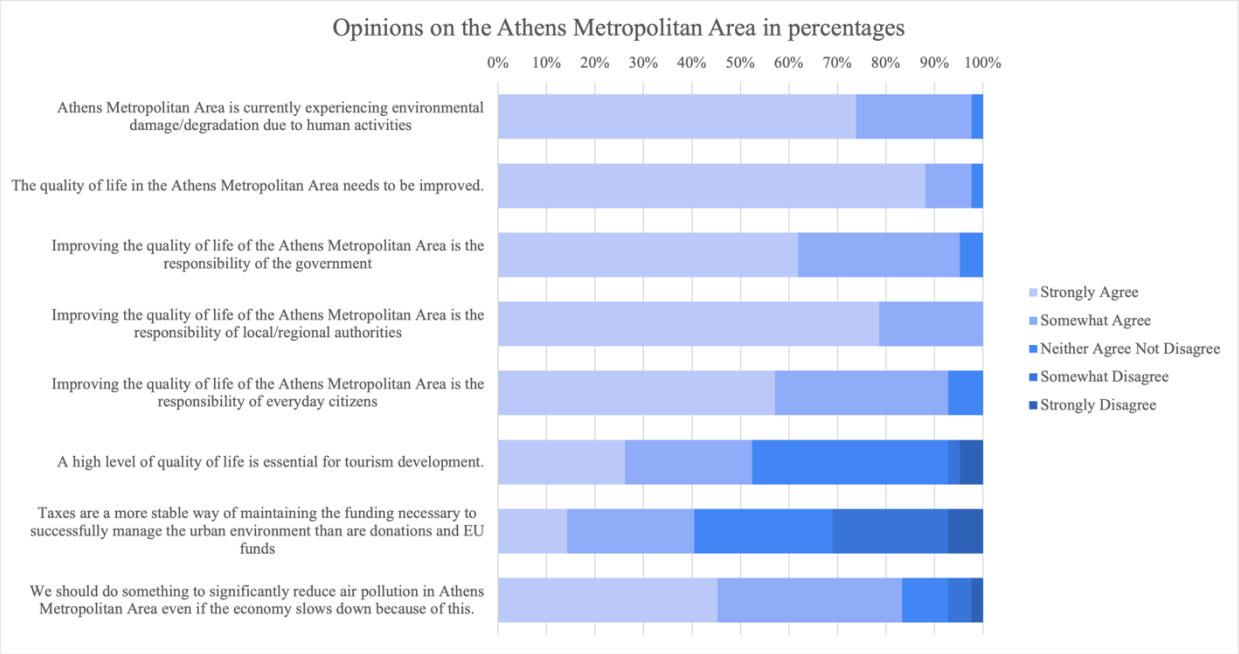


Figure 8 - Opinions on the Athens Metropolitan Area in percentages

Table 7 Important cultural elements in the urban environments in percentages (number of respondents in parentheses).

History	81% (34)
Arts	38.1% (16)
Daily Life	54.8% (23)
Religion	19% (8)
Other (Politics, Environment)	7.1% (3)

3.2.5 Virtual Reality Experiment Design

Moreover, ARSINOE, which promotes inclusive and participatory approaches to climate adaptation, can leverage methodologies such as contingent valuation method (CVM) and discrete choice experiments (CE) from these studies to engage local communities in decision-making processes. Additionally, the project has the potential to expand the existing literature by applying these valuation techniques in diverse scenarios and integrating them into a more holistic climate adaptation framework that utilizes systems thinking. By combining scientific, economic, and social perspectives, ARSINOE enhances our understanding of the valuation of various ecosystem services and environmental goods across different regions, thereby improving the effectiveness of climate adaptation strategies and nature-based solutions programs.

The Choice Experiment Questionnaire will be embedded into the VR environment created and presented in Deliverable 2.5 (D2.5). An example of a VR choice card is presented in Figure 8. The Application provides an immersive VR environment where the users: can fill in choice experiment questionnaires, by directly experience the consequences of the available options.

The VR labs are expected to start by November 2025 and collect more than 200 responses from the in-person participants.

The results of the statistical processing of the VR questionnaires will be compared also to the results of the traditional experiment to explore if the use of innovative methods, such as VR affects the preferences of citizens towards resilience to climate change. The samples for the two experiments will be independent and the results will be included in detail in Deliverable 7.5.

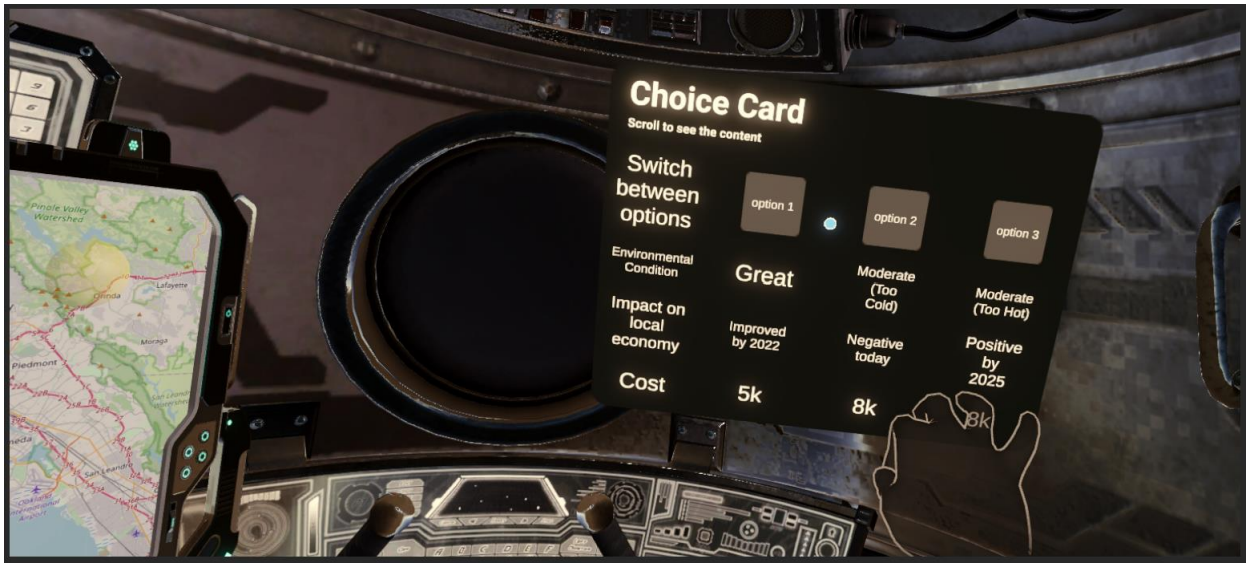


Figure 9 VR Choice Experiment – Indicative Card

4.0 Conclusions and Next Steps

This study emphasizes the significance of grasping citizens' willingness to pay (WTP) for environmental and socio-economic goods and services in the context of urban sustainability and multi-hazard assessments. It indicates that citizens prioritize issues such as biodiversity loss, air pollution, and the adverse impacts of traffic and noise, all of which carry substantial economic

consequences for urban planning and conservation efforts. The decline in biodiversity adversely affects ecosystem services and overall human well-being, while the differences in WTP across various countries and situations underscore the necessity for tailored solutions.

Specifically, the analysis of 80 valuation studies reveals that the primary hazard most concerning to citizens is climate change, particularly heatwaves, with a mean WTP of €142. In contrast, air pollution has a mean WTP of only €76. The findings indicate that population density driven by residential and commercial activities poses the most critical challenge for policymakers, reflected in a WTP of €298. This is followed by biodiversity loss at €96, health issues at €63, and traffic and noise at €42. Notably, biodiversity loss significantly impacts all affected groups, particularly flora and fauna, residents, and both outdoor and indoor workers.

To enhance urban sustainability, policy considerations for both primary and cascading hazards must be addressed. Climate change adversely affects both indoor and outdoor employment, contributing to issues like social exclusion and energy poverty. Implementing energy-efficient technologies rooted in circular economy principles can help alleviate indoor challenges. Furthermore, outdoor workers are particularly vulnerable during heatwaves due to direct exposure to the elements; hence, governments and employers should adopt strategies like modifying work schedules, providing shaded areas, ensuring regular breaks, and facilitating access to hydration. Air pollution, a significant contributor to climate change and a health risk, leads to respiratory, cardiovascular, mental, and chronic diseases. Thus, policymakers should invest in green and blue infrastructure, such as creating green spaces (like green roofs and walls) and enhancing water supply through blue infrastructure (like fountains) to improve urban liability. Additionally, population density, along with its associated traffic and noise pollution, poses serious challenges in both developed and developing nations, affecting health and mental well-being. Policymakers must advocate for sustainable transportation solutions to alleviate traffic congestion, while the construction sector should adhere to regulations regarding working hours to avoid disrupting urban communities. Recognizing citizens' preferences is vital for effective urban planning and conservation initiatives.

In conclusion, addressing both primary and cascading hazards is essential for fostering urban sustainability. Economic valuation studies highlight the importance of robust experimental design, multi-level governance, stakeholder engagement, and an understanding of public preferences in environmental and urban policymaking. Consequently, policymakers should use WTP estimates to prioritize investments in green infrastructure, biodiversity conservation, and pollution reduction, ensuring that resources are allocated effectively to meet public needs. This can only be accomplished through integrated planning that not only addresses immediate environmental threats but also anticipates and manages potential chain reactions. Ultimately, urban sustainability strategies informed by economic valuation principles can strengthen resilience against both primary and cascading hazards.

The above considerations are important for the design of specific financial instruments to be included in the tailor-made portfolio of financing solutions for the CS1, which will be presented in detail in Deliverable 7.5.

Next Steps in relation to Task 7.3 include the finalization and the processing of the Choice experiments and the implications to be available in the Manual for sustainable finance (D7.5).

References

Aizaki, H., Sato, K., & Osari, H. (2006). Contingent valuation approach in measuring the multifunctionality of agriculture and rural areas in Japan. Paddy and Water Environment, 4(4), 217–222. https://doi.org/10.1007/s10333-006-0052-8

Akinsete, E., Stergiopoulou, L., El Said, N., Koundouri, P. (2022) Multi-Actor Working Groups as Fora for WEF Nexus Innovation and Resilience. *Environmental Sciences Proceedings*. 15(1):69. https://doi.org/10.3390/environsciproc2022015069

Ambrey, C. L., Fleming, C. M., & Chan, A. Y.-C. (2014). Estimating the cost of air pollution in South East Queensland: An application of the life satisfaction non-market valuation approach. Ecological Economics, 97, 172–181. https://doi.org/10.1016/j.ecolecon.2013.11.007

Ami, D., Aprahamian, F., Chanel, O., Joulé, R.-V., & Luchini, S. (2014). Willingness to pay of committed citizens: A field experiment. Ecological Economics, 105, 31–39. https://doi.org/10.1016/j.ecolecon.2014.04.014

Andersson, J., Oudin, A., Sundström, A., Forsberg, B., Adolfsson, R., & Nordin, M. (2018). Road traffic noise, air pollution, and risk of dementia – results from the Betula project. Environmental Research, 166, 334–339. https://doi.org/10.1016/j.envres.2018.06.008

Andrews, B., Ferrini, S., & Bateman, I. (2017). Good parks – bad parks: the influence of perceptions of location on WTP and preference motives for urban parks. Journal of Environmental Economics and Policy, 6(2), 204–224. https://doi.org/10.1080/21606544.2016.1268543

Aoun, D. (2015). Who pays more to preserve a natural reserve, visitors or locals? A confidence analysis of a contingent valuation application. Environmental Economics and Policy Studies, 17(4), 471–486. https://doi.org/10.1007/s10018-014-0095-9

Arabomen, O. J., Chirwa, P. W., & Babalola, F. D. (2019). Willingness-to-pay for Environmental Services Provided By Trees in Core and Fringe Areas of Benin City, Nigeria 1. International Forestry Review, 21(1), 23–36. https://doi.org/10.1505/146554819825863717

Aslanidis, P.-S. C., & Golia, E. E. (2022). Urban Sustainability at Risk Due to Soil Pollution by Heavy Metals—Case Study: Volos, Greece. Land, 11(7). https://doi.org/10.3390/land11071016

Báez-Montenegro, A., Centeno, A. B., Lara, J. Á. S., & Prieto, L. C. H. (2016). Contingent valuation and motivation analysis of tourist routes. Tourism Economics, 22(3), 558–571. https://doi.org/10.5367/te.2015.0459

Barreca, A., Clay, K., Deschenes, O., Greenstone, M., & Shapiro, J. S. (2016). Adapting to Climate Change: The Remarkable Decline in the US Temperature-Mortality Relationship over the Twentieth Century. Journal of Political Economy, 124(1), 105–159. https://doi.org/10.1086/684582

Bateman, I. J., Munro, A., & Poe, G. L. (2008). Decoy Effects in Choice Experiments and Contingent Valuation: Asymmetric Dominance. Land Economics, 84(1), 115–127. https://doi.org/10.3368/le.84.1.115

Bennett, J., McNair, B., & Cheesman, J. (2016). Community preferences for recycled water in Sydney. Australasian Journal of Environmental Management, 23(1), 51–66. https://doi.org/10.1080/14486563.2015.1129364

Bernath, K., & Roschewitz, A. (2008). Recreational benefits of urban forests: Explaining visitors' willingness to pay in the context of the theory of planned behavior. Journal of Environmental Management, 89(3), 155–166. https://doi.org/10.1016/j.jenvman.2007.01.059

Bertram, C., Meyerhoff, J., Rehdanz, K., & Wüstemann, H. (2017). Differences in the recreational value of urban parks between weekdays and weekends: A discrete choice analysis. Landscape and Urban Planning, 159, 5–14. https://doi.org/10.1016/j.landurbplan.2016.10.006

Beutel, M. E., Jünger, C., Klein, E. M., Wild, P., Lackner, K., Blettner, M., Binder, H., Michal, M., Wiltink, J., Brähler, E., & Münzel, T. (2016). Noise Annoyance Is Associated with Depression and Anxiety in the General Population- The Contribution of Aircraft Noise. PLOS ONE, 11(5), e0155357. https://doi.org/10.1371/journal.pone.0155357

Bhat, M. Y., & Sofi, A. A. (2021). Willingness to pay for biodiversity conservation in Dachigam National Park, India. Journal for Nature Conservation, 62, 126022. https://doi.org/10.1016/j.jnc.2021.126022

Bimonte, S., Ferrini, S., & Grilli, G. (2016). Transport infrastructures, environment impacts and tourists' welfare: a choice experiment to elicit tourist preferences in Siena–Italy. Journal of Environmental Planning and Management, 59(5), 891–910. https://doi.org/10.1080/09640568.2015.1044746

Blaeij, A. T. de, Polman, N. B. P., & Reinhard, A. J. (2011). Economic Governance to Expand Commercial Wetlands: Within- and Cross-Scale Challenges. Agricultural Economics and Rural PolicyWASS, 16(1). https://doi.org/https://edepot.wur.nl/166820

Bosworth, R., Cameron, T. A., & DeShazo, J. R. (2015). Willingness to pay for public health policies to treat illnesses. Journal of Health Economics, 39, 74–88. https://doi.org/10.1016/j.jhealeco.2014.10.004

Botelho, A., Pinto, L. M. C., Lourenço-Gomes, L., Valente, M., & Sousa, S. (2016). Social sustainability of renewable energy sources in electricity production: An application of the contingent valuation method. Sustainable Cities and Society, 26, 429–437. https://doi.org/10.1016/j.scs.2016.05.011

Boyle, K. J., Paterson, R., Carson, R., Leggett, C., Kanninen, B., Molenar, J., & Neumann, J. (2016). Valuing shifts in the distribution of visibility in national parks and wilderness areas in the United States. Journal of Environmental Management, 173, 10–22. https://doi.org/10.1016/j.jenvman.2016.01.042

Brauer, M. (2016). The Global Burden of Disease from Air Pollution. AAAS 2016 Annual Meeting, Global Science Engagement.

Bravo-Moncayo, L., Pavón-García, I., Lucio-Naranjo, J., & Mosquera, R. (2017). Contingent valuation of road traffic noise: A case study in the urban area of Quito, Ecuador. Case Studies on Transport Policy, 5(4), 722–730. https://doi.org/10.1016/j.cstp.2017.08.003

Bronnmann, J., Liebelt, V., Marder, F., Meya, J., & Quaas, M. F. (2020). The Value of Naturalness of Urban Green Spaces: Evidence From a Discrete Choice Experiment. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3721942

Brook, R. D., Franklin, B., Cascio, W., Hong, Y., Howard, G., Lipsett, M., Luepker, R., Mittleman, M., Samet, J., Smith, S. C., & Tager, I. (2004). Air Pollution and Cardiovascular Disease. Circulation, 109(21), 2655–2671. https://doi.org/10.1161/01.CIR.0000128587.30041.C8

Calleja, A., Díaz-Balteiro, L., Iglesias-Merchan, C., & Soliño, M. (2017). Acoustic and economic valuation of soundscape: An application to the 'Retiro' Urban Forest Park. Urban Forestry & Urban Greening, 27, 272–278. https://doi.org/10.1016/j.ufug.2017.08.018

Carneiro, D. Q., & Carvalho, A. R. (2014). Payment vehicle as an instrument to elicit economic demand for conservation. Ocean & Coastal Management, 93, 1–6. https://doi.org/10.1016/j.ocecoaman.2014.03.002

Chen, B., & Qi, X. (2018). Protest response and contingent valuation of an urban forest park in Fuzhou City, China. Urban Forestry & Urban Greening, 29, 68–76. https://doi.org/10.1016/j.ufug.2017.11.005

Chen, H.-S., & Chen, C.-W. (2019). Economic Valuation of Green Island, Taiwan: A Choice Experiment Method. Sustainability, 11(2), 403. https://doi.org/10.3390/su11020403

Chen, W. Y. (2015). Public willingness-to-pay for conserving urban heritage trees in Guangzhou, south China. Urban Forestry & Urban Greening, 14(4), 796–805. https://doi.org/10.1016/j.ufug.2015.07.002

Ciuha, U., Pogačar, T., Bogataj, L. K., Gliha, M., Nybo, L., Flouris, A. D., & Mekjavic, I. B. (2019). Interaction between Indoor Occupational Heat Stress and Environmental Temperature Elevations during Heat Waves. Weather, Climate, and Society, 11(4), 755–762. https://doi.org/10.1175/WCAS-D-19-0024.1

Collins, M., & Curtis, J. (2018). Willingness-to-pay and free-riding in a national energy efficiency retrofit grant scheme. Energy Policy, 118, 211–220. https://doi.org/10.1016/j.enpol.2018.03.057

Collins, M., & Curtis, J. A. (2017). Can tenants afford to care? Investigating the willingness-to-pay for improved energy efficiency of rental tenants and returns to investment for landlords. ESRI Working Paper, No. 565.

Cong, L., Zhang, Y., Su, C.-H. (Joan), Chen, M.-H., & Wang, J. (2019). Understanding Tourists' Willingness-to-Pay for Rural Landscape Improvement and Preference Heterogeneity. Sustainability, 11(24), 7001. https://doi.org/10.3390/su11247001

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., ... & van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. Nature, 387(6630), 253-260.

Costanza, R., De Groot, R., Braat, L., Kubiszewski, I., Fioramonti, L., Sutton, P., et al. (2017). Twenty years of ecosystem services: how far have we come and how far do we still need to go? Ecosystem Services 28, 1–16. doi: 10.1016/j.ecoser.2017. 09.008.

Costanza, R., De Groot, R., Sutton, P., Van der Ploeg, S., Anderson, S. J., Kubiszewski, I., et al. (2014). Changes in the global value of ecosystem services. Global Environmental. Change 26, 152 158. doi: 10.1016/j.gloenvcha.2014.04.002.

Cook, D., Eiríksdóttir, K., Davíðsdóttir, B., & Kristófersson, D. M. (2018). The contingent valuation study of Heiðmörk, Iceland – Willingness to pay for its preservation. Journal of Environmental Management, 209, 126–138. https://doi.org/10.1016/j.jenvman.2017.12.045

Dahal, R. P., Grala, R. K., Gordon, J. S., Petrolia, D. R., & Munn, I. A. (2018). Estimating the willingness to pay to preserve waterfront open spaces using contingent valuation. Land Use Policy, 78, 614–626. https://doi.org/10.1016/j.landusepol.2018.07.027

Dall'Osso, F., Dominey-Howes, D., Moore, C., Summerhayes, S., & Withycombe, G. (2014). The exposure of Sydney (Australia) to earthquake-generated tsunamis, storms and sea level rise: a probabilistic multi-hazard approach. Scientific Reports, 4(1), 7401. https://doi.org/10.1038/srep07401

Daily, G. C. (1997). "Introduction: what are ecosystem services?" in Nature's Services: Societal Dependence on Natural Ecosystems, ed G. C. Daily (Washington, DC: Island Press), 1–10.

DEFRA (2007). An Introductory Guide to Valuing Ecosystem Services. Available online at: https://ec.europa.eu/environment/nature/biodiversity/economics/pdf/valuing_ecosystems.pdf (accessed December 23, 2023).

Dasgupta, P. (2021). The Economics of Biodiversity: The Dasgupta Review. HM Treasury. https://assets.publishing.service.gov.uk/media/602e92b2e90e07660f807b47/The_Economics_of_Biodiversity_The_Dasgupta_Review_Full_Report.pdf

De Martino, S., Kondylis, F., & Zwager, A. (2017). Protecting the Environment. Public Finance Review, 45(1), 68–96. https://doi.org/10.1177/1091142115604352

Degirmenci, K., Desouza, K. C., Fieuw, W., Watson, R. T., & Yigitcanlar, T. (2021). Understanding policy and technology responses in mitigating urban heat islands: A literature review and directions for future research. Sustainable Cities and Society, 70, 102873. https://doi.org/10.1016/j.scs.2021.102873

Dominski, F. H., Lorenzetti Branco, J. H., Buonanno, G., Stabile, L., Gameiro da Silva, M., & Andrade, A. (2021). Effects of air pollution on health: A mapping review of systematic reviews and meta-analyses. Environmental Research, 201, 111487. https://doi.org/10.1016/j.envres.2021.111487

Drescher, K., & Janzen, B. (2023). When weather wounds workers: The impact of temperature on workplace accidents. BGPE Discussion Paper, No. 226.

