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Project acronym: Nature4Cities

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Research and Innovation Action

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D4.2 – Development of a monetary value scale in MIMES

<table>
<tr><th colspan="3">Organisation name of lead contractor for this deliverable: LIST</th></tr>
<tr><td rowspan="4">Version 1 – Rev.3</td><td>Due Date</td><td>30/11/2018</td></tr>
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<tr><td>Authors</td><td>Petucco, C.; Babí Almenar, J.; Rugani, B. (LIST)
Maider, A.; Usobiaga, E.; Sopelana, A.; Hernando, S.; Egusquiza, A. (TEC)
Yilmaz, O.; Naneci,S.; Aytac, B. (EKO)
Kraus, F.; Schnepf, D. (G4C)
Laïlle, P. (P&C)
Regoyos Sainz, M. (ACC)
Anna Paraboschi, Elisa Massa (RINA)</td></tr>
</table>

Dissemination Level		
PU	Public	X
CO	Confidential, only for members of the consortium (including the Commission Services)	

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Document history

History			
Version	**Date**	**Authors**	**Comment**
1	06/11/2018	LIST, TEC, EKO, G4C, P&C, ACC, RINA	1st Draft of the deliverable to share with the internal reviewer (Doris Schnepf/G4C) to obtain inputs and comments about the structure of the document.
2	22/11/2018	LIST (All Team)	2nd Draft of the deliverable to share with the internal reviewer (Doris Schnepf / G4C)
3	14/12/2018	LIST (All Team)	Final version of the deliverable
4	30/04/2020	LIST (All Team)	Final version released to the European Commission, incorporating duly revisions to address reviewers' remarks as follows.

Summary of performed revisions:

- Improvements on the Executive Summary in order to streamline the text considered of minor importance in this revised version of the deliverable, and to focus on the most meaningful outputs that form the basis to enable a more effective dissemination of the results; a ToC Art (Table of Contents) figure was also added to facilitate the communication of the deliverable's results;
- Modifications to the Conclusions made in order to give more insights about the positioning of the deliverable's results in the state-of-the-art practice for NBS deployment when considering costs-benefits assessments. The revised text also provided a deeper and broader illustration of the advantages and potential implications for urban planning and design when the complete set of species and NBS models will be available for access and for use in the decision support tool; a deeper and broader illustration of the current limitations of the tested model of Madrid was also offered;

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Glossary

Acronym	Full name
CE	Choice experiment
cLCC	conventional (or financial) Life Cycle Costing
CS	Consumer surplus
CV	Contingent valuation
EC	European Commission
eLCC	environmental Life Cycle Costing
ES	Ecosystem Service(s)
FU	Functional Unit
GDP	Gross Domestic Product
GI	Green Infrastructure
IRR	Internal Rate of Return
LCA	Life Cycle Assessment
LCC	Life Cycle Costing
LCSA	Life Cycle Sustainability Assessment
LID	Low Impact Development
MAES	Mapping and Assessment of Ecosystems and their Services
MIMES	Multiscale Integrated Modelling of Ecosystem Services
NBS	Nature-based Solutions
NPV	Net Present Value
PBP	Pay Back Period
PS	Producer Surplus
PVB	Present Value of Benefit
PVC	Present Value of Costs
SDM	System Dynamics Model
sLCC	Societal Life Cycle Costing
TEEB	The Economics of Ecosystems and Biodiversity
TEV	Total Economic Value
UC	Urban Challenge
UES	Urban Ecosystem Service(s)
USC	Urban Sub-Challenge
UN	United Nations
WFD	Water Framework Directive
WP	Work Package
WTA	Willingness to Accept
WTP	Willingness to Pay

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Executive Summary

To support sustainable policies and decision-making on Nature-based Solutions (NBS) it is of primary importance to take into account the economic dimension to assess the potential trade-offs and weight costs and benefits with a common (monetary) unit. Starting from these considerations, the Nature4Cities team of the Task 4.2 developed a monetary value scale to better inform the planning and design process for NBS implementation.

The work illustrated in this Deliverable 4.2 (D4.2) represents the practical follow up of the methodological framework proposed in the previous Task 4.1 about modelling urban ecosystem services (UES) associated with NBS. This was developed within a system dynamics framework for UES analysis based on the Multiscale Integrated Model of Ecosystem Services (MIMES). Building on MIMES, the Task 4.2 team defined a quantification approach for establishing a monetary value scale that takes into account costs and benefits derived from urban NBS, allowing evaluating the net societal benefit generated by their implementation. This monetary value scale was validated with a proof-of-concept model of urban forest applied to a case study in Madrid (Valdebebas Park), Spain. As a result of an extensive literature review and modelling exercise, the Task 4.2 team identified advantages, limitations and future activities required to improve such a monetary value scale.

The investigation of the literature suggests that the most studied practice for NBS implementation does not always turn out to be the most economically desirable one. However, once cost effectiveness is properly evaluated, the NBS investigated in the literature can become economically attractive. This is because the costs of an NBS system shall be accounted for the entire duration of the NBS life cycle, allowing to capture a more exhaustive picture of the economic flows associated with an NBS. In this regard, life cycle costs are typically represented by all the financial flows associated with the investment, implementation, use, management and possible end-of-life phases of the NBS, as well as by the external costs internalized or expected to be internalized in the near future. An approach based on life cycle costing can thus allow to handle the monetarization of impacts associated with externalities when operating the NBS, being either positive or negative. In this regard, NBS do essentially provide benefits to the society in terms of UES, which can be accounted for and compared against NBS life cycle costs by means of several monetarisation techniques.

A benefit transfer approach was selected after this literature review as the most appropriate way to monetarise the physical output from an NBS-MIMES model. Benefit transfer is a technique that allows assigning UES values taken from previous studies (and hence different locations) to the new location of interest. This transfer accounts for and corrects the temporal and economic differences between the original location and the target location and it is commonly used when primary valuation studies (e.g. choice experiments, contingent valuations) are not feasible due to

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economic or time constraints, as in the case of this work. The Task 4.2 team performed an extended literature review to identify for each UES and NBS type a set of values to perform the monetary valuation via benefit transfer. One common characteristics of the selected studies was to provide a unitary value for a specific UES (i.e. a monetary value per physical unit for each selected UES) in order to make the link between the monetary valuation scale and the NBS-MIMES framework.

By applying this valuation approach to the simulation outputs of the Valdebebas Park NBS model, a proof-of-concept was made for the development of a monetary value scale for NBS-MIMES models in Nature4Cities. This proof-of-concept model provides an illustrative example of dynamic accounting of three UES (biomass provision as wood, carbon sequestration and regulation of temperature and humidity), two management costs (treatment of plant residues, and replanting), and investment costs for urban forests in a detailed spatial (100 m^2) and temporal (modelling by month, later aggregated by year) resolution. In its current version (on which the Task 4.2 team is working at the date the Revised version of this deliverable has been released, i.e. 30/04/2020), the modelling scope has been expanded to include the following UES: regulation of chemical composition of the atmosphere (carbon sequestration), regulation of temperature and humidity, water flow regulation (avoided run