Durán, R., Farizo, B. A., & Vázquez, M. X. (2015). Conservation of maritime cultural heritage: A discrete choice experiment in a European Atlantic Region. Marine Policy, 51, 356–365. https://doi.org/10.1016/j.marpol.2014.09.023

EEA. (2020). Environmental noise in Europe — 2020. EEA Report No 22/2019. https://www.eea.europa.eu/publications/environmental-noise-in-europe

Einarsdóttir, S. R., Cook, D., & Davíðsdóttir, B. (2019). The contingent valuation study of the

wind farm Búrfellslundur - Willingness to pay for preservation. Journal of Cleaner Production, 209, 795–802. https://doi.org/10.1016/j.jclepro.2018.10.156

ESVD. (2024). Ecosystem Services Valuation Database. https://www.esvd.info

EVRI. (2024). Environmental Valuation Reference Inventory. https://evri.ca/en

Falk, J., Attig-Bahar, F., Colwell, R.R., Behera, S.K., El-Beltagy, A.S., von Braun, J., Dasgupta, P., Gleick, P.H., Kaneko, R., Kennel, C.F. and Koundouri, P., 2022. Consensus statement from the presenters and International Advisory Committee of the Regional Action on Climate Change (RACC) Symposium held in conjunction with the Kyoto-based Science and Technology in Society (STS) Forum, 1 October 2021. SUSTAINABILITY SCIENCE, 17(1), pp.5-7.

Flammer, C. (2021). Corporate Green Bonds. Journal of Financial Economics, 142(2), 535-558.

Founda, D., & Santamouris, M. (2017). Synergies between Urban Heat Island and Heat Waves in Athens (Greece), during an extremely hot summer (2012). Scientific Reports, 7(1), 10973. https://doi.org/10.1038/s41598-017-11407-6

Generaal, E., Timmermans, E. J., Dekkers, J. E. C., Smit, J. H., & Penninx, B. W. J. H. (2019). Not urbanization level but socioeconomic, physical and social neighbourhood characteristics are associated with presence and severity of depressive and anxiety disorders. Psychological Medicine, 49(1), 149–161. https://doi.org/10.1017/S0033291718000612

Getzner, M., & Švajda, J. (2015). Preferences of tourists with regard to changes of the landscape of the Tatra National Park in Slovakia. Land Use Policy, 48, 107–119. https://doi.org/10.1016/j.landusepol.2015.05.018

Gigante, A., Papadaki, D., Mazzoli, C., Ntouros, V., De Masi, R. F., Assimakopoulos, M.-N., & Ferrante, A. (2024). Indoor quality-oriented approach for the performance evaluation of building retrofit with façade transformation: Case study of student dormitory in Mediterranean climate. Energy and Buildings, 312, 114227. https://doi.org/10.1016/j.enbuild.2024.114227

Guo, H., & Chen, M. (2018). Short-term effect of air pollution on asthma patient visits in Shanghai area and assessment of economic costs. Ecotoxicology and Environmental Safety, 161, 184–189. https://doi.org/10.1016/j.ecoenv.2018.05.089

Halkos, G. E. (2021). Economics of Natural Resources and the Environment (2nd Ed., in Greek). DISIGMA.

Halkos, G. E., & Aslanidis, P.-S. C. (2023a). Addressing Multidimensional Energy Poverty Implications on Achieving Sustainable Development. Energies, 16(9), 3805. https://doi.org/10.3390/en16093805

Halkos, G. E., & Aslanidis, P.-S. C. (2023b). Causes and Measures of Poverty, Inequality, and Social Exclusion: A Review. Economies, 11(4), 110. https://doi.org/10.3390/economies11040110

Halkos, G. E., & Aslanidis, P.-S. C. (2023c). Sustainable energy development in an era of geopolitical multi-crisis. Applying productivity indices within institutional framework.

Resources Policy, 85, 103854. https://doi.org/10.1016/j.resourpol.2023.103854
Halkos, G. E., & Aslanidis, P.-S. C. (2024a). How Waste Crisis altered the Common Understanding: from Fordism to Circular Economy and Sustainable Development. *Circular Economy and Sustainability*. https://doi.org/https://doi.org/10.1007/s43615-023-00337-3
Halkos, G. E., & Aslanidis, P.-S. C. (2024b). Green Energy Pathways Towards Carbon Neutrality. Environmental and Resource Economics. https://doi.org/10.1007/s10640-024-00856-z
Halkos, G. E., Bampatsou, C., & Aslanidis, P. -S. (2024). Global perspectives on club convergence: Unraveling the nexus of human and sustainable development in the face of corruption. Sustainable Development. https://doi.org/10.1002/sd.3137
Halkos, G. E., Koundouri, P. C., Aslanidis, P.-S. C., & Plataniotis, A. (2024). Evaluating the tangible and intangible parameters of cultural heritage: an economic meta-analysis in a global context. Discover Sustainability, 5(1), 187. https://doi.org/10.1007/s43621-024-00398-w
HM Treasury (2020). Final Report of the 2020 Green Book Review, 25 November 2020, ISBN 978-1-5286-2229-5. PU3051. London: HM Treasury.
Hang, N. D., Huong, T. T. L., Dat, T. T., Truong, D. D., & Huan, L. H. (2023). Valuing local residents' willingness to pay for the conservation of Cat Ba Marrine National Park, Vietnam. Applied Ecology and Environmental Research, 21(2), 1549–1563.
He, Z., & Zhai, G. (2017). How does probability judgment influence contingent valuation method to estimate WTP for natural disaster reduction. Human and Ecological Risk Assessment: An International Journal, 23(3), 508–518. https://doi.org/10.1080/10807039.2016.1208048
Heal et al. (2013). Decision-Making Under Uncertainty and the Economics of Climate Change. Environmental and Resource Economics, 62(3), 455-478.
Hegewald, J., Schubert, M., Freiberg, A., Romero Starke, K., Augustin, F., Riedel-Heller, S. G., Zeeb, H., & Seidler, A. (2020). Traffic Noise and Mental Health: A Systematic Review and Meta-Analysis. International Journal of Environmental Research and Public Health, 17(17), 6175. https://doi.org/10.3390/ijerph17176175
Hu, W., Qing, P., Penn, J., Pelton, M., & Pagoulatos, A. (2015). Rider preferences and economic values for equestrian trails. Journal of Environmental Planning and Management, 58(7), 1154–1172. https://doi.org/10.1080/09640568.2014.918027
Iglesias Merchan, C., Diaz-Balteiro, L., & Soliño, M. (2014). Noise pollution in national parks: Soundscape and economic valuation. Landscape and Urban Planning, 123, 1–9. https://doi.org/10.1016/j.landurbplan.2013.11.006
Ireland, A., Johnston, D., & Knott, R. (2023). Heat and worker health. Journal of Health Economics, 91, 102800. https://doi.org/10.1016/j.jhealeco.2023.102800
Japelj, A., Mavsar, R., Hodges, D., Kovač, M., & Juvančič, L. (2016). Latent preferences of residents regarding an urban forest recreation setting in Ljubljana, Slovenia. Forest Policy and Economics, 71, 71–79. https://doi.org/10.1016/j.forpol.2015.10.003
Kamri, T., Ali, J. K., & Aini Harun, N. F. (2017). Willingness to pay for conservation of natural

resources in Santubong National Park. Jurnal Manajemen Dan Kewirausahaan, 19(1). https://doi.org/10.9744/jmk.19.1.16-21

Kang, S., Shin, J., Kim, K., & Lee, C. H. (2021). Improving noise policies in South Korea: non-market valuation based on an impact pathway approach. Environmental Science and Pollution Research, 28(18), 23510–23520. https://doi.org/10.1007/s11356-020-12313-7

Keske, C. M. H., & Mayer, A. (2014). Visitor Willingness to Pay U.S. Forest Service Recreation Fees in New West Rural Mountain Economies. Economic Development Quarterly, 28(1), 87–100. https://doi.org/10.1177/0891242413506744

Khan, Lei, Ali, Ali, & Zhao. (2019). Public Attitudes, Preferences and Willingness to Pay for River Ecosystem Services. International Journal of Environmental Research and Public Health, 16(19), 3707. https://doi.org/10.3390/ijerph16193707

Kim, J.-H., Kim, C.-M., & Yoo, S.-H. (2021). Environmental conservation value of an endangered species: the case of Cypripedium Japonicum. Environmental Science and Pollution Research, 28(27), 36894–36903. https://doi.org/10.1007/s11356-021-14771-z

Kleiber, O. (2001). Valuation of Recreational Benefits and Visitor Conflicts in an Urban Forest. Fifth International Conference of the International Society for Ecological Economics (ISEE).

Koundouri, P. C., Aslanidis, P., Dellis, K., Feretzakis, G., & Plataniotis, A. (2024). Uncovering the SDG content of Human Security Policies through a Machine Learning web application. Department of International and European Economic Studies, Athens University of Economics and Business.

Koundouri, P. C., Halkos, G., Landis, C., Dellis, K., Stratopoulou, A., Plataniotis, A., & Chioatto, E. (2023). Valuation of marine ecosystems and Sustainable Development Goals. Frontiers in Environmental Economics, 2. https://doi.org/10.3389/frevc.2023.1160118

Kutiel, P. B., & Becker, N. (2020). Sand dunes management: a comparative analysis of ecological versus economic valuations applied to the Coastal region in Israel. Regional Environmental Change, 16, 941–950.

Latinopoulos, D., Mallios, Z., & Latinopoulos, P. (2016). Valuing the benefits of an urban park project: A contingent valuation study in Thessaloniki, Greece. Land Use Policy, 55, 130–141. https://doi.org/10.1016/j.landusepol.2016.03.020

Lera-López, F., Sánchez, M., Faulin, J., & Cacciolatti, L. (2014). Rural environment stakeholders and policy making: Willingness to pay to reduce road transportation pollution impact in the Western Pyrenees. Transportation Research Part D: Transport and Environment, 32, 129–142. https://doi.org/10.1016/j.trd.2014.07.003

Lewis, S. E., Popp, J. S., English, L. A., & Odetola, T. O. (2017). Willingness to Pay for Riparian Zones in an Ozark Watershed. Journal of Water Resources Planning and Management, 143(5). https://doi.org/10.1061/(ASCE)WR.1943-5452.0000740

Li, W., Chien, F., Hsu, C. C., Zhang, Y. Q., Nawaz, M. A., Iqbal, S., & Mohsin, M. (2021). Nexus between energy poverty and energy efficiency: Estimating the long-run dynamics. Resources Policy, 72(March), 102063. https://doi.org/10.1016/j.resourpol.2021.102063

Lindley, S. J., Cook, P. A., Dennis, M., & Gilchrist, A. (2019). Biodiversity, Physical Health and Climate Change: A Synthesis of Recent Evidence. In Biodiversity and Health in the Face of Climate Change (pp. 17–46). Springer International Publishing. https://doi.org/10.1007/978-3-030-02318-8_2

Liu, C., Chen, R., Sera, F., Vicedo-Cabrera, A. M., Guo, Y., Tong, S., Coelho, M. S. Z. S., Saldiva, P. H. N., Lavigne, E., Matus, P., Valdes Ortega, N., Osorio Garcia, S., Pascal, M., Stafoggia, M., Scortichini, M., Hashizume, M., Honda, Y., Hurtado-Díaz, M., Cruz, J., … Kan, H. (2019). Ambient Particulate Air Pollution and Daily Mortality in 652 Cities. New England Journal of Medicine, 381(8), 705–715. https://doi.org/10.1056/NEJMoa1817364

Liu, Z., Hanley, N., & Campbell, D. (2022). Effects of air pollution on Beijing residents' willingness to pay for green amenities.

Longo, A., Hoyos, D., & Markandya, A. (2015). Sequence Effects in the Valuation of Multiple Environmental Programs Using the Contingent Valuation Method. Land Economics, 91(1), 20–35. https://doi.org/10.3368/le.91.1.20

López-Mosquera, N., García, T., & Barrena, R. (2014). An extension of the Theory of Planned Behavior to predict willingness to pay for the conservation of an urban park. Journal of Environmental Management, 135, 91–99. https://doi.org/10.1016/j.jenvman.2014.01.019

Lowe, D., Ebi, K. L., & Forsberg, B. (2011). Heatwave Early Warning Systems and Adaptation Advice to Reduce Human Health Consequences of Heatwaves. International Journal of Environmental Research and Public Health, 8(12), 4623–4648. https://doi.org/10.3390/ijerph8124623

Markandya A, Ortiz RA, Chiabai A (2019) Estimating Environmental Health Costs: General Introduction to Valuation of Human Health Risks. In: Encyclopedia of Environmental Health. Elsevier, pp 719–727

Mahieu, P. A., Crastes, R., & Louviere, J. (2015). Lie Detection in Stated Preferences: the Recoding and the Reward Approaches. Paper Presented at the Third Workshop On Non-Market Valuation (WONV), Nancy, France.

Mohajerani, A., Bakaric, J., & Jeffrey-Bailey, T. (2017). The urban heat island effect, its causes, and mitigation, with reference to the thermal properties of asphalt concrete. Journal of Environmental Management, 197, 522–538. https://doi.org/10.1016/j.jenvman.2017.03.095

Molina, J. R., Silva, F. R. y, & Herrera, M. Á. (2016). Integrating economic landscape valuation into Mediterranean territorial planning. Environmental Science & Policy, 56, 120–128. https://doi.org/10.1016/j.envsci.2015.11.010

Morey, E. R., & Thiene, M. (2017). Can Personality Traits Explain Where and With Whom You Recreate? A Latent-Class Site-Choice Model Informed by Estimates From Mixed-Mode LC Cluster Models With Latent-Personality Traits. Ecological Economics, 138, 223–237. https://doi.org/10.1016/j.ecolecon.2017.03.038

Morrison, M., & Dowell, D. J. (2015). Sense of Place and Willingness to Pay: Complementary

Concepts When Evaluating Contributions of Cultural Resources to Regional Communities. Regional Studies, 49(8), 1374–1386. https://doi.org/10.1080/00343404.2013.827335

Münch, A., Nielsen, S. P. P., Racz, V. J., & Hjalager, A.-M. (2016). Towards multifunctionality of rural natural environments?—An economic valuation of the extended buffer zones along Danish rivers, streams and lakes. Land Use Policy, 50, 1–16. https://doi.org/10.1016/j.landusepol.2015.08.024

Mutafoglu, K., Brink, P. ten, Dekker, S., Woollard, J., & Schweitzer, J.-P. (2017). Adapting to climate change and improving urban resilience: the role of nature and biodiversity protection in cities. In Building a Climate Resilient Economy and Society. Edward Elgar Publishing. https://doi.org/10.4337/9781785368455.00015

Nijkamp, P. (2012). Economic Valuation of Cultural Heritage. In G. Licciardi & R. Amirtahmasebi (Eds.), *The economics of Uniqueness: Investing in Historic Citry Cores and Cultural Heritage Assets for Sustainable Development* (pp. 75–106). The World Bank.

O'Neill, S., & Yadav, L. P. (2016). Willingness to pay towards a public good: how does a refund option affect stated values? Journal of Environmental Planning and Management, 59(2), 342–359. https://doi.org/10.1080/09640568.2015.1010683

Ogbeide, O. A., Ford, C., & Stringer, R. (2015). The Environmental Benefits of Organic Wine: Exploring Consumer Willingness-to-Pay Premiums? Journal of Food Products Marketing, 21(5), 482–502. https://doi.org/10.1080/10454446.2013.856054

Ouyang, Z., Song, C., Zheng, H., Polasky, S., and Daily, G. C. (2020). Using gross ecosystem product (GEP) to value nature in decision making. Proc. Natl. Acad. Sci. U.S. A. 117, 201911439. doi: 10.1073/pnas.1911439117.

Palmieri, N., Suardi, A., & Pari, L. (2020). Italian Consumers' Willingness to Pay for Eucalyptus Firewood. Sustainability, 12(7), 2629. https://doi.org/10.3390/su12072629

Park, J., Lee, D., Park, C., Kim, H., Jung, T., & Kim, S. (2017). Park Accessibility Impacts Housing Prices in Seoul. Sustainability, 9(2), 185. https://doi.org/10.3390/su9020185

Perez Loyola, R., Wang, E., & Kang, N. (2021). Economic valuation of recreational attributes using a choice experiment approach: An application to the Galapagos Islands. Tourism Economics, 27(1), 86–104. https://doi.org/10.1177/1354816619885236

Petcharat, A., Lee, Y., & Chang, J. B. (2020). Choice Experiments for Estimating the Non-Market Value of Ecosystem Services in the Bang Kachao Green Area, Thailand. Sustainability, 12(18), 7637. https://doi.org/10.3390/su12187637

Pearce, D. W., and Turner, R. K. (1991). Economics of Natural Resources and the Environment. Baltimore, MD: The Johns Hopkins University Press.

Pimpin, L., Retat, L., Fecht, D., de Preux, L., Sassi, F., Gulliver, J., Belloni, A., Ferguson, B., Corbould, E., Jaccard, A., & Webber, L. (2018). Estimating the costs of air pollution to the National Health Service and social care: An assessment and forecast up to 2035. PLOS Medicine, 15(7), e1002602. https://doi.org/10.1371/journal.pmed.1002602

Ratzke, L. (2022). Revealing Preferences for Urban Biodiversity as an Environmental Good.

SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4257771
Raviv, O., Tchetchik, A., Lotan, A., Izhaki, I., & Zemah Shamir, S. (2021). Direct and indirect valuation of air-quality regulation service as reflected in the preferences towards distinct types of landscape in a biosphere reserve. Ecological Economics, 180, 106835. https://doi.org/10.1016/j.ecolecon.2020.106835
Rocchi, L., Cortina, C., Paolotti, L., Massei, G., Fagioli, F. F., Antegiovanni, P., & Boggia, A. (2019). Provision of ecosystem services from the management of Natura 2000 sites in Umbria (Italy): Comparing the costs and benefits, using choice experiment. Land Use Policy, 81, 13–20. https://doi.org/10.1016/j.landusepol.2018.10.007
Rolfe, J., & Windle, J. (2015). Multifunctional recreation and nouveau heritage values in plantation forests. Journal of Forest Economics, 21(3), 131–151. https://doi.org/10.1016/j.jfe.2015.06.001
Sanyal, S., Rochereau, T., Maesano, C. N., Com-Ruelle, L., & Annesi-Maesano, I. (2018). Long-Term Effect of Outdoor Air Pollution on Mortality and Morbidity: A 12-Year Follow-Up Study for Metropolitan France. International Journal of Environmental Research and Public Health, 15(11), 2487. https://doi.org/10.3390/ijerph15112487
Seidler, A., Hegewald, J., Seidler, A. L., Schubert, M., Wagner, M., Dröge, P., Haufe, E., Schmitt, J., Swart, E., & Zeeb, H. (2017). Association between aircraft, road and railway traffic noise and depression in a large case-control study based on secondary data. Environmental Research, 152, 263–271. https://doi.org/10.1016/j.envres.2016.10.017
Shen, Y., Wu, Y., Chen, G., Van Grinsven, H. J. M., Wang, X., Gu, B., & Lou, X. (2017). Non-linear increase of respiratory diseases and their costs under severe air pollution. Environmental Pollution, 224, 631–637. https://doi.org/10.1016/j.envpol.2017.02.047
Sicard, P., Agathokleous, E., Anenberg, S. C., De Marco, A., Paoletti, E., & Calatayud, V. (2023). Trends in urban air pollution over the last two decades: A global perspective. Science of The Total Environment, 858, 160064. https://doi.org/10.1016/j.scitotenv.2022.160064
Sinha, B., & Mishra, S. (2015). Ecosystem services valuation for enhancing conservation and livelihoods in a sacred landscape of the Indian Himalayas. International Journal of Biodiversity Science, Ecosystem Services & Management, 11(2), 156–167. https://doi.org/10.1080/21513732.2015.1030693
Song, X., Lv, X., & Li, C. (2015). Willingness and motivation of residents to pay for conservation of urban green spaces in Jinan, China. Acta Ecologica Sinica, 35(4), 89–94. https://doi.org/10.1016/j.chnaes.2015.06.003
Soy-Massoni, E., Langemeyer, J., Varga, D., Sáez, M., & Pintó, J. (2016). The importance of ecosystem services in coastal agricultural landscapes: Case study from the Costa Brava, Catalonia. Ecosystem Services, 17, 43–52. https://doi.org/10.1016/j.ecoser.2015.11.004
Stern, N. (2007). The Economics of Climate Change: The Stern Review. Cambridge University Press.
Su, W., Liu, M., Zeng, S., Štreimikienė, D., Baležentis, T., & Ališauskaitė-Šeškienė, I. (2018). Valuating renewable microgeneration technologies in Lithuanian households: A study on

willingness to pay. Journal of Cleaner Production, 191, 318–329. https://doi.org/10.1016/j.jclepro.2018.04.199

TEEB (2010). The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A Synthesis of the Approach, Conclusions and Recommendations of TEEB. London: TEEB.

Turner, R. K., Paavola, J., Cooper, P., Farber, S., Jessamy, V., and Georgiou, S. (2003). Valuing nature: lessons learned and future research directions. Ecol. Econ. 46, 493–510. doi: 10.1016/S.0921-8009(03)00189-7.

Turner, K.et al. (1993). Sustainable Environmental Economics and Management: Principles and Practice. Routledge.

Teotónio, I., Oliveira Cruz, C., Matos Silva, C., & Morais, J. (2020). Investing in Sustainable Built Environments: The Willingness to Pay for Green Roofs and Green Walls. Sustainability, 12(8), 3210. https://doi.org/10.3390/su12083210

Thomson, H., Bouzarovski, S., & Snell, C. (2017). Rethinking the measurement of energy poverty in Europe: A critical analysis of indicators and data. Indoor and Built Environment, 26(7), 879–901. https://doi.org/10.1177/1420326X17699260

Tilahun, M., Vranken, L., Muys, B., Deckers, J., Gebregziabher, K., Gebrehiwot, K., Bauer, H., & Mathijs, E. (2015). Rural Households' Demand for Frankincense Forest Conservation in Tigray, Ethiopia: A Contingent Valuation Analysis. Land Degradation and Development, 26.

Tooze, A. (2022). Welcome to the world of the polycrisis. Financial Times. https://www.ft.com/content/498398e7-11b1-494b-9cd3-6d669dc3de33

UNEP. (2023). Wastewater: Turning Problem to Solution - A UNEP Rapid Response Assessment. In United Nations Environment Programme. United Nations Environment Programme. https://doi.org/10.59117/20.500.11822/43142

van Steen, Y., Ntarladima, A.-M., Grobbee, R., Karssenberg, D., & Vaartjes, I. (2019). Sex differences in mortality after heat waves: are elderly women at higher risk? International Archives of Occupational and Environmental Health, 92(1), 37–48. https://doi.org/10.1007/s00420-018-1360-1

Varghese, B. M., Hansen, A., Nitschke, M., Nairn, J., Hanson-Easey, S., Bi, P., & Pisaniello, D. (2019). Heatwave and work-related injuries and illnesses in Adelaide, Australia: a case-crossover analysis using the Excess Heat Factor (EHF) as a universal heatwave index. International Archives of Occupational and Environmental Health, 92(2), 263–272. https://doi.org/10.1007/s00420-018-1376-6

Vojáček, O., & Louda, J. (2017). Economic value of ecosystem services in the eastern Ore mountains. E+M Ekonomie a Management, 20(3), 4–18. https://doi.org/10.15240/tul/001/2017-3-001

Varian HR (1992) Microeconomic Analysis, Third Edition. W.W.Norton Company, New York.

Wang, G., Song, Y., Chen, J., & Yu, J. (2016). Valuation of Haze Management and Prevention Using the Contingent Valuation Method with the Sure Independence Screening

Algorithm. Sustainability, 8(4), 310. https://doi.org/10.3390/su8040310
Wang, Y., Sun, M., Yang, X., & Yuan, X. (2016). Public awareness and willingness to pay for tackling smog pollution in China: a case study. Journal of Cleaner Production, 112, 1627–1634. https://doi.org/10.1016/j.jclepro.2015.04.135
Westerberg, V., Costa, L., & Gambashidze, G. (2017). Reducing Wildfires in Georgia: Cost Benefit Analysis of Agricultural Burning Practices in the Dedoplistskaro Municipality, Georgia. www.eld-initiative.org.
WHO. (2018a). Environmental Noise Guidelines for the European Region. World Health Organization: Geneva, Switzerland.
WHO. (2018b). World Health Organization releases new global air pollution data. https://www.ccacoalition.org/news/world-health-organization-releases-new-global-air-pollution-data
WHO. (2021). Urban health. https://www.who.int/news-room/fact-sheets/detail/urban-health
WHO. (2022). Health and Climate Change urban profiles. https://www.who.int/teams/environment-climate-change-and-health/climate-change-and-health/evidence-monitoring/urban-profiles
WHO. (2024). Exposure & health impacts of air pollution. https://www.who.int/teams/environment-climate-change-and-health/air-quality-energy-and-health/health-impacts/exposure-air-pollution
Wondifraw, Y., Taw, T. B., & Meried, E. W. (2021). Economic valuation of ecosystem services: application of a choice experiment approach on mount Guna services, North West of Ethiopia. Heliyon, 7(6), e07164. https://doi.org/10.1016/j.heliyon.2021.e07164
Xiang, J., Bi, P., Pisaniello, D., & Hansen, A. (2014). The impact of heatwaves on workers′ health and safety in Adelaide, South Australia. Environmental Research, 133, 90–95. https://doi.org/10.1016/j.envres.2014.04.042
Zhang, L., Fukuda, H., & Liu, Z. (2019). Households' willingness to pay for green roof for mitigating heat island effects in Beijing (China). Building and Environment, 150, 13–20. https://doi.org/10.1016/j.buildenv.2018.12.048
Zhang, L., Sun, C., Liu, H., & Zheng, S. (2016). The role of public information in increasing homebuyers' willingness-to-pay for green housing: Evidence from Beijing. Ecological Economics, 129, 40–49. https://doi.org/10.1016/j.ecolecon.2016.05.010
Zhang, P., Deschenes, O., Meng, K., & Zhang, J. (2018). Temperature effects on productivity and factor reallocation: Evidence from a half million chinese manufacturing plants. Journal of Environmental Economics and Management, 88, 1–17. https://doi.org/10.1016/j.jeem.2017.11.001
Zhang, S., Wang, B., Zhang, L., Lacasse, S., Nadim, F., & Chen, Y. (2023). Increased human risk caused by cascading hazards – A framework. Science of The Total Environment, 857, 159308. https://doi.org/10.1016/j.scitotenv.2022.159308
Zhang, Y., Chen, C., Ban, J., Zhao, J. H., Xu, D. D., Zhu, P. F., & Li, T. T. (2016). Willingness to Pay for Measures of Managing the Health Effects of Heat Wave in Beijing, China: a Cross-sectional Survey. Biomedical and Environmental Studies, 9.

https://doi.org/10.3967/bes2016.085

Appendix I

Table A.1: The WTP values extracted from the studies.

Title of the study	WTP Values	Reference
Estimating the Willingness to Pay to Preserve Waterfront Open Spaces Using Contingent Valuation.	3	(Dahal et al., 2018)
The Contingent Valuation Study of the Wind Farm Búrfellslundur - Willingness to Pay for Preservation.	1	(Einarsdóttir et al., 2019)
The Role of Public Information in Increasing Homebuyers' Willingness-to-Pay for Green Housing: Evidence from Beijing.	2	(L. Zhang et al., 2016)
Valuating Renewable Microgeneration Technologies in Lithuanian Households: A study on Willingness to Pay	2	(Su et al., 2018)
Willingness-to-Pay and Free-Riding in a National Energy Efficiency Retrofit Grant Scheme.	3	(Collins & Curtis, 2018)
Economic Valuation of Green Island, Taiwan: A Choice Experiment Method.	6	(H.-S. Chen & Chen, 2019)
Understanding Tourists' Willingness-to-Pay for Rural Landscape Improvement and Preference Heterogeneity.	4	(Cong et al., 2019)
Acoustic and Economic Valuation of Soundscape: An Application to the 'Retiro' Urban Forest Park.	1	(Calleja et al., 2017)
Contingent valuation approach in measuring the multifunctionality of agriculture and rural areas in Japan.	8	(Aizaki et al., 2006)
An extension of the Theory of Planned Behavior to predict willingness to pay for the conservation of an urban park.	1	(López-Mosquera et al., 2014)
Decoy effects in choice experiments and contingent valuation, asymmetric dominance.	4	(Bateman et al., 2008)
Recreational benefits of urban forests: Explaining visitors' willingness to pay in the context of the theory of planned behavior.	4	(Bernath & Roschewitz, 2008)
Can Personality Traits Explain Where and With Whom You Recreate? A Latent-Class Site-Choice Model Informed by Estimates From Mixed-Mode LC Cluster Models With Latent-Personality Traits.	6	(Morey & Thiene, 2017)

Can tenants afford to care? Investigating the willingness-to-pay for improved energy efficiency of rental tenants and returns to investment for landlords.	2	(Collins & Curtis, 2017)
Protest response and contingent valuation of an urban forest park in Fuzhou City, China.	4	(B. Chen & Qi, 2018)
Choice Experiments for Estimating the Non-Market Value of Ecosystem Services in the Bang Kachao Green Area, Thailand.	6	(Petcharat et al., 2020)
Community preferences for recycled water in Sydney.	2	(Bennett et al., 2016)
Conservation of Maritime Cultural Heritage: A Discrete Choice Experiment in a European Atlantic Region.	1	(Durán et al., 2015)
Contingent valuation and motivation analysis of tourist routes: an application to the cultural heritage of Valdivia, Chile.	3	(Báez-Montenegro et al., 2016)
Contingent Valuation of Road Traffic Noise: A Case Study in the Urban Area of Quito, Ecuador.	1	(Bravo-Moncayo et al., 2017)
Economic governance to expand commercial wetlands: within-and cross-scale challenges.	2	(Blaeij et al., 2011)
Differences in the Recreational Value of Urban Parks Between Weekdays and Weekends: A Discrete Choice Analysis.	4	(Bertram et al., 2017)
Direct and Indirect Valuation of Air-Quality Regulation Service as Reflected in the Preferences Towards Distinct Types of Landscape in a Biosphere Reserve.	4	(Raviv et al., 2021)
Economic Valuation of Ecosystem Services: Application of a Choice Experiment Approach on Mount Guna Services, North West of Ethiopia.	3	(Wondifraw et al., 2021)
Economic valuation of recreational attributes using a choice experiment approach: An application to the Galapagos Islands.	3	(Perez Loyola et al., 2021)
Economic Value of Ecosystem Services in the Eastern Ore Mountains.	1	(Vojáček & Louda, 2017)
Ecosystem Services Valuation For Enhancing Conservation And Livelihoods In A Sacred Landscape Of The Indian Himalayas.	3	(Sinha & Mishra, 2015)
Effects of air pollution on Beijing residents' willingness to pay for green amenities.	14	(Z. Liu et al., 2022)

Environmental conservation value of an endangered species: the case of Cypripedium Japonicum.	1	(Kim et al., 2021)
Estimating the Cost of Air pollution in South East Queensland: An Application of the Life Satisfaction Non-market Valuation Approach.	1	(Ambrey et al., 2014)
Good parks – Bad Parks: The Influence of Perceptions of Location on WTP and Preference Motives for Urban Parks.	6	(Andrews et al., 2017)
Households' willingness to pay for green roof mitigating heat island effects in Beijing (China).	2	(L. Zhang et al., 2019)
How Does Probability Judgment Influence Contingent Valuation Method to Estimate WTP for Natural Disaster Reduction.	1	(He & Zhai, 2017)
Improving noise policies in South Korea: non-market valuation based on an impact pathway approach.	8	(Kang et al., 2021)
Integrating economic landscape valuation into Mediterranean territorial planning.	2	(Molina et al., 2016)
Investing in Sustainable Built Environments: The Willingness to Pay for Green Roofs and Green Walls.	3	(Teotónio et al., 2020)
Italian Consumers' Willingness to Pay for Eucalyptus Firewood.	1	(Palmieri et al., 2020)
Valuation of recreational benefits and visitor conflicts in an urban forest.	1	(Kleiber, 2001)
Latent Preferences of Residents Regarding An Urban Forest Recreation Setting in Ljubljana, Slovenia.	20	(Japelj et al., 2016)
Lie Detection in Stated Preferences: the Recoding and the Reward Approaches.	3	(Mahieu et al., 2015)
Multifunctional Recreation and Nouveau Heritage Values in Plantation Forests.	1	(Rolfe & Windle, 2015)
Noise Pollution in National Parks: Soundscape and Economic Valuation.	1	(Iglesias Merchan et al., 2014)
Park Accessibility Impacts Housing Prices in Seoul.	1	(Park et al., 2017)
Payment Vehicle as an Instrument to Elicit Economic Demand for Conservation.	1	(Carneiro & Carvalho, 2014)

Preferences of Tourists With Regard to Changes of the Landscape of the Tatra National Park in Slovakia.	2	(Getzner & Švajda, 2015)
Protecting the Environment: For Love or Money? The Role of Motivation and Incentives in Shaping Demand for Payments for Environmental Services Programs.	1	(De Martino et al., 2017)
Provision of ecosystem services from the management of Natura 2000 sites in Umbria (Italy): Comparing the costs and benefits, using choice experiment.	2	(Rocchi et al., 2019)
Public Attitudes, Preferences and Willingness to Pay for River Ecosystem Services.	7	(Khan et al., 2019)
Public Awareness and Willingness to Pay for Tackling Smog Pollution in China: A Case Study.	1	(Y. Wang et al., 2016)
Public willingness-to-pay for conserving urban heritage trees in Guangzhou, south China.	2	(W. Y. Chen, 2015)
Revealing preferences for urban biodiversity as an environmental good.	2	(Ratzke, 2022)
Rider Preferences and Economic Values for Equestrian Trails.	1	(Hu et al., 2015)
Rural environment stakeholders and policy making: Willingness to pay to reduce road transportation pollution impact in the Western Pyrenees.	2	(Lera-López et al., 2014)
Rural Households' Demand for Frankincense Forest Conservation in Tigray, Ethiopia: A Contingent Valuation Analysis.	1	(Tilahun et al., 2015)
Sand Dunes Management: a Comparative Analysis of Ecological versus Economic Valuations Applied to the Coastal Region in Israel.	1	(Kutiel & Becker, 2020)
Sense of Place and Willingness to Pay: Complementary Concepts When Evaluating Contributions of Cultural Resources to Regional Communities.	3	(Morrison & Dowell, 2015)
Sequence Effects in the Valuation of Multiple Environmental Programs Using the Contingent Valuation Method.	2	(Longo et al., 2015)
Social Sustainability of Renewable Energy Sources in Electricity Production: An Application of the Contingent Valuation Method.	4	(Botelho et al., 2016)
The importance of ecosystem services in coastal agricultural landscapes: Case study from the Costa Brava, Catalonia.	7	(Soy-Massoni et al., 2016)
The contingent valuation study of Heidmörk, Iceland - Willingness to pay for its preservation.	2	(Cook et al., 2018)

The Environmental Benefits of Organic Wine: Exploring Consumer Willingness-to-Pay Premiums?	1	(Ogbeide et al., 2015)
The value of naturalness of urban green spaces: Evidence from a discrete choice experiment.	1	(Bronnmann et al., 2020)
Towards multifunctionality of rural natural environments? An economic valuation of the extended buffer zones along Danish rivers, streams and lake.	1	(Münch et al., 2016)
Transport Infrastructures, Environment Impacts and Tourists' Welfare: a Choice Experiment to Elicit Tourist Preferences in Siena, Italy.	2	(Bimonte et al., 2016)
Valuation of Haze Management and Prevention Using the Contingent Valuation Method with the Sure Independence Screening Algorithm.	1	(G. Wang et al., 2016)
Valuing Local Residents' Willingness to Pay for the Conservation of Cat Ba Marine National Park, Vietnam.	1	(Hang et al., 2023)
Valuing Shifts in the Distribution of Visibility in National Parks and Wilderness Areas in the United States.	3	(Boyle et al., 2016)
Valuing the Benefits of an Urban Park Project: A Contingent Valuation Study in Thessaloniki, Greece.	1	(Latinopoulos et al., 2016)
Reducing Wildfires in Georgia: A Cost Benefit Analysis of Agricultural Burning Practices in the Dedoplistskaro Municipality, Georgia.	2	(Westerberg et al., 2017)
Visitor Willingness to Pay U.S. Forest Service Recreation Fees in New West Rural Mountain Economies.	2	(Keske & Mayer, 2014)
Who pays more to preserve a natural reserve, visitors or locals? A confidence analysis of a contingent valuation application.	2	(Aoun, 2015)
Willingness and motivation of residents to pay for conservation of urban green spaces in Jinan, China.	1	(Song et al., 2015)
Willingness to pay for biodiversity conservation in Dachigam National Park, India.	1	(Bhat & Sofi, 2021)
Willingness to pay for conservation of natural resources in santubong national park.	1	(Kamri et al., 2017)
Willingness to Pay for Measures of Managing the Health Effects of Heat Wave in Beijing, China: a Cross-sectional Survey.	1	(Y. Zhang et al., 2016)
Willingness to Pay for Public Health Policies to Treat Illnesses.	2	(Bosworth et al., 2015)
Willingness to Pay for Riparian Zones in an Ozark Watershed.	1	(Lewis et al., 2017)
Willingness to pay of committed citizens: A field experiment.	2	(Ami et al., 2014)

Willingness To Pay Towards A Public Good: How Does A Refund Option Affect Stated Values?	1	(O'Neill & Yadav, 2016)
Willingness-to-Pay for Environmental Services Provided by Trees in Core and Fringe Areas of Benin City, Nigeria.	1	(Arabomen et al., 2019)

Appendix II

A.1 Choice Experiment Questionnaire – English Version

Case Study 1: Greening the Athens Metropolitan Area

Research laboratory on Socio-Economic and Environmental Sustainability (ReSEES) - Athens University ofEconomics and Business

Dear Sir/Madam:

Hello! Today you will be asked to
answer some questions about your opinions on Athens Metropolitan Area (AMA).

Who is funding this work?

ARSINOE is an EU-funded project aimed at creating climate resilient-regions through systemic solutions and innovations. ARSINOE will shape the pathways to resilience by bringing together the Systems Innovation Approach (SIA) and the Climate Innovation Window (CIW) to build an ecosystem for climate change adaptation solutions. This approach is showcased in nine demonstrators, as a proof-of-concept with regards to its applicability, replicability, potential and efficacy.

This specific part combines scientific, economic, and social research in order to investigate answers totwo main questions:

- What are possible ways to improve the health of Athens Metropolitan Area between nowand 2030/2050?
- What larger impacts, if any, might there be because of taking action to tryand improve the conditions of Athens Metropolitan Area, with focus to the Municipality of Athens?

What will I be asked to do?

There are several parts to this
survey that you will be asked to complete should you agree to participate.

- Part I: You will be asked to provide us with some of your opinions about the AthensMetropolitan Area.

Part II: You will then be asked to read a small amount of background information
Part III: You will be presented with a series of choice-based questions. Each question will ask you to compare two scenarios. For each comparison question,you will be asked to pick the scenario that you prefer the most.
Part IV: You will be asked to answer some background classification questions aboutyourself. These questions will **not** be connected to your name but will allow us to improve our analysis of the results of the survey
Part V: You will be asked to provide feedback on the survey itself.

There are no wrong answers in this survey because it is only your opinions that matter

How will my answers be used?

The answers provided to the questions in the survey will help us to assess some of the positive and negative consequences that might arise as a result of various hypothetical efforts to improve the quality of life? of the Athens Metropolitan Areabetween now and 2030. When the answers from every respondent are collected, they will be made anonymous and combined with the answers of all theother participants to help us assess these potential impacts.

Additionally, all the answers to this survey are strictly confidential. Under no circumstances will your answers be linked to your name, and in no case will they be forwarded to the European Commission, any other government, university,or third party.

Why have I been invited to take part?

You have been asked to take part in this survey as a part of a sample of the public of this region and because your opinions on these issues are valued. If at any point during the survey youshould wish to leave, you are free to do so.

If you are happy to participate in the survey today and understand that you are free to leave at any time as well as you have been given all the necessary information for that survey and your rights as participant, please check the box below, and continue to the next page and the completion of the questionnaire.

* Indicates required question

Greening the Athens Metropolitan Area

Happy to Participate? *

Check all that apply.

YES, I confirm that I am happy to participate in this survey today, and yes, I understand that I may leave at any timebefore the end of the survey if I want to.
NO. Thank you for your time, have a good day/afternoon.

Part I: Opinions on the Athens Metropolitan Area

First, we
have a few questions to help us understand some of your opinions about the Athens Metropolitan Area. There is no wronganswer to these questions. Please also remember that all of these answers are completelyconfidential. We will never use them to identify individuals.

1. In what city and country were you born? *

2. In what city and country do you currently live? *

3. Is there anything in the urban environment that you perceive as being important to your culture? *

Check all that apply.

History Arts Daily LifeReligion
I don't knowNothing
Other:

4. It is absolutely safe to say that the Athens Metropolitan Area is currently experiencing environmental damage/degradation? due to human activities *

Mark only one oval.

Strongly Agree Somewhat Agree
Neither Agree Not DisagreeSomewhat Disagree Strongly Disagree

5. The quality of life in the Athens Metropolitan Area needs to be improved. *

Mark only one oval.

Strongly Agree Somewhat Agree
Neither Agree Not DisagreeSomewhat Disagree Strongly Disagree

6. Improving the quality of life of the Athens Metropolitan Area is the responsibility of: *

Check all that apply.

	Strongly Agree	Somewhat Agree	Neither Agree Nor Disagree	Somewhat Disagree	StronglyDisagree
The Government?	☐	☐	☐	☐	☐
Local/Regional Authorities?	☐	☐	☐	☐	☐
EverydayCitizens?	☐	☐	☐	☐	☐

7. A high level of quality of life is essential for tourism development. *

Mark only one oval.

Strongly Agree Somewhat Agree
Neither Agree Nor DisagreeSomewhat Disagree Strongly Disagree

8. Taxes are a more stable way of maintaining the funding necessary to successfully manage the urban * environment than are donations and EU funds ?

Mark only one oval.

Strongly Agree Somewhat Agree
Neither Agree Nor DisagreeSomewhat Disagree Strongly Disagree

9. We should do something to significantly reduce air pollution in Athens Metropolitan Area even if the economy slows down because of this. *

Mark only one oval.

Strongly Agree Somewhat Agree
Neither Agree Nor DisagreeSomewhat Disagree Strongly Disagree

PART II: Geographical Information on the Athens Metropolitan Area

Necessary information about the current condition in Athens Metropolitan Area. Please take a look!

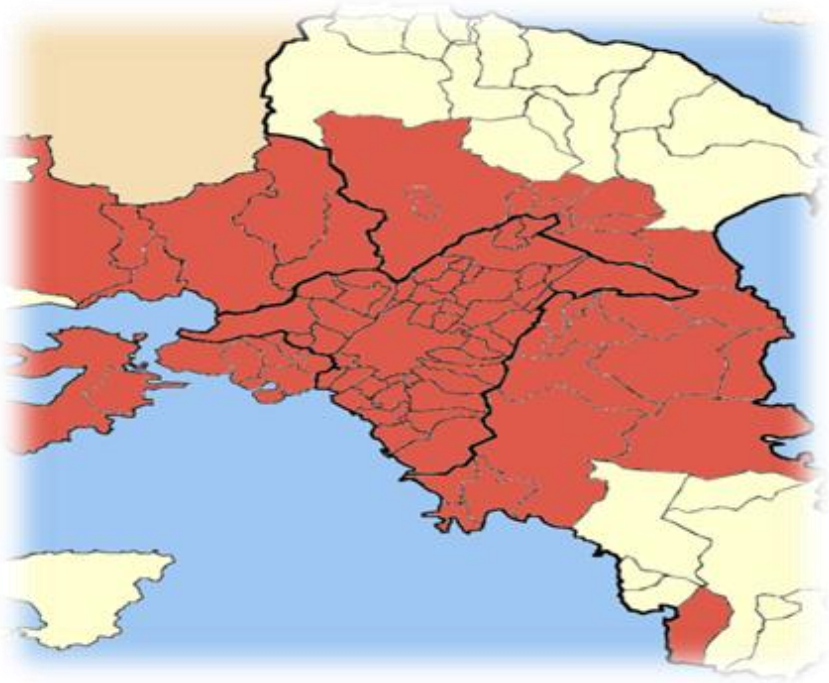
Climatic and Demographic characteristics of AMA

What happens to Athens Metropolitan area (AMA) is important and requires the attention of the policymakers. The main task ofthe questionnaire is to explore what lowers living standards. Specifically, some phenomena that might aggravate urban living standards are:

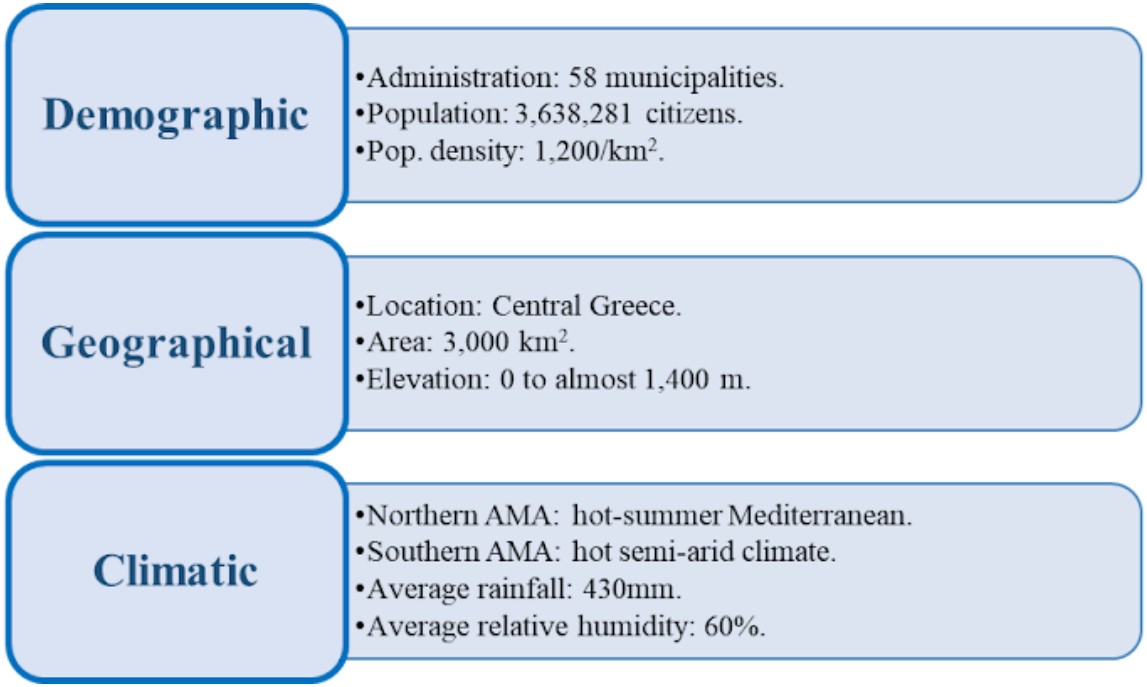
- Heatwaves – Climate – Urban Heat Island (UHI) effectPopulation density – violence
- Air pollution Traffic – Noise
- Health issues – Morbidity and mortality.

The aforementioned phenomena are considered as our attributes with changing levelsas well be shown in the choice cards. Below there is a summary of the main demographic, geographic, and climatic characteristics in AMA.

Athens Metropolitan Area



Demographic Characteristics



The interrelations between the study attributes

Risk assessment is based on the interrelations between (i) hazards, (ii) vulnerabilities, and (iii) exposures, which are also the attributes of the present study. In essence, this three-level assessment might/can enable tounderstand how to build resilience to risks in urban systems.

The hazards

The first level refers to the main *hazards* that can pressure the urban systems. The main hazards can be further decomposedinto primary hazards (e.g, heatwave, air pollution, traffic, and noise) and the cascading hazards (e.g., biodiversity loss, population density, overcrowding and violence).

Air pollution in AMA main pollutants are carbon dioxide (CO2) and particulate matter (e.g., PM2.5 and PM10). Significant factors for respiratory problems lie with rising air pollution levels. Especially the urban heat island (UHI) effect denotes that thehigh morning temperatures cannot be lowered during nighttime due to inadequate building infrastructure or lack of green and blue spaces.

Traffic and noise can have adverse impacts on human well-being. For example, the long commute from and towards theworking place, the construction operation, and even café-bars. Apparently, other negative phenomena are drug dealing inDowntown Athens or minor wrongdoings that are boosting criminality and violence in some districts.

Biodiversity loss can be easily spotted in a city's center, biodiversity loss can be the inexistence of green (e.g., trees and bushes) or blue (e.g., and fountains) infrastructure. Green spaces have positive environmental functions that can alleviate a cityfrom problems like air pollution and noise.

Figure 1: Air Pollution in AMA. Acropolis of Athens (Left) and the Hellenic Parliament (Right).

Figure 2: Heatwaves can affect residents and the natural environment.

Figure 3: Population density, traffic, noise in Athens.

Figure 4: Urban biodiversity examples

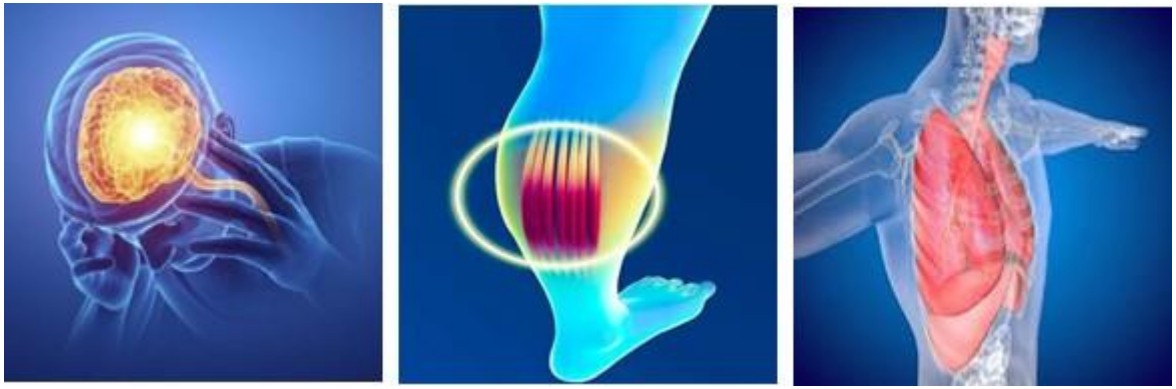
The Vulnerabilities

The second level refers to the *vulnerabilities*, which measure the impact of main *hazards on human well-being*. The evaluation of the vulnerabilities also contains information about the pressures on the economy (e.g., tourism) and on society(e.g., human health).

More essentially, vulnerabilities play a significant role in urban sustainability as they are related to vulnerabilities is the riseof *morbidity and mortality* rates, especially for pregnant women, people with asthma or aged people, during heatwave ordecrease of tourism.

Figure 5: Health issues due to different hazards in AMA.

Figure 6: Health issues due to heatwaves, in more detail (a) headache, (b) creation of clots, and (c) cardiovascular and respiratory deceases, and (d) mental health issues.



The Exposures

The third level (micro-level) tries to grasp the main *impacts* on the people, meaning that it is important to monitor how theexposure to hazards affects residents, tourists, workers, and also the fauna and flora.

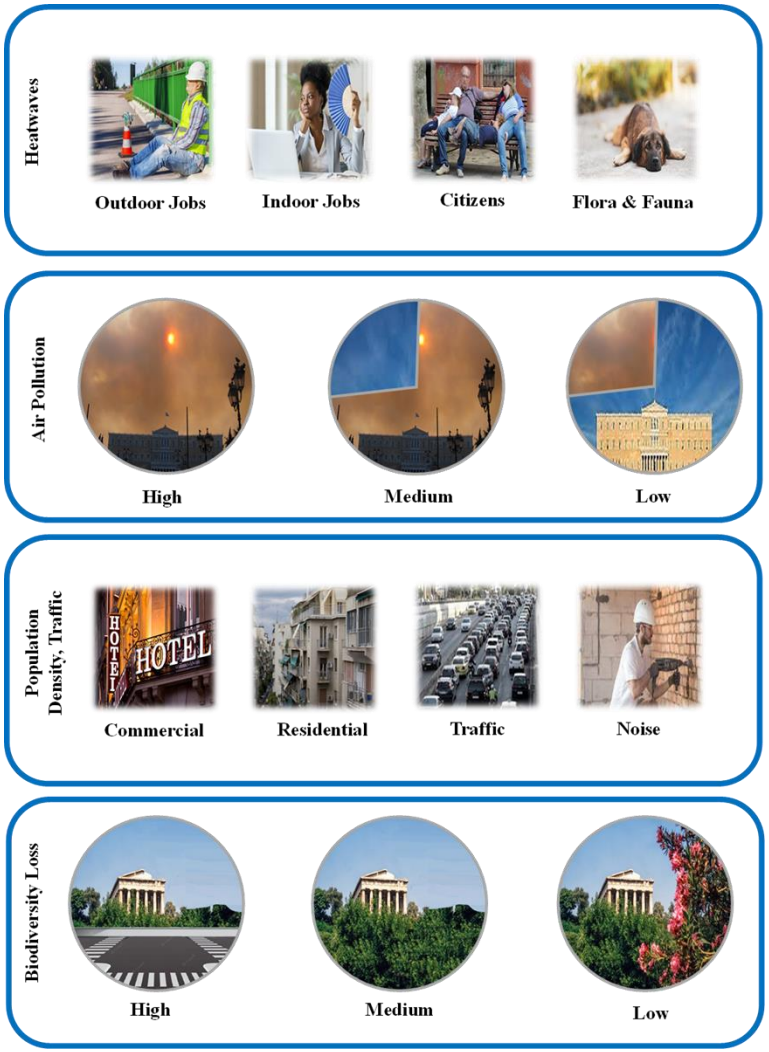
The *workers on outdoor operations* (e.g., delivery personnel, construction workers, or waiters) ought to be also asked howhazards affect them. Another special category of group with great exposure is *women* (e.g. pregnant women)
and *elderly* people due to different reasons (e.g., heatwaves, air pollution, or noise).

Figure 7: Exposure on heatwaves for different social groups: (a) tourists or residents, (b) workers or business,and (c) animals or plants.

Part III: Choice Experiment

Please have in mind that you are going to answer two different scenarios, both of which have four different price choices.

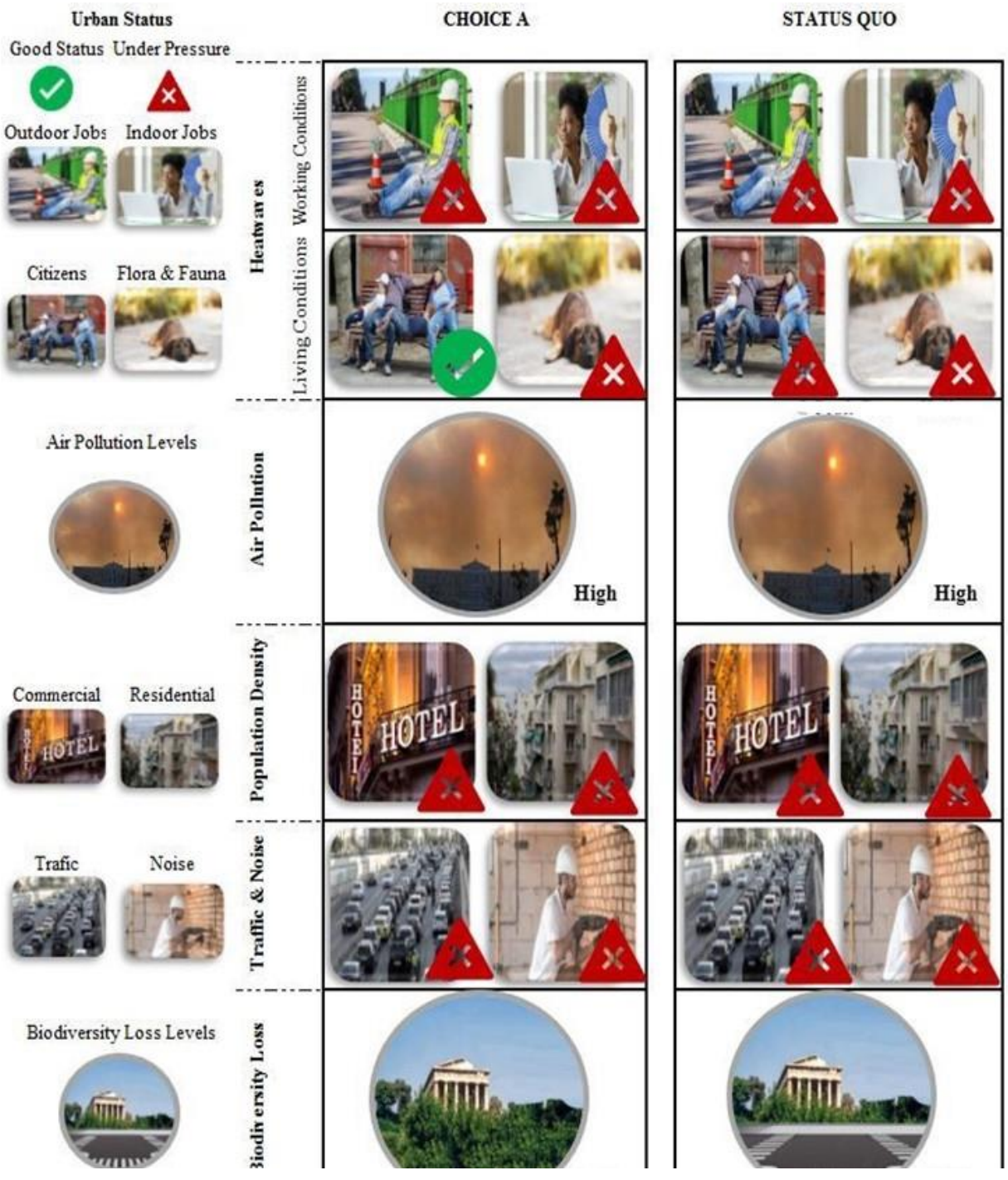
Legend
The attributes of the questionnaire and their levels

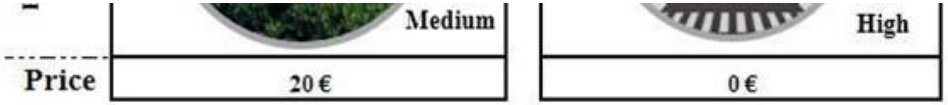


Choice A

Air Quality and Population are under pressure at Choice A scenario. You have to select either the proposed price at the leftcolumn of the Figure or the current condition card (Status Quo= 0 Euros) at the right column.

Choice A: 20 Euros

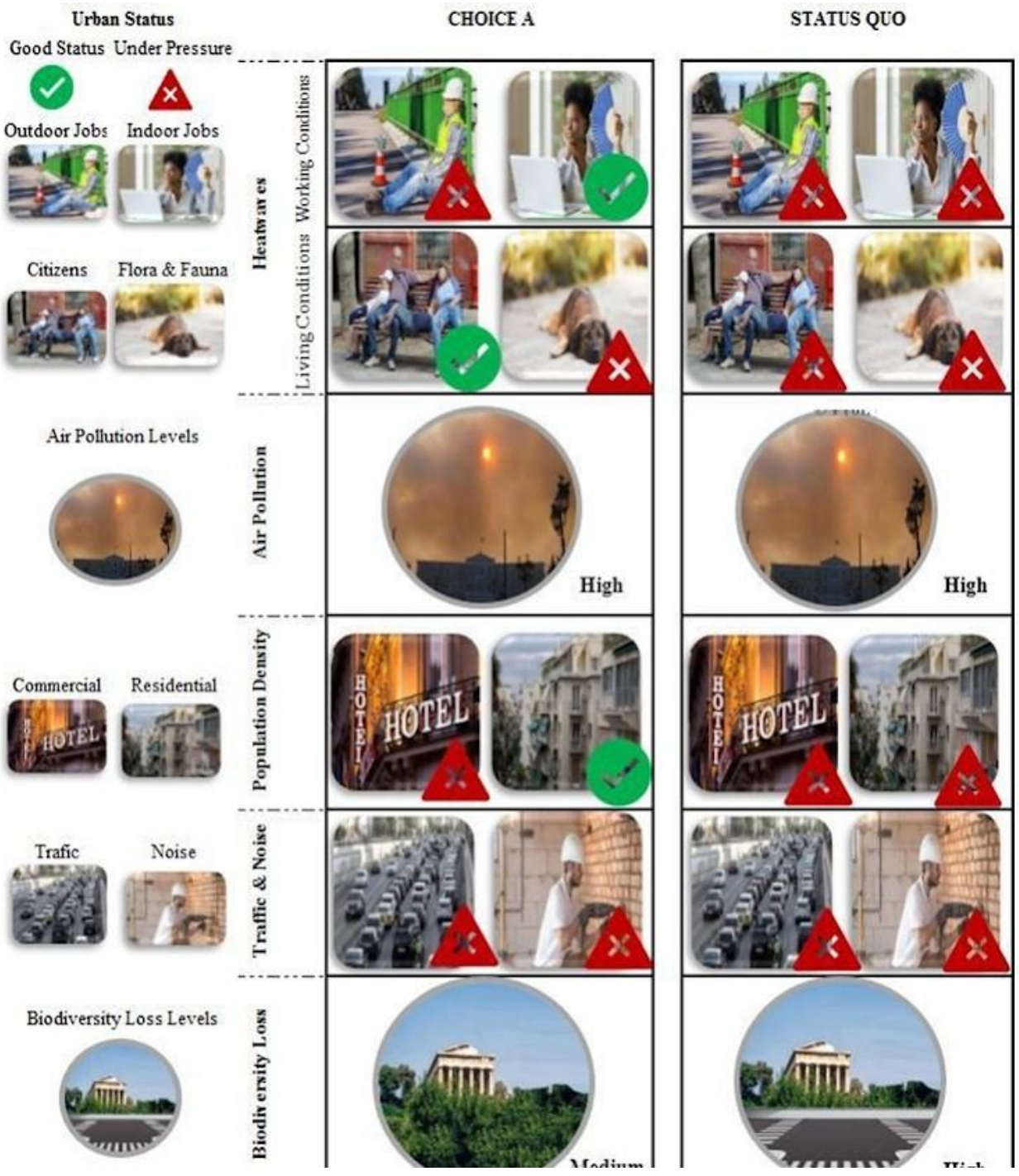

Urban Status
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Air Pollution Levels
Commercial
Residential
Trafic
Noise
Biodiversity Loss Levels
CHOICE A
STATUS QUO
Heatwaves
Working Conditions
Living Conditions
Air Pollution
High
High
Population Density
Traffic & Noise
Biodiversity Loss
HOTEL



Check all that apply.

20 Euros ☐
0 Euro ☐

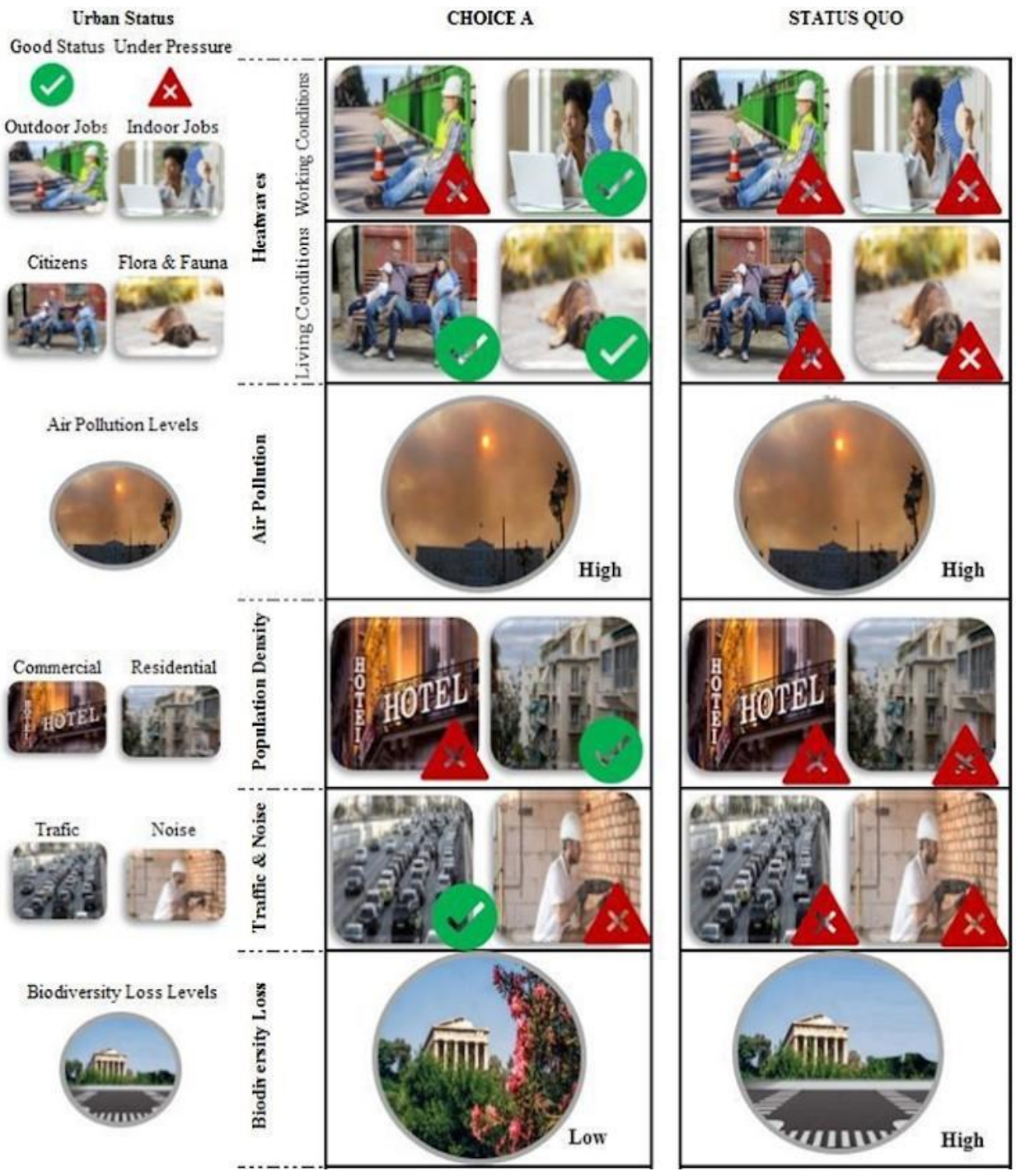
Choice A: 40 Euros


Urban Status
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Air Pollution Levels
Commercial
Residential
HOTEL
Trafic
Noise
Biodiversity Loss Levels
Heatwaves
Working Conditions
Living Conditions
Air Pollution
Population Density
Traffic & Noise
Biodiversity Loss
CHOICE A
STATUS QUO
High
High
Medium

Check all that apply.

40 Euros ☐
0 Euro ☐

Choice A: 80 Euros

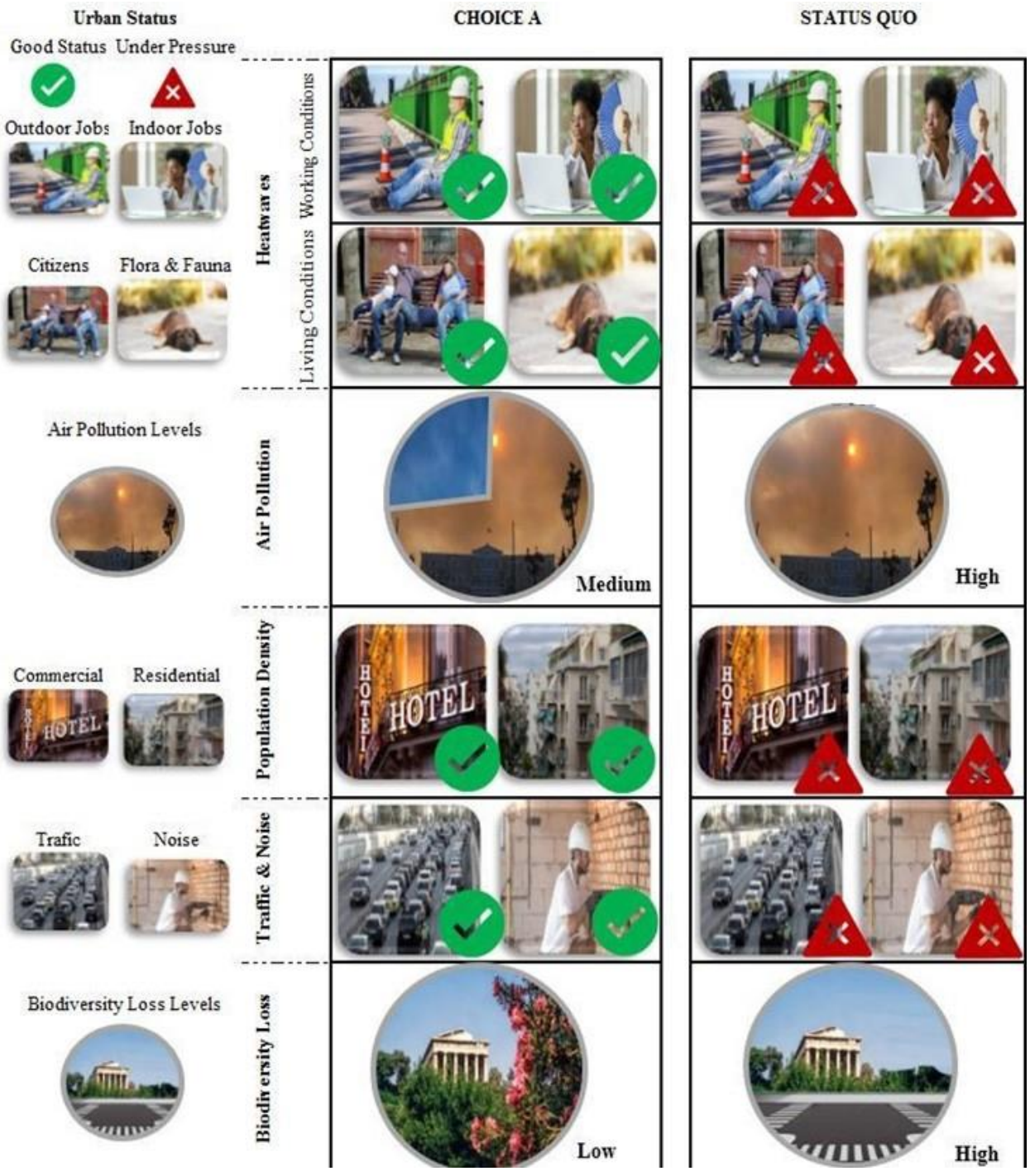

Urban Status
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Air Pollution Levels
Commercial
Residential
Trafic
Noise
Biodiversity Loss Levels
CHOICE A
STATUS QUO
Heatwaves
Working Conditions
Living Conditions
Air Pollution
High
High
Population Density
HOTEL
Traffic & Noise
Biodiversity Loss
Low
High

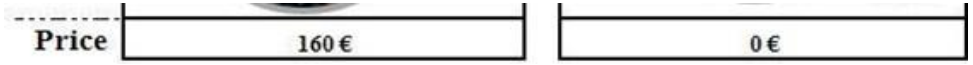
Price	80 €	0 €

Check all that apply.

80 Euros ☐
0 Euro ☐

Choice A: 160 Euros


Urban Status
CHOICE A
STATUS QUO
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Heatwaves
Working Conditions
Living Conditions
Air Pollution Levels
Air Pollution
Medium
High
Commercial
Residential
Population Density
HOTEL
Trafic
Noise
Traffic & Noise
Biodiversity Loss Levels
Biodiversity Loss
Low
High



Check all that apply.

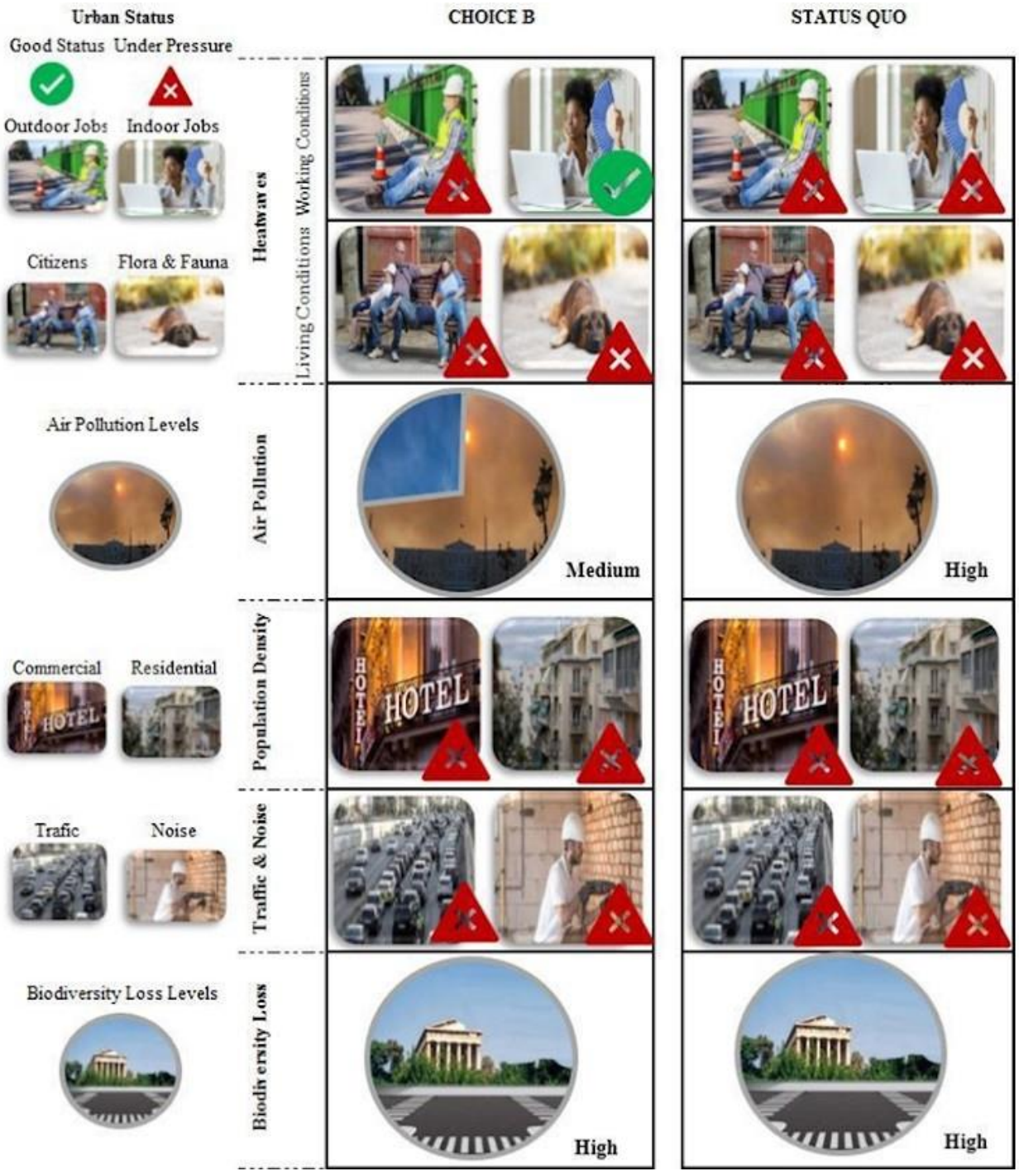
160 Euros ☐
0 Euro ☐

Choice B

Biodiver*sity is under pressure at Choice B scenario.*

You have to select either the proposed price at the left column of the Figure or the current condition card (Status Quo= 0 Euros)at the right column.

Choice B: 20 Euros

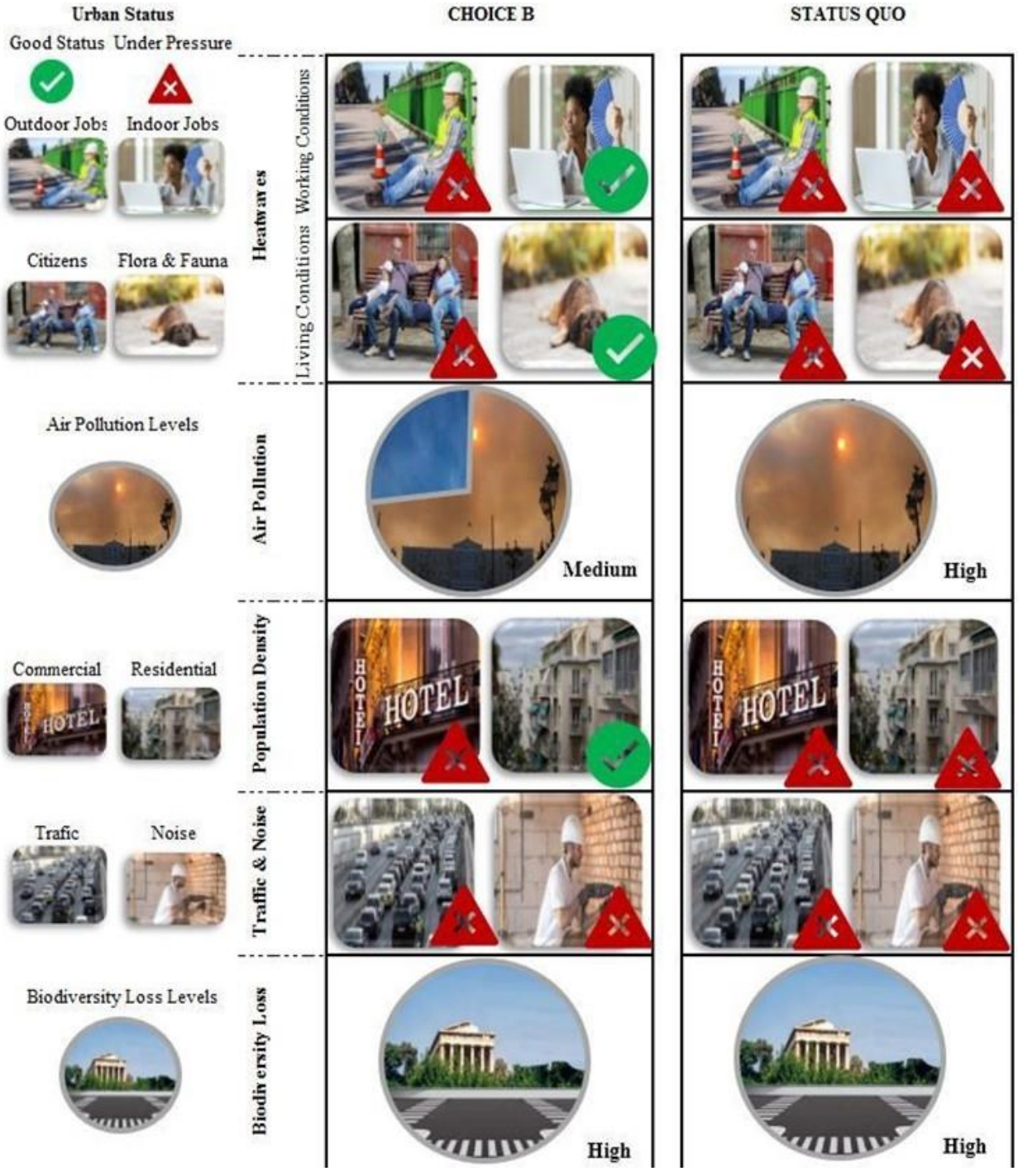

Urban Status
CHOICE B
STATUS QUO
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Heatwaves
Working Conditions
Living Conditions
Air Pollution Levels
Air Pollution
Medium
High
Commercial
Residential
HOTEL
Population Density
Trafic
Noise
Traffic & Noise
Biodiversity Loss Levels
Biodiversity Loss
High
High

Price	20 €	0 €

Check all that apply.

20 Euros ☐
0 Euro ☐

Choice B: 40 Euros


Urban Status
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Air Pollution Levels
Commercial
Residential
HOTEL
Trafic
Noise
Biodiversity Loss Levels
Heatwaves
Working Conditions
Living Conditions
Air Pollution
Population Density
Traffic & Noise
Biodiversity Loss
CHOICE B
STATUS QUO
Medium
High
High
High

Price	40 €	0 €

Check all that apply.

40 Euros ☐
0 Euro ☐

Choice B: 80 Euros

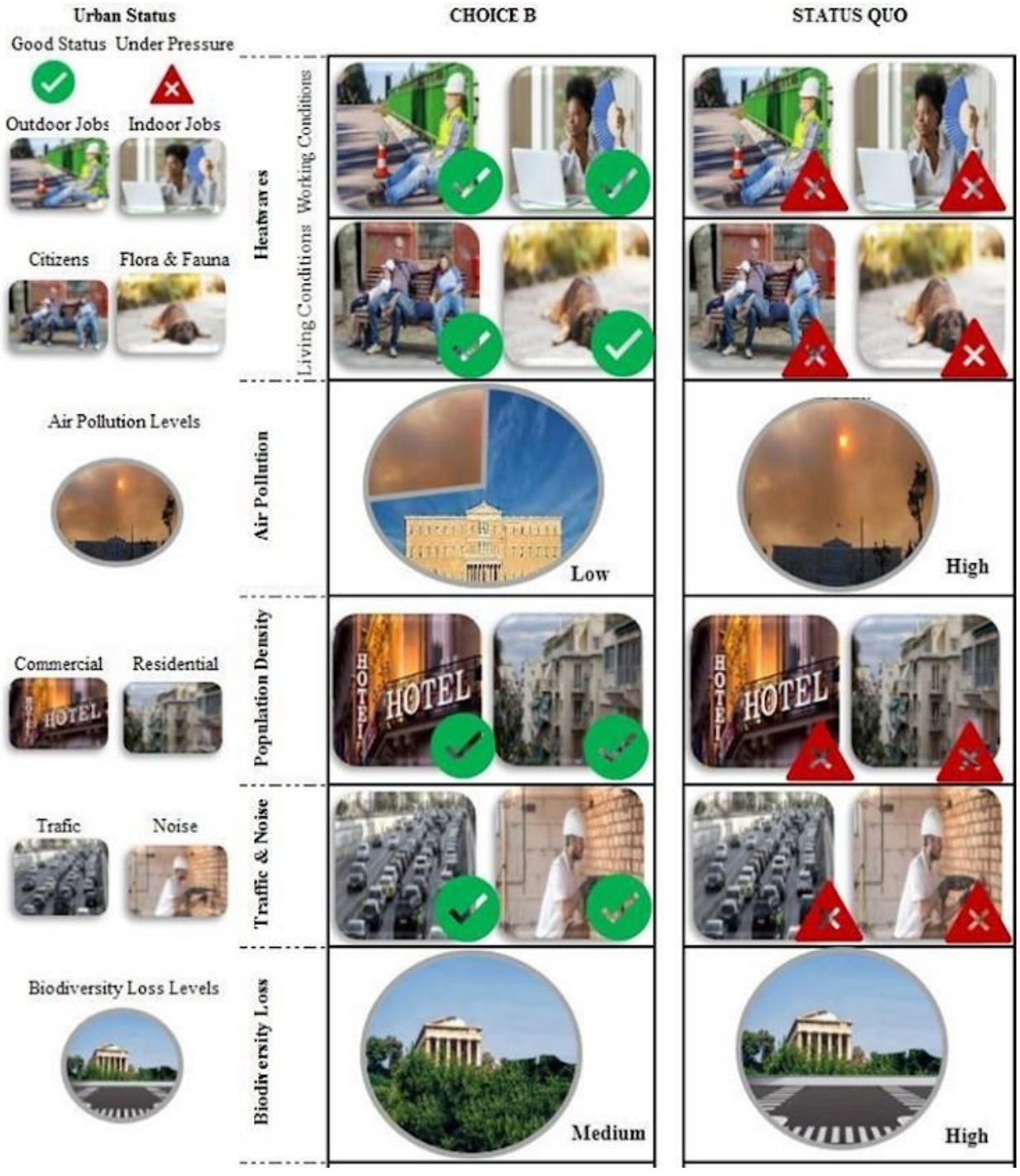

Urban Status
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Air Pollution Levels
Commercial
Residential
Trafic
Noise
Biodiversity Loss Levels
CHOICE B
STATUS QUO
Heatwaves
Working Conditions
Living Conditions
Air Pollution
Medium
High
Population Density
HOTEL
Traffic & Noise
Biodiversity Loss
Medium
High

Price 80€ 0€

Check all that apply.

80 Euros ☐
0 Euro ☐

Choice B: 160 Euros


Urban Status
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Air Pollution Levels
Commercial
Residential
HOTEL
Trafic
Noise
Biodiversity Loss Levels
CHOICE B
STATUS QUO
Heatwaves
Working Conditions
Living Conditions
Air Pollution
Low
High
Population Density
Traffic & Noise
Biodiversity Loss
Medium
High

Price	160 €	0 €

Check all that apply.

160 Euros ☐
0 Euro ☐

Part IV: Demographic and attitude profile

1. What is your gender? *

Check all that apply.

Male Female ☐
Prefer not to say ☐
☐

2. What is your age? *

Check all that apply.

18-25 ☐
26-35 ☐
36-45 ☐
46-55 ☐
56-65 ☐
Older than 65 ☐

3. Please describe your marital status *

Check all that apply.

Single Married
Separated/DivorcedWidowed

4. Do you have children and/or grandchildren under the age of 18? *

Check all that apply.

YesNo

5. Educational level having been completed: *

Check all that apply.

- [ ] Has not attended/completed any education level
- [ ] (Dimotiko) Primary school
- [ ] (Gymnasium) Lower secondary school
- [ ] General/ Vocational (EPAL) lyceum (Upper secondary) Institutes of vocational training (IEK) (upper secondary) Technical Vocational Institutes
- [ ] (TEI) (Tertiary education)Universities, higher military schools, Open University Post graduate studies (Msc.,MBA, MA, Mlit, MPHIL) Doctorate
- [ ] Other: _____

6. Occupation *

Check all that apply.

Full-time job in the public sector Part-time job in the public sector Full-time job in the private sectorPart-time job in the private sectorUnemployed Pensioner Student Freelancer Homemaker
Other:

7. Is your work focused on the environment?*

Check all that apply.

YesNo

8. Please provide to us the total annual income after taxes earned by all members of your household last year: *

Check all that apply.

- [ ] 0 – 4999,99 €
- [ ] 5000 – 9999,99 €
- [ ] 10000 – 14999,99 €
- [ ] 15000 – 19999,99 €
- [ ] 20000 – 24999,99 €
- [ ] 25000 – 29999,99 €
- [ ] 30000 – 39999,99 €
- [ ] 40000 – 49999,99 €
- [ ] 50000 – or higher

9. Are you currently a member of an environmental organization(s)? *

Check all that apply.

YesNo

- [ ]
- [ ]

10. Please write the names of the organization(s):

Part V: Questionnaire Feedback

1. Please provide us the reasons of your participation in the survey: *

Check all that apply.

- [ ] Interest for the Survey
- [ ] Wanting to make your voice heard
- [ ] Wanting to help the procession of the Survey
- [ ] Other: _____

Thank you! We are grateful for your time!

A.2 Choice Experiment Questionnaire – Greek Version

Μελέτη Περίπτωσης 1: Κάνουμε Πράσινη την Μητροπολιτική Αθήνα

Εργαστήριο έρευνας για την κοινωνικοοικονομική και περιβαλλοντική βιωσιμότητα (ReSEES) - Οικονομικό Πανεπιστήμιο Αθηνών

Αγαπητοί,

Στο πλαίσιο του έργου ARSINOE θα θέλαμε να ρωτήσουμε την άποψή σας για την Μητροπολιτική Περιοχή των Αθηνών. Ορισμένες πληροφορίες:
ΠΟΙΟΣ χρηματοδοτεί αυτή την μελέτη;

ARSINOE είναι ένα χρηματοδοτούμενο έργο από την Ευρωπαϊκή Ένωση το οποίο στοχεύει να δημιουργήσει περιφέρειες οι οποίες θα είναι ανθεκτικές στην κλιματική αλλαγή μέσω συστημικών λύσεων και καινοτομιών. Το πρόγραμμα ARSINOE θα ανασχηματίσει την πορεία προς την ανθεκτικότητα μέσω της ένωσης όπως Systems Innovation
Approach (SIA) και Climate Innovation Window (CIW) για να δημιουργήσει ένα οικοσύστημα λύσεων ανθεκτικότητας ενάντια στην κλιματική αλλαγή. Τούτη η προσέγγιση λαμβάνει μέρος σε εννέα (9) μελέτες περίπτωσης ως απόδειξη της ιδέας για
λόγους εφαρμογής, αναπαραγωγής, δυναμισμού και αποτελεσματικότητας.

Το συγκεκριμένο έργο συνδυάζει επιστημονική, οικονομική και κοινωνική έρευνα προκειμένου να ερευνήσει απαντήσεις σε δύο ερωτήματα που τίθενται:

- Ποιοι τρόποι υπάρχουν για την βελτίωσης της κατάστασης υγείας στην μητροπολιτική Αθήνα τώρα και το 2030/2050;
- Ποιες είναι οι πιθανές επιπτώσεις, εάν υπάρξουν, ως αποτέλεσμα της λήψης αποφάσεων για την βελτίωση των περιβαλλοντικών καταστάσεων στην Μητροπολιτική Αθήνα με επίκεντρο τον Δήμο Αθηναίων;

Τι καλούμαι να απαντήσω?

Υπάρχουν ορισμένα μέρη του ερωτηματολογίου τα οποία θα κληθείτε να απαντήσετε, εάν συναινεσετε να συμμετάσχετε.

Μέρος Ι: Θα ερωτηθείτε να μας παρέχετε ορισμένες πληροφορίες και την άποψή σας σχετικά με την Μητροπολιτική Αθήνα.
Μέρος ΙΙ: Θα κληθείτε να διαβάσετε ορισμένες πληροφορίες σχετικά με το ερευνητικό υπόβαθρο του προγράμματος. Μέρος ΙΙΙ: Θα παρουσιαστούν ορισμένες ερωτήσεις επιλογής. Σε κάθε ερώτηση θα συγκρίνετε δύο υποθέσεις (σενάριο). Για κάθε ερώτηση σύγκρισης θα ερωτηθείτε να επιλέξετε το προτιμότερο σενάριο.
Μέρος ΙV: Θα απαντήσετε ορισμένες ερωτήσεις σχετικά με το δικό σας υπόβαθρο, αυτές οι ερωτήσεις ΔΕΝ θα συνδεθούν με το όνομά σας, αλλά θα βελτιώσουν την ανάλυση των αποτελεσμάτων της παρούσας έρευνας. Μέρος V: Θα ερωτηθείτε να κρίνετε την έρευνα βάσει της προσωπικής σας άποψης.

Δεν υπάρχουν λανθασμένες απαντήσεις στην έρευνα, αφού αυτό που μας ενδιαφέρει είναι η άποψή σας

Πώς θα χρησιμοποιηθούν οι απαντήσεις μου;

Οι απαντήσεις που θα μας δώσετε θα μας βοηθήσουν να μελετήσουμε ορισμένες θετικές και αρνητικές επιπτώσεις που προέρχονται από διάφορα υποθετικά σενάρια με σκοπό την βελτίωση του βιοτικού επιπέδου στην Μητροπολιτική Αθήνα τώρα και το 2030. Όταν συλλεχθούν όλες οι απαντήσεις, θα γίνει ανώνυμη επεξεργασία τους και θα συνδυαστούν με τις απαντήσεις όλων των υπόλοιπων ερωτηθέντων, προκειμένου να ερευνήσουμε πιθανές επιπτώσεις.
Επιπροσθέτως, όλες οι απαντήσεις του ερωτηματολογίου είναι αυστηρώς εμπιστευτικές. Σε καμία περίπτωση δεν θα συνδεθούν οι απαντήσεις σας με το όνομά σας και επ' ουδενί δεν θα σταλούν στην Ευρωπαϊκή Επιτροπή (European Commission), κυβέρνηση, πανεπιστήμιο ή τρίτο μέρος.
Γιατί επιλέχθηκα να λάβω μέρος;

Έχετε επιλεχθεί να λάβετε μέρος στην έρευνα ως μέρος ενός δείγματος του γενικού κοινού αυτής της περιφέρειας και επειδή μας ενδιαφέρει η άποψή σας. Εάν σε οποιαδήποτε στιγμή αυτούς του ερωτηματολογίου επιθυμείτε να διακόψετε, είστε
ελεύθεροι να το κάνετε.

Εάν συμφωνείτε να συμμετέχετε στην έρευνα και κατανοείτε ότι είστε ελεύθεροι να σταματήσετε οποιαδήποτε στιγμή, καθώς επίσης κι ότι λάβατε κάθε πληροφορία για την έρευνα και τα δικαιώματα σας, παρακαλώ επιλέξτε στο παρακάτω "κουτί"

επιλογής και συνεχίστε στην επόμενη σελίδα και την απάντηση του ερωτηματολογίου.

* Indicates required question

Greening the Athens Metropolitan Area

Επιθυμείτε να συμμετέχετε; *

Check all that apply.

- [ ] ΝΑΙ, συναινώ και είμαι χαρούμενος να συμμετέχω σε αυτή την έρευνα και ναι καταλαβαίνω ότι μπορώ να διακόψω οποιαδήποτε στιγμή πριν το τέλος της έρευνας, εάν το επιθυμώ.
- [ ] ΟΧΙ, Ευχαριστούμε για τον χρόνο σας, καλή σας συνέχεια.

Μέρος Ι: Απόψεις για την Μητροπολιτική Περιοχή Αθηνών

Αρχικά, θα παρουσιαστούν ορισμένες ερωτήσεις οι οποίες θα μας βοηθήσουν να καταλάβουμε τις απόψεις σας για την Μητροπολιτική Αθήνα. Δεν υπάρχουν λάθος απαντήσεις σε αυτά τα ερωτήματα. Παρακαλώ να θυμάστε ότι όλες οι απαντήσεις σας είναι άκρως εμπιστευτικές. Δεν θα τις χρησιμοποιήσουμε για να σας αναγνωρίσουμε/ταυτοποιήσουμε.

1. Σε ποια πόλη και χώρα έχετε γεννηθεί; *

_____

2. Σε ποια πόλη και χώρα κατοικείτε; *

_____

3. Υπάρχει κάποιο στοιχείο του αστικού περιβάλλοντος το οποίο αναγνωρίζετε ως σπουδαίο για την κουλτούρα σας; *

Check all that apply.

☐ Ιστορία ☐ Τέχνες
☐ Καθημερινή Ζωή ☐ Θρησκεία
☐ Δεν γνωρίζω ☐ Τίποτε
Other: ☐ _____

4. Είναι ασφαλές να πει κανείς ότι η Μητροπολιτική Περιοχή Αθηνών βιώνει κάποια περιβαλλοντική υποβάθμιση λόγω των ανθρώπινων δραστηριοτήτων; *

Mark only one oval.

◯ Συμφωνώ Απόλυτα ◯ Συμφωνώ εν μέρει
◯ Ούτε συμφωνώ, ούτε διαφωνώ ◯ Διαφωνώ εν μέρει
◯ Διαφωνώ Απόλυτα

5. Το βιοτικό επίπεδο στην Μητροπολιτική Περιοχή Αθηνών χρήζει βελτίωσης; *
Mark only one oval.

Συμφωνώ Απόλυτα Συμφωνώ εν μέρει
Ούτε συμφωνώ, ούτε διαφωνώ Διαφωνώ εν μέρει
Διαφωνώ Απόλυτα

6. Η βελτίωση του βιοτικού επιπέδου στην Μητροπολιτική Περιοχή Αθηνών είναι ευθύνη: *

Check all that apply.

	Συμφωνών Απόλυτα	Συμφωνώ εν μέρει	Ούτε συμφωνώ, ούτε διαφωνώ	Διαφωνώ εν μέρει	Διαφωνώ Απόλυτα
Της κυβέρνησης;;	☐	☐	☐	☐	☐
Των τοπιικών// περιφερειιακών αρχών;;	☐	☐	☐	☐	☐
Των καθημεριινών πολιιτών;;	☐	☐	☐	☐	☐

7. Ένα υψηλό βιοτικό επίπεδο είναι απαραίτητο στοιχείο για την τουριστική ανάπτυξη; *
Mark only one oval.

Συμφωνώ Απόλυτα Συμφωνώ εν μέρει
Ούτε συμφωνώ, ούτε διαφωνώ Διαφωνώ εν μέρει
Διαφωνώ Απόλυτα

8. Οι φόροι είναι ένας πιο κατάλληλος τρόπος για την διατήρηση της απαραίτητης χρηματοδότησης ώστε * να γίνει επιτυχής διαχείριση του αστικού περιβάλλοντος σε σχέση με τις δωρεές και κονδύλια από την Ευρωπαϊκή Ένωση;
Mark only one oval.

Συμφωνώ Απόλυτα Συμφωνώ εν μέρει
Ούτε συμφωνώ, ούτε διαφωνώ Διαφωνώ εν μέρει
Διαφωνώ Απόλυτα

9. Πρέπει να λάβουμε δραστικά μέτρα για να μειώσουμε την αέρια ρύπανση στην Μητροπολιτική Περιοχή Αθηνών, ακόμη και εάν υπάρξει επιβράδυνση της οικονομικής ανάπτυξης λόγω αυτού. *

Mark only one oval.

Συμφωνώ Απόλυτα Συμφωνώ εν μέρει
Ούτε συμφωνώ, ούτε διαφωνώ Διαφωνώ εν μέρει
Διαφωνώ Απόλυτα

Μέρος ΙΙ: Γεωγραφικές Πληροφορίες για την Μητροπολιτική Περιοχή Αθηνών

Απαραίτητες πληροφορίες για την παρούσα κατάσταση στην Μητροπολιτική Περιοχή Αθηνών. Παρακαλούμε, ελέγξτε τις παρακάνω πληροφορίες.

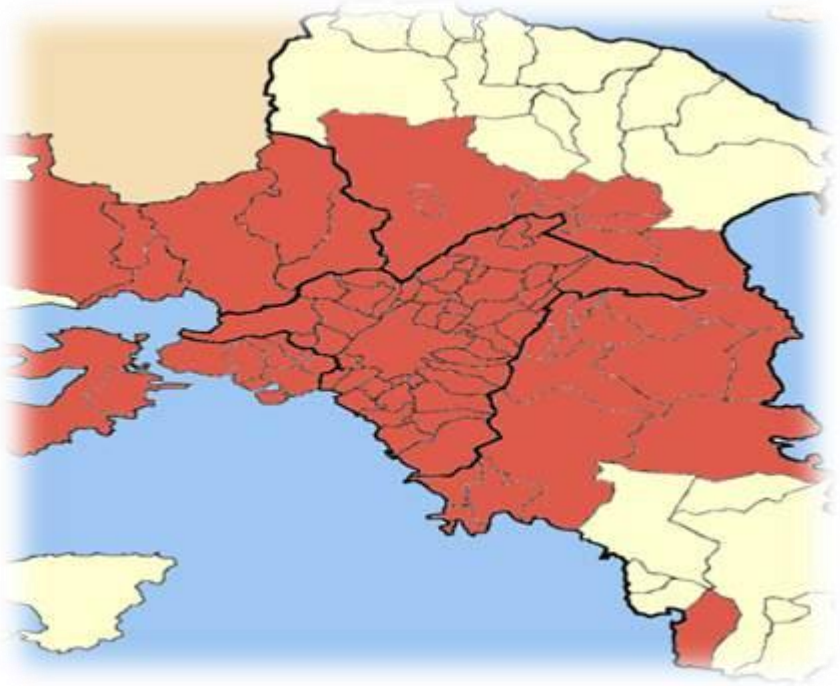
Κλιματικά και Δημογραφικά χαρακτηριστικά της Μητροπολιτικής Περιοχής Αθηνών

Τα φαινόμενα που λαμβάνουν μέρος στην Μητροπολιτική Περιοχή Αθηνών είναι σημαντικά και πρέπει να ληφθούν υπόψιν των φορέων χάραξης πολιτικής. Ο κύριος σκοπός του ερωτηματολογίου είναι να ερευνήσει τους λόγους μείωσης του βιοτικού επιπέδου. Πιο συγκεκριμένα, ορισμένα φαινόμενα τα οποία δυσχεραίνουν το βιοτικό επίπεδο είναι:

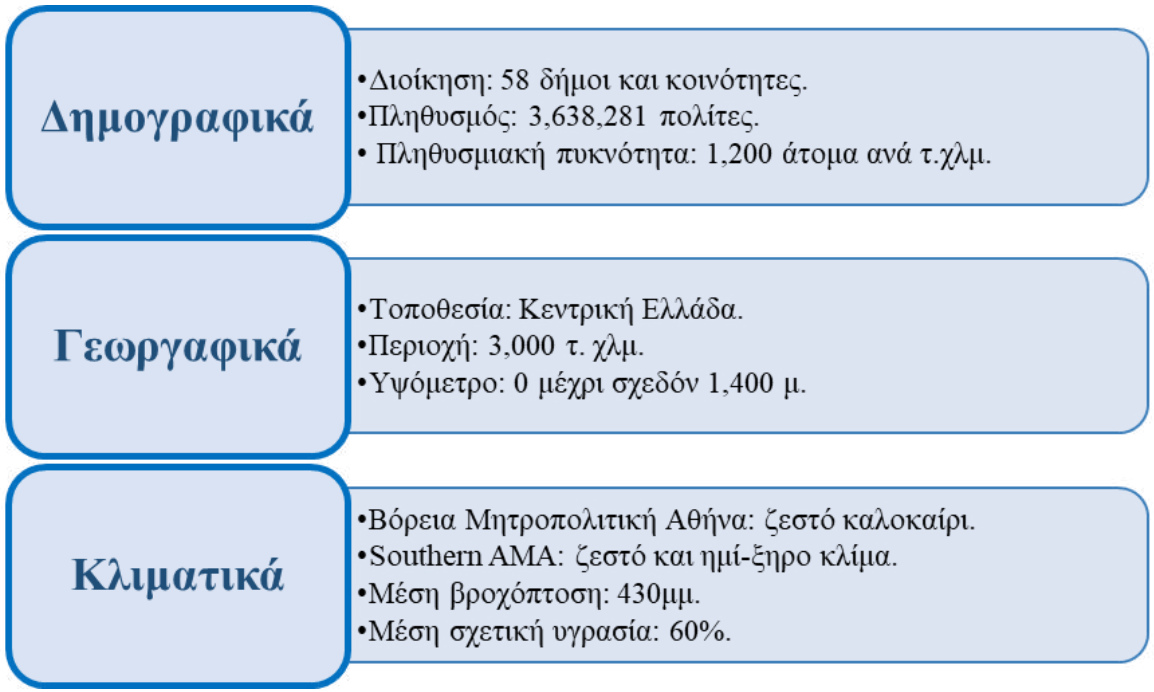
- Καύσωνας– Φαινόμενο αστικής θερμικής νησίδας. • Πληθυσμιακή πυκνότητα - Βία.
- Αέρια Ρύπανση.
- Οδική συμφόρηση - Θόρυβος.
- Προβλήματα υγείας - Θνησιμότητα και Νοσηρότητα.

Τα παραπάνω φαινόμενα έχουν ληφθεί ως χαρακτηριστικά στοιχεία με διαφορετικές διαβαθμίσεις όπως θα δείτε στις κάρτες επιλογής. Στη συνέχεια παρουσιάζεται μία σύνοψη των κύριων δημογραφικών, γεωγραφικών και κλιματικών χαρακτηριστικών της Μητροπολιτικής Περιοχής Αθηνών.

Μητροπολιτική Περιοχή Αθηνών



Δημογραφικά Χαρακτηριστικά



Η διασύνδεση μεταξύ των χαρακτηριστικών στοιχείων της έρευνας

Η εκτίμηση κινδύνου βασίζεται στην αλληλεπίδραση μεταξύ (α) κινδύνων, (β) επικινδυνοτήτων) και (γ) έκθεση σε κινδύνους, οι σχέσεις των τριών παραπάνω στοιχείων λαμβάνονται υπόψη στην παρούσα έρευνα. Ουσιαστικά, αυτή η εκτίμηση κινδύνου σε
τρία επίπεδα μπορεί να μας βοηθήσει να καταλάβουμε πώς θα αναπτυχθεί η ανθεκτικότητα των αστικών συστημάτων ενάντια σε κινδύνους.

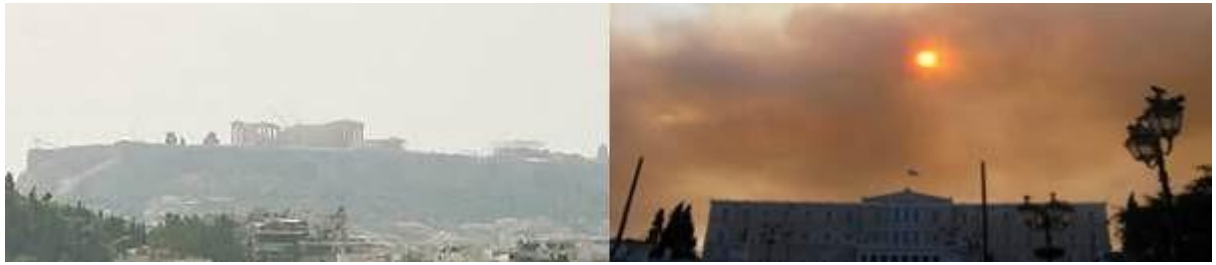
Οι Κίνδυνοι

Το πρώτο επίπεδο αφορά τους κύριους κινδύνους οι οποίοι πιέζουν τα αστικά οικοσυστήματα. Οι κύριοι κίνδυνοι κατατάσσονται στους πρωτογενείς κινδύνους (π.χ. καύσωνες, αέρια ρύπανση, κυκλοφοριακή συμφόρηση και θόρυβος) και
τους δευτερογενείς κινδύνους (π.χ. απώλεια βιοποικιλότητας, πληθυσμιακή πυκνότητα, υπερπληθυσμός και βία).

Αέρια Ρύπανση στην Μητροπολιτική Αθήνα λόγων των επιπέδων του διοξειδίου του άνθρακα (CO2) και ύπαρξης αιωρούμενων σωματιδίων (particulate matter - PM) (π.χ. PM2.5 και PM10). Η αέρια ρύπανση αποτελεί σημαντικό παράγοντα για αναπνευστικά προβλήματα. Κυκλοφοριακή συμφόρηση (μποτιλιάρισμα) και θόρυβος μπορούν να προκαλέσουν ανεπιθύμητες επιπτώσεις στην ανθρώπινη ευημερία. Επί παραδείγματι, η κυκλοφοριακή συμφόρηση από και προς την εργασία του κάθε πολίτη, οι
κατασκευαστικές δραστηριότητες (π.χ. ανέγερση κτηρίων ή μεγάλα αστικά έργα) ακόμη και οι καφετέριες. Προφανώς, υπάρχουν και λοιπά σημαντικά προβλήματα όπως το θέμα της δοσοληψίας ναρκωτικών ουσιών στο ιστορικό κέντρο της Αθήνας και των
πέριξ περιοχών ή συμβάντα εγκληματικότητας τα οποία τονώνουν τα επίπεδα βίας.

Απώλεια Βιοποικιλότητας η οποία μπορεί να παρατηρηθεί κυρίως στο ιστορικό κέντρο, τυπικά φορά την ανυπαρξία πράσινων (π.χ. δέντρα και θάμνων) ή μπλε (π.χ. σιντριβανιών) υποδομών. Οι πράσινοι χώροι επιδρούν θετικά στην ανθρώπινη ευημερία λόγων των περιβαλλοντικών υπηρεσιών που παρέχουν και μπορούν να καταπραΰνουν άλλα προβλήματα όπως η ρύπανση και ο θόρυβος.

Εικόνα 1: Αέρια ρύπανση στην Μητροπολιτική Περιοχή Αθηνών. Ακρόπολη των Αθηνών (Αριστερά) και το κτήριο της Βουλής των Ελλήνων (Δεξιά).



Εικόνα 2: Οι καύσωνες μπορούν να επηρεάσουν τους πολίτες και το φυσικό περιβάλλον.

Εικόνα 3: Πληθυσμιακή πυκνότητα, κυκλοφοριακή συμφόρηση, και θόρυβος στην Αθήνα.

Εικόνα 4: Παραδείγματα βιοποικιλότητας

Οι Επικινδυνότητες

Το δεύτερο επίπεδο ανάλυσης αφορά τις επικινδυνότητες, οι οποίες μετρούν τις επιπτώσεις των κινδύνων στην ανθρώπινη ευημερία. Η εκτίμηση των επικινδυνοτήτων περιέχει πληθώρα πληροφοριών για την οικονομία (π.χ. τουρισμός) και για την κοινωνία (π.χ. ανθρώπινη υγεία).

Πιο συγκεκριμένα, οι επικινδυνότητες διαδραματίζουν σπουδαίο ρόλο στην αστική αειφορία. Σε περιόδους καύσωνα οι επικινδυνότητες αυξάνουν τα επίπεδα νοσηρότητας ή θνησιμότητας, ειδικά σε εγκύους, ανθρώπων με άσθμα ή των μεγαλύτερων ηλικιακά ατόμων.

Εικόνα 5: Προβλήματα υγείας λόγω επικινδυνοτήτων στην Μητροπολιτική Περιοχή Αθηνών.

Εικόνα 6: Προβλήματα υγείας κατά την περίοδο καύσωνα, πιο συγκεκριμένα με (α) πονοκεφάλους, (β) δημιουργία θρόμβων, (γ) αναπνευστικών προβλημάτων και (δ) ψυχικών νοσημάτων.

Η Έκθεση σε κινδύνους

Το τρίτο επίπεδο της ανάλυσης επικεντρώνεται στις επιπτώσεις στην ανθρώπινη υγεία, εννοώντας ότι είναι σημαντικό να παρακολουθήσουμε πώς η έκθεση σε κινδύνους επηρεάζει αφενός τους κατοίκους, τους τουρίστες, του εργαζόμενους και αφετέρου την χλωρίδα και πανίδα.
Οι εργαζόμενοι σε εξωτερικές δραστηριότητες (π.χ. προσωπικό διανομής φαγητού (delivery), οι σερβιτόροι) θα ήταν καλό να αναφέρουν τους παράγοντες που τους επηρεάζουν. Μία άλλη κατηγορία πολιτών η οποία θα ήταν καλό να μας δώσει
απαντήσεις είναι οι γυναίκες (π.χ. έγκυοι) και οι ηλικιωμένοι πολίτες για πληθώρα λόγων (π.χ. καύσωνες, αέρια ρύπανση και θόρυβος).

Εικόνα 7: Η έκθεση σε καύσωνα επηρεάζει διαφορετικές κοινωνικές ομάδες: (α) τουρίστες, (β) εργαζόμενοι σε εσωτερικές ή εξωτερικές εργασίες, παράλληλα σημαντική είναι η σημασία προστασίας για την χλωρίδα και πανίδα.

Μέρος ΙΙΙ: Μέθοδος του Πειράματος Επιλογής (Choice Experiment)

Παρακαλούμε να έχετε υπόψιν ότι θα κληθείτε να απαντήσετε δύο διαφορετικά σενάρια, το καθένα από τα οποία έχει τέσσερις (4) διαφορετικές επιλογές χρηματικής τιμής.

Υπόμνημα - Λεζάντα
Τα κύρια χαρακτηριστικά του ερωτηματολογίου και τα επίπεδά τους.

Heatwaves

Outdoor Jobs

Indoor Jobs

Citizens

Flora & Fauna

Air Pollution

High

Medium

Low

Population Density, Traffic

Commercial

Residential

Traffic

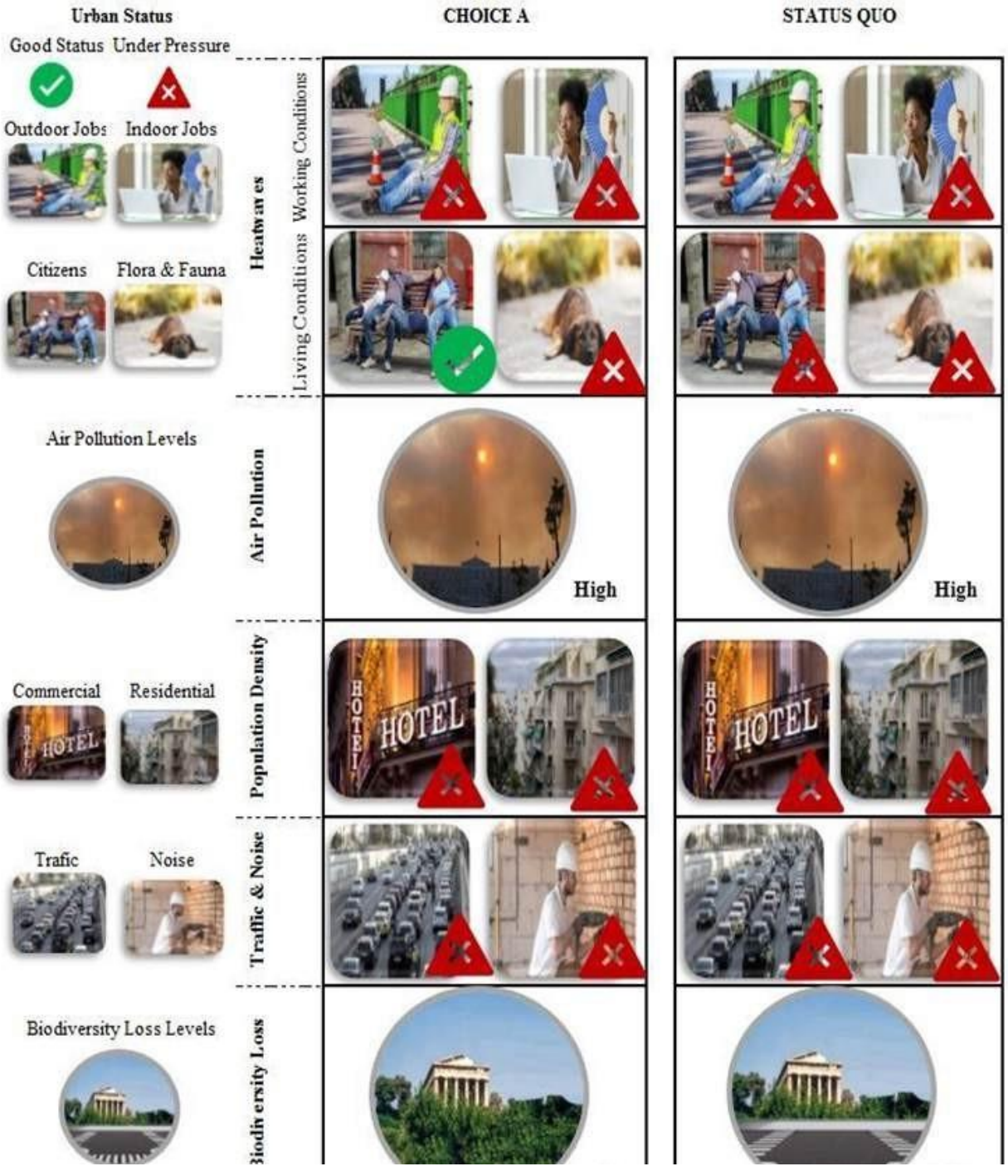
Noise

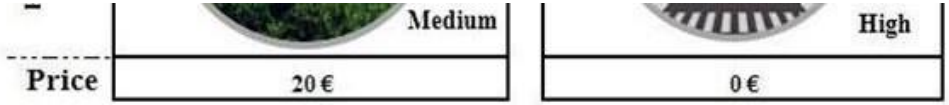
odiversity Loss

Choice A - Επιλογή A

Η ποιότητα του αέρα και ο πληθυσμός βρίσκονται υπό πίεση στο σενάριο της Επιλογής Α (Choice A). Θα πρέπει να επιλέξετε είτε την προτεινόμενη τιμή στην αριστερή στήλη της εικόνας ή την κάρτα της παρούσας κατάστασης (μηδέν ευρώ, 0€) στην δεξιά στήλη της εικόνας.

Choice A: 20 Euros


Urban Status
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Air Pollution Levels
Commercial
Residential
HOTEL
Trafic
Noise
Biodiversity Loss Levels
CHOICE A
STATUS QUO
Heatwaves
Working Conditions
Living Conditions
Air Pollution
High
High
Population Density
Traffic & Noise
Biodiversity Loss

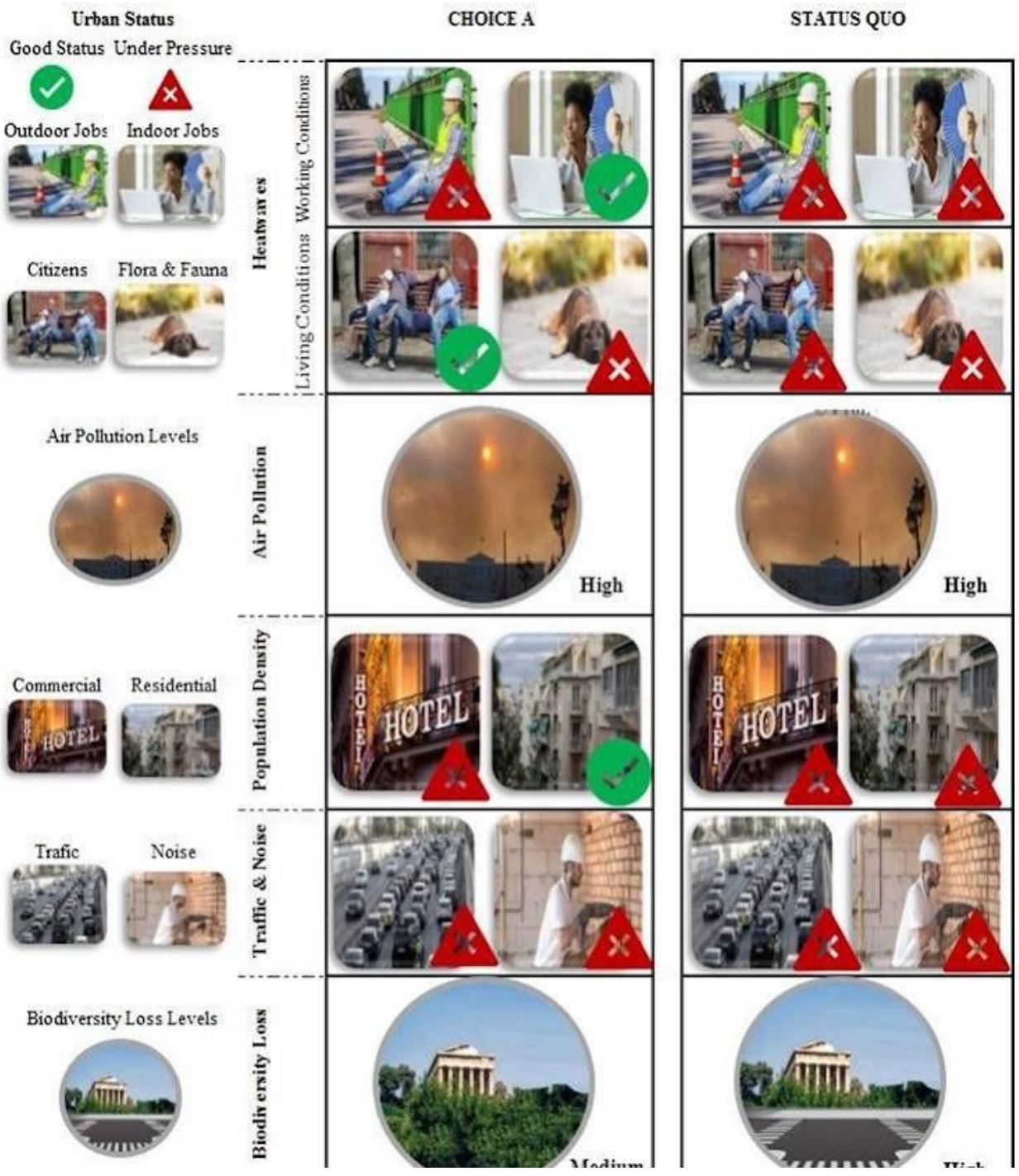


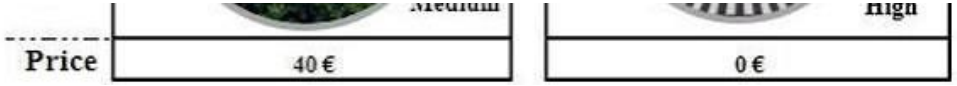
Price	20 €	0 €

Check all that apply.

- [ ] 20 Euros
- [ ] 0 Euro

Choice A: 40 Euros

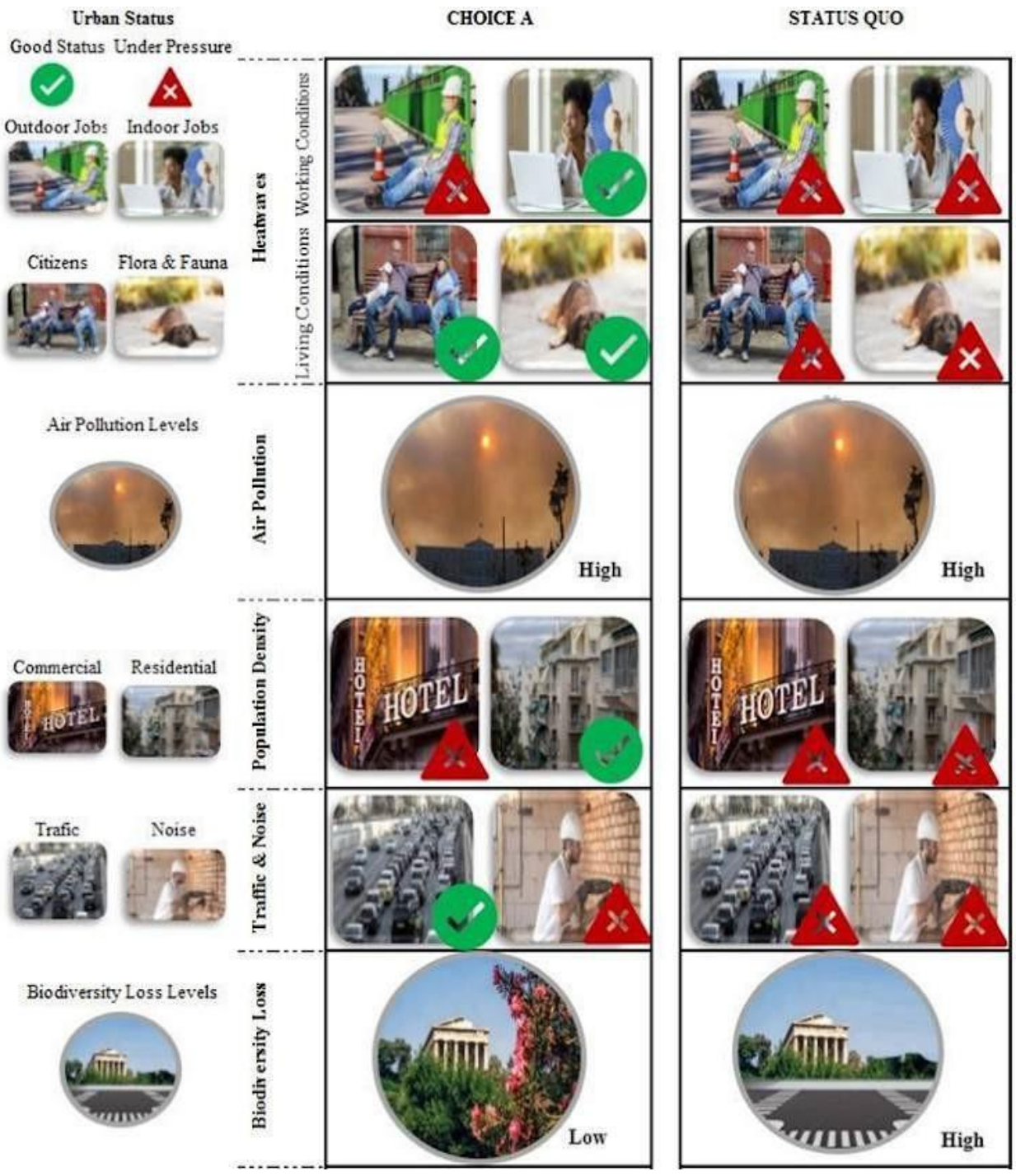

Urban Status
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Air Pollution Levels
Commercial
Residential
HOTEL
Trafic
Noise
Biodiversity Loss Levels
CHOICE A
STATUS QUO
Heatwaves
Working Conditions
Living Conditions
Air Pollution
High
High
Population Density
Traffic & Noise
Biodiversity Loss
Medium
High



Check all that apply.

- [ ] 40 Euros
- [ ] 0 Euro

Choice A: 80 Euros

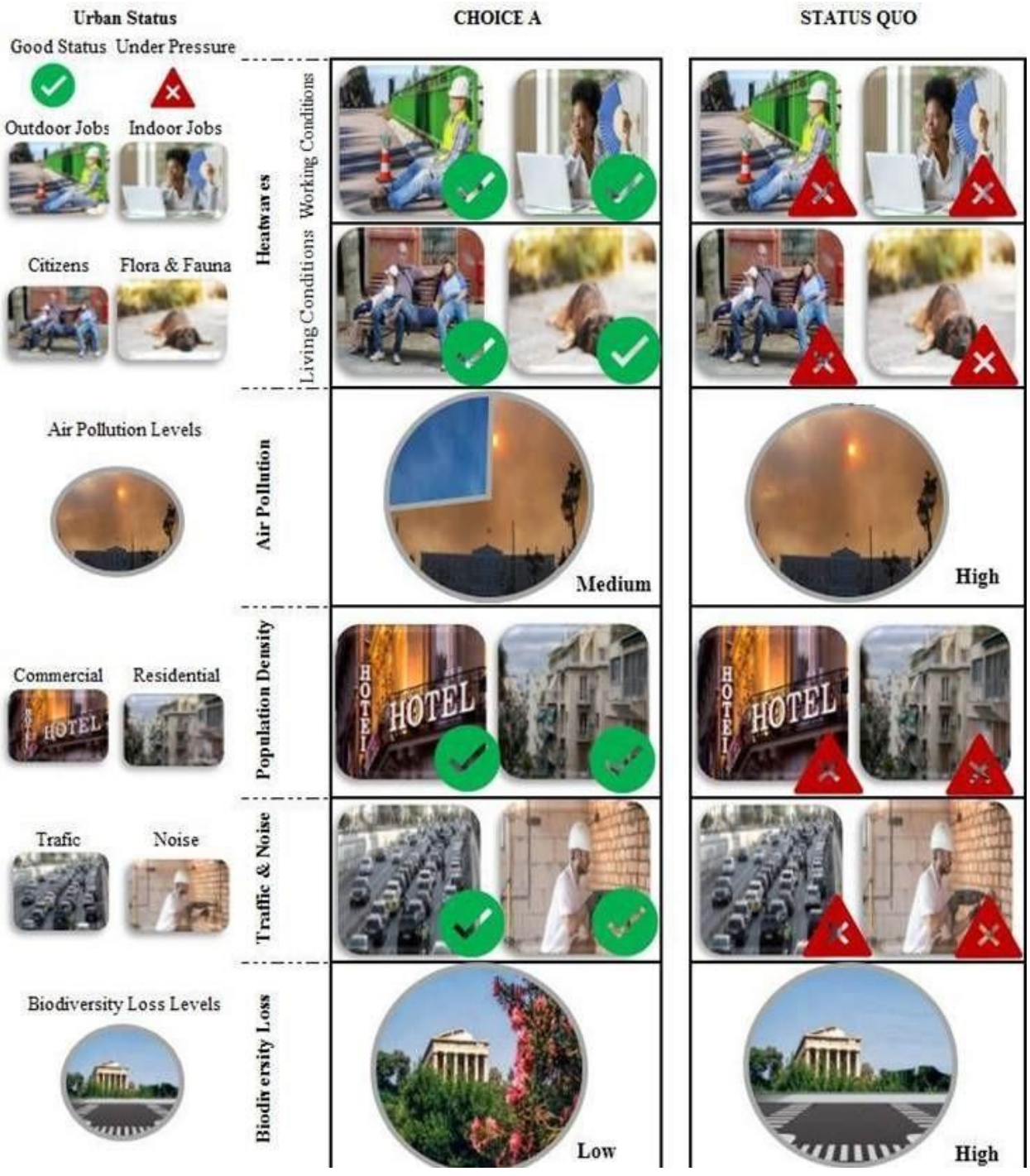

Urban Status
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Air Pollution Levels
Commercial
Residential
Trafic
Noise
Biodiversity Loss Levels
CHOICE A
STATUS QUO
Heatwaves
Working Conditions
Living Conditions
Air Pollution
High
High
Population Density
HOTEL
Traffic & Noise
Biodiversity Loss
Low
High

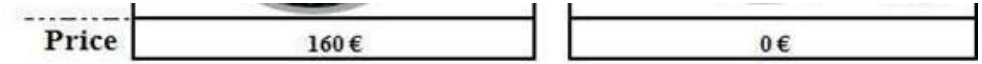
Price	80 €	0 €

Check all that apply.

- [ ] 80 Euros
- [ ] 0 Euro

Choice A: 160 Euros


Urban Status
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Air Pollution Levels
Commercial
Residential
Trafic
Noise
Biodiversity Loss Levels
CHOICE A
STATUS QUO
Heatwaves
Working Conditions
Living Conditions
Air Pollution
Population Density
Traffic & Noise
Biodiversity Loss
HOTEL
Medium
High
Low
High



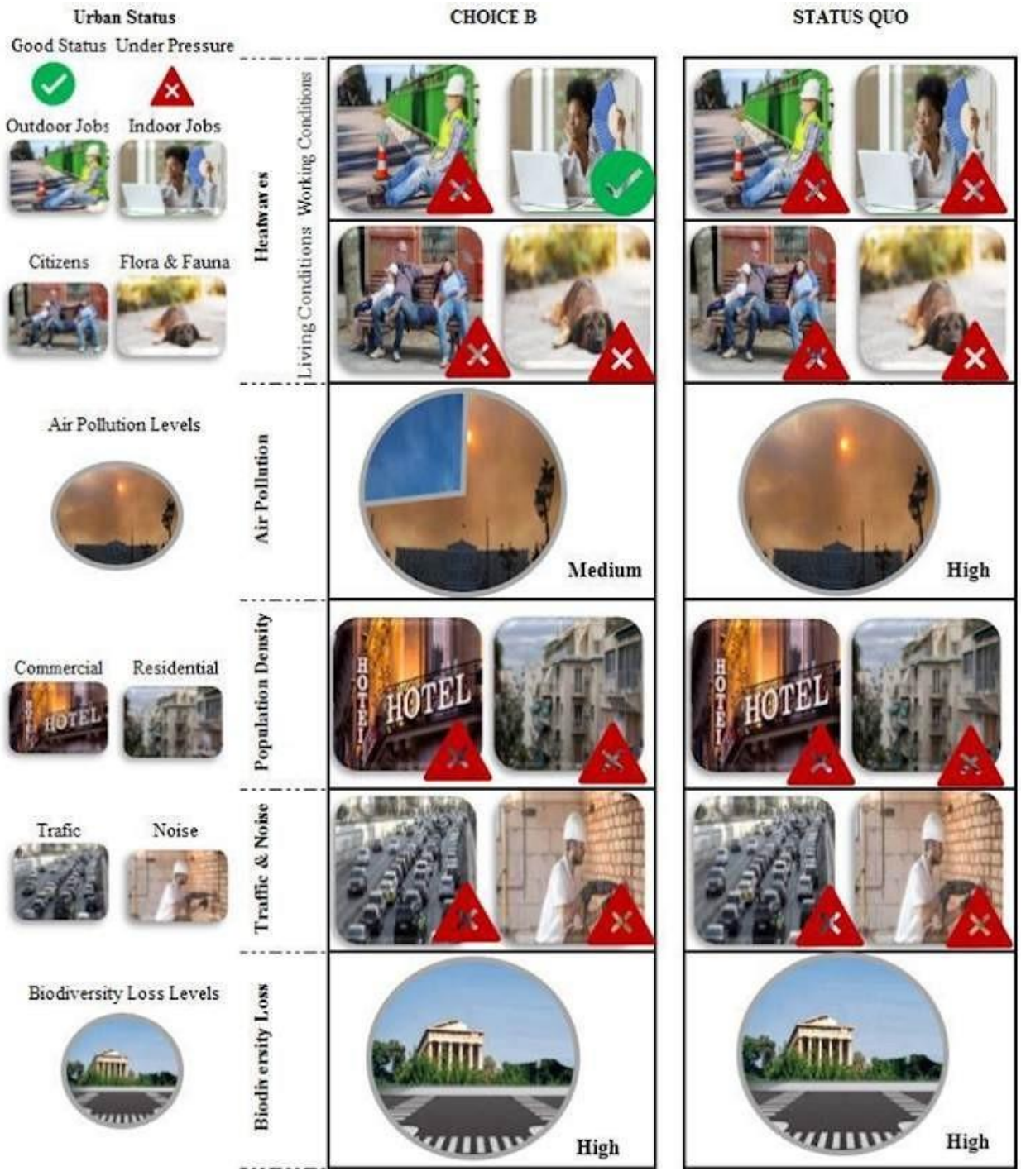
Check all that apply.

- [ ] 160 Euros
- [ ] 0 Euro

Choice B - Επιλογή B

Η Βιοποικιλότητα βρίσκεται υπό πίεση *στο σενάριο της Επιλογής B (Choice B)*. Θα πρέπει να επιλέξετε είτε την προτεινόμενη τιμή στην αριστερή στήλη της εικόνας ή την κάρτα της παρούσας κατάστασης (μηδέν ευρώ, 0€) στην δεξιά στήλη της εικόνας.

Choice B: 20 Euros

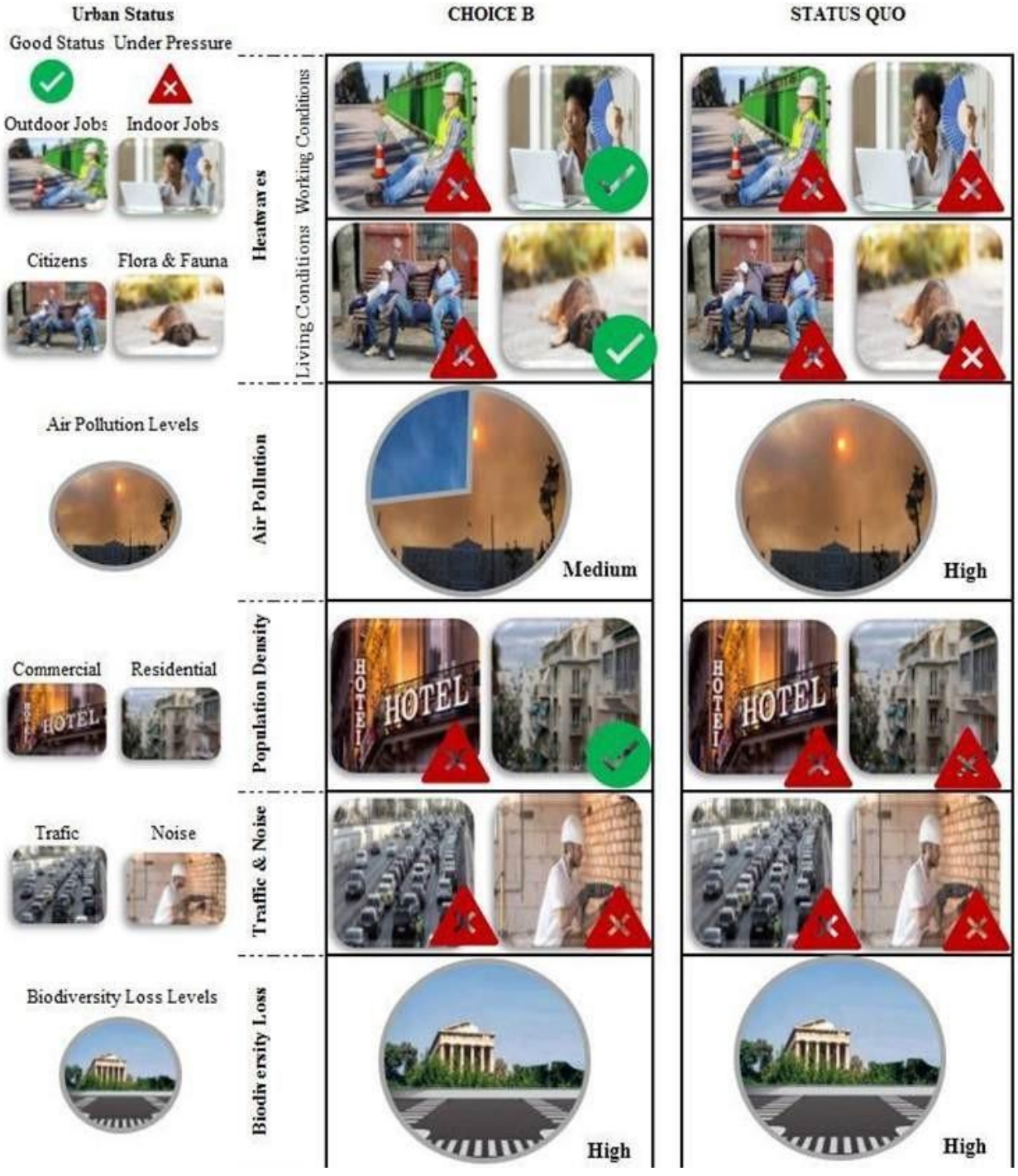

Urban Status
CHOICE B
STATUS QUO
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Heatwaves
Working Conditions
Living Conditions
Air Pollution Levels
Air Pollution
Medium
High
Commercial
Residential
HOTEL
Population Density
Trafic
Noise
Traffic & Noise
Biodiversity Loss Levels
Biodiversity Loss
High
High

Price	20 €	0 €

Check all that apply.

- [ ] 20 Euros
- [ ] 0 Euro

Choice B: 40 Euros

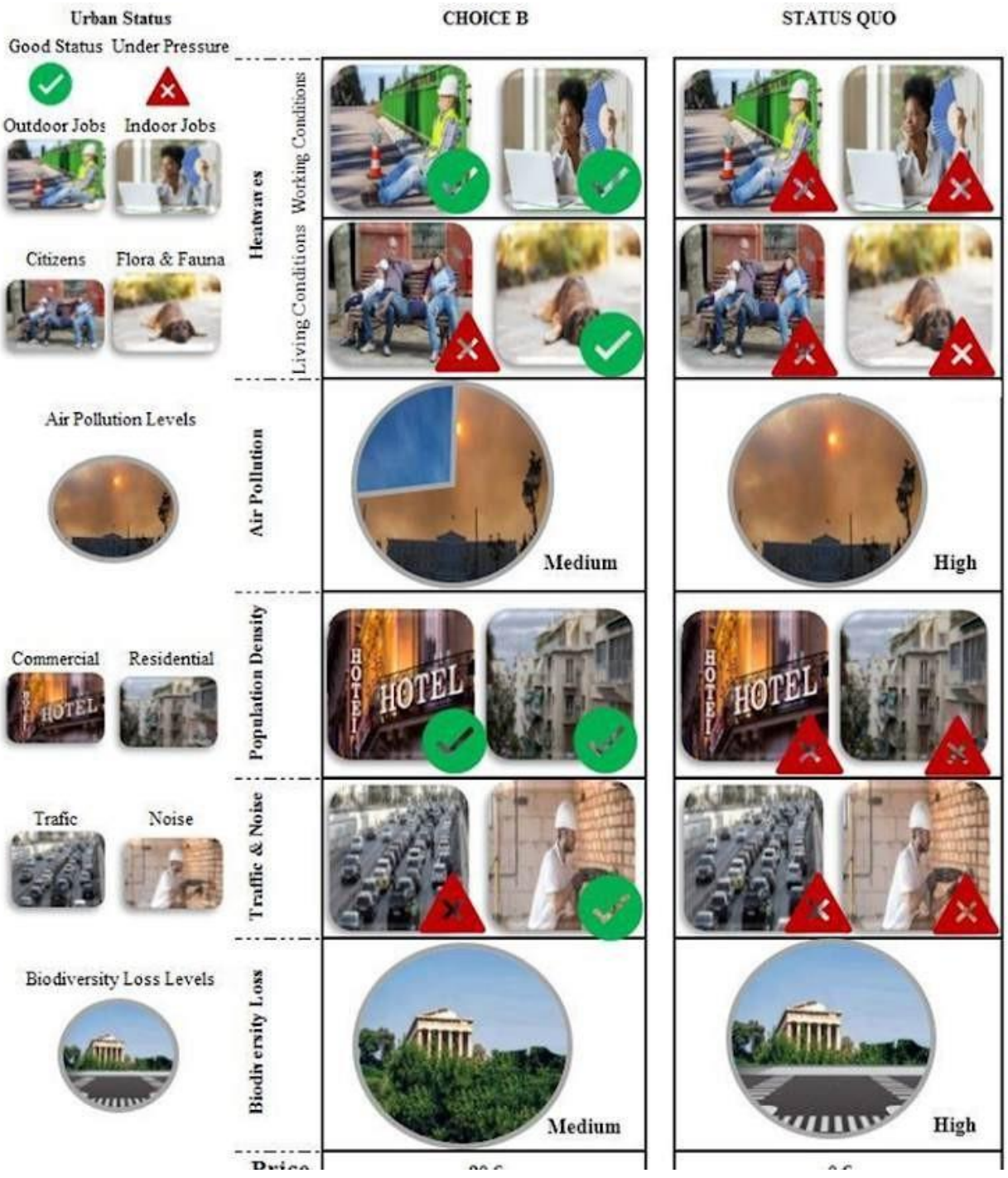

Urban Status
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Air Pollution Levels
Commercial
Residential
HOTEL
Trafic
Noise
Biodiversity Loss Levels
Heatwaves
Working Conditions
Living Conditions
Air Pollution
Population Density
Traffic & Noise
Biodiversity Loss
CHOICE B
STATUS QUO
Medium
High
High
High

Price	40 €	0 €

Check all that apply.

- [ ] 40 Euros
- [ ] 0 Euro

Choice B: 80 Euros

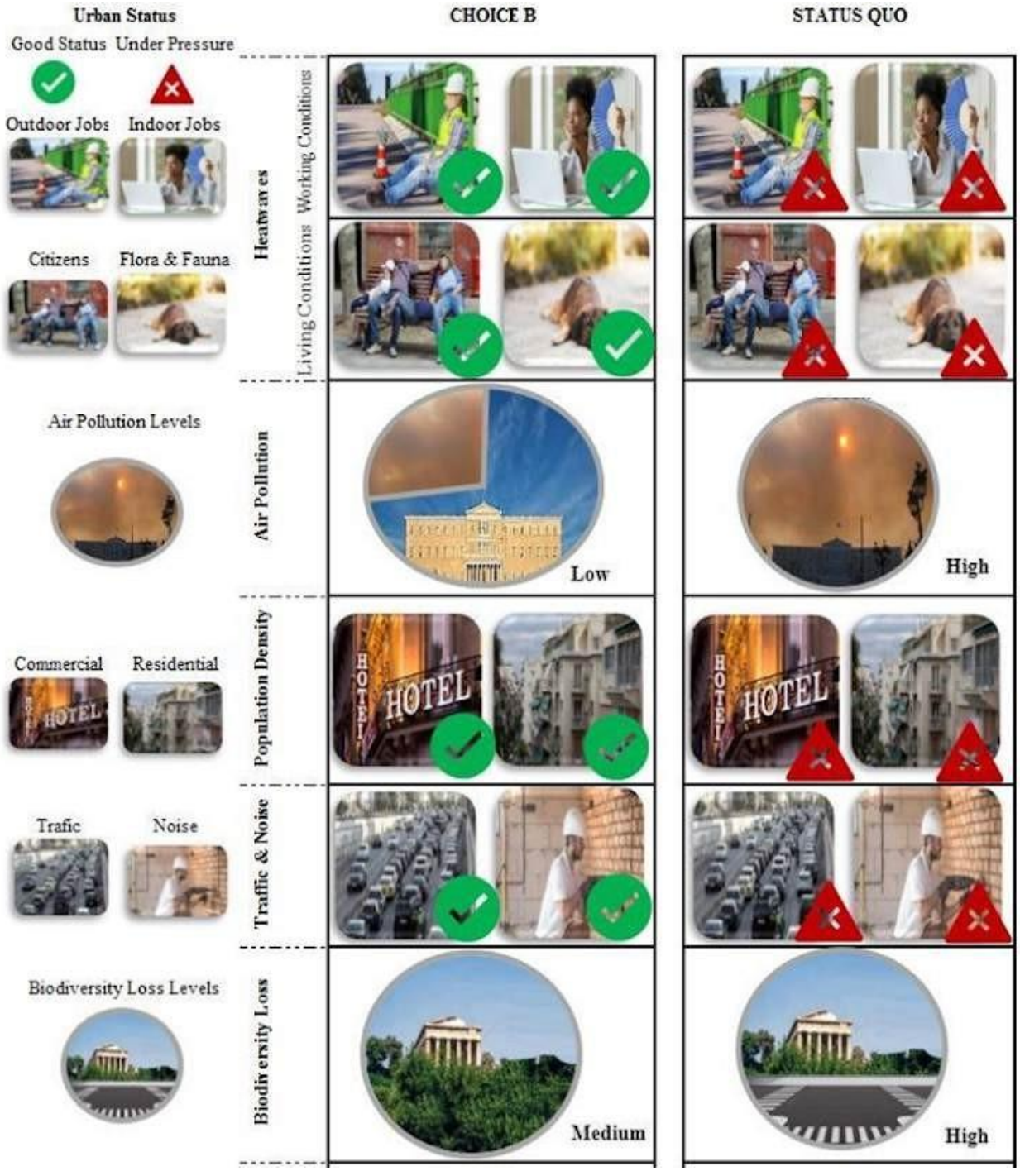

Urban Status
Good Status
Under Pressure
Outdoor Jobs
Indoor Jobs
Citizens
Flora & Fauna
Air Pollution Levels
Commercial
Residential
HOTEL
Trafic
Noise
Biodiversity Loss Levels
CHOICE B
STATUS QUO
Heatwaves
Working Conditions
Living Conditions
Air Pollution
Medium
High
Population Density
Traffic & Noise
Biodiversity Loss
Medium
High

Price 80€ 0€

Check all that apply.

- [ ] 80 Euros
- [ ] 0 Euro

Choice B: 160 Euros


Urban Status
Good Status
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Indoor Jobs
Citizens
Flora & Fauna
Air Pollution Levels
Commercial
Residential
HOTEL
Trafic
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Biodiversity Loss Levels
CHOICE B
STATUS QUO
Heatwaves
Working Conditions
Living Conditions
Air Pollution
Low
High
Population Density
Traffic & Noise
Biodiversity Loss
Medium
High

Price	160 €	0 €

Check all that apply.

- [ ] 160 Euros
- [ ] 0 Euro

Part IV: Δημογραφικά χαρακτηριστικά και η προσωπική στάση

1. Ποιο είναι το φύλο σας; *

Check all that apply.

- [ ] Αρσενικό
- [ ] Θηλυκό
- [ ] Προτιμώ να μην πω

2. Ποια είναι η ηλικία σας; *

Check all that apply.

- [ ] 18-25
- [ ] 26-35
- [ ] 36-45
- [ ] 46-55
- [ ] 56-65
- [ ] Μεγαλύτερη από 65

3. Παρακαλώ περιγράψτε την οικογενειακή σας κατάσταση *

Check all that apply.

☐ Ελεύθερος/η/ο ☐ Παντρεμένος/η/ο
☐ Σε διάσταση/ Χωρισμός ☐ Χηρεία

4. Έχετε παιδιά ή/και εγγόνια κάτω από την ηλικία των 18 χρόνων; *

Check all that apply.

☐ Ναι ☐ Όχι

5. Εκπαιδευτικό επίπεδο που έχετε ολοκληρώσει: *

Check all that apply.

☐ Δεν έχω παρακολουθήσει/ολοκληρώσει κάποιο εκπαιδευτικό επίπεδο ☐ (Δημοτικό) Πρωτοβάθμια εκπαίδευση
☐ (Γυμνάσιο) Κατώτερη Δευτεροβάθμια Εκπαίδευση
☐ Γενικό/ Επαγγελματικό λύκειο (ΕΠΑΛ) - Ανώτερη Δευτεροβάθμια Εκπαίδευση
☐ Ινστιτούτο επαγγελματικής κατάρτισης (ΙΕΚ) (Ανώτερη Δευτεροβάθμια Εκπαίδευση) ☐ Τεχνική Επαγγελματικό Ινστιτούτο (ΤΕΙ) (Τριτοβάθμια εκπαίδευση)
☐ Πανεπιστήμιο, Ανώτατες Στρατιωτικές Σχολές, Ανοιχτό Πανεπιστήμιο ☐ Μεταπτυχιακές σπουδές (Msc.,MBA, MA, Mlit, MPHIL)
☐ Διδακτορικές σπουδές
Other:
☐ _____

6. Επάγγελμα *

Check all that apply.

☐ Πλήρης απασχόληση στον δημόσιο τομέα (Full-time job in the public sector) ☐ Μερική απασχόληση στον δημόσιο τομέα (Part-time job in the public sector) ☐ Πλήρης απασχόληση στον ιδιωτικό τομέα (Full-time job in the private sector) ☐ Μερική απασχόληση στον ιδιωτικό τομέα (Part-time job in the private sector) ☐ Άνεργος/η/ο

☐ Συνταξιούχος

☐ Φοιτητής/Φοιτήτρια

☐ Ελεύθερος επαγγελματίας ☐ Οικοκυρική

Other: ☐ _____

7. Σχετίζεται η απασχόλησή σας με τον φυσικό περιβάλλον; *

Check all that apply.

☐ Ναι ☐ Όχι

8. Παρακαλώ αναφέρετε το συνολικό ετήσιο εισόδημα μετά φόρων από όλα τα μέλη του νοικοκυριού το περασμένο έτος. *

Check all that apply.

- [ ] 0 – 4999,99 €
- [ ] 5000 – 9999,99 €
- [ ] 10000 – 14999,99 €
- [ ] 15000 – 19999,99 €
- [ ] 20000 – 24999,99 €
- [ ] 25000 – 29999,99 €
- [ ] 30000 – 39999,99 €
- [ ] 40000 – 49999,99 €
- [ ] 50000 – or higher

9. Είστε μέλος σε περιβαλλοντική οργάνωση (ή περιβαλλοντικές οργανώσεις); *

Check all that apply.

- [ ] Ναι
- [ ] Όχι

10. Παρακαλώ αναφέρετε το όνομα της περιβαλλοντικής οργάνωσης (ή περιβαλλοντικών οργανώσεων) που είστε μέλος:

Μέρος V: Γνώμη και σχόλια για το ερωτηματολόγιο

1. Παρακαλούμε παρουσιάστε ορισμένους λόγους για την συμμετοχή σας στην έρευνα: *

Check all that apply.

- ☐ Ενδιαφέρον για την έρευνα
- ☐ Θέλω να ακουστεί η φωνή μου
- ☐ Θέλω να βοηθήσω την διαδικασία της έρευνας

Other:

☐ _____

Ευχαριστούμε πολύ! Είμαστε ευγνώμονες για τον χρόνο σας!

Systems Innovation Approach (SIA) addresses the growing complexity, interdependencies and interconnectedness of modern societies and economies, focusing on the functions of the cross-sectoral system as a whole and on the variety of actors. The Climate Innovation Window (CIW) is the EU reference innovations marketplace for climate adaptation technologies. ARSINOE shapes the pathways to resilience by bringing together SIA and CIW, to build an ecosystem for climate change adaptation solutions. Within the ARSINOE ecosystem, pathways to solutions are co-created and co-designed by stakeholders, who can then select either existing CIW technologies, or technologies by new providers (or a combination) to form an innovation package. This package may be designed for implementation to a specific region, but its building blocks are transferable and re-usable; they can be re-adapted and updated. In this way, the user (region) gets an innovation package consisting of validated technologies (expanding the market for CIW); new technologies implemented in the specific local innovation package get the opportunity to be validated and become CIW members, while the society (citizens, stakeholders) benefits as a whole. ARSINOE applies a three-tier, approach: (a) using SIA it integrates multi-faceted technological, digital, business, governance and environmental aspects with social innovation for the development of adaptation pathways to climate change for specific regions; (b) it links with CIW to form innovation packages by matching innovators with end-users/regions; (c) it fosters the ecosystem sustainability and growth with cross-fertilization and replication across regions and scales, at European level and beyond, using specific business models, exploitation and outreach actions. The ARSINOE approach is show-cased in nine widely varied demonstrators, as a proof-of-concept with regards to its applicability, replicability, potential and efficacy.

ARSINOE

CLIMATE-RESILIENT REGIONS THROUGH SYSTEMIC SOLUTIONS AND INNOVATIONS

This project has received funding from the European Union's Horizon H2020 innovation action programme under grant agreement 101037424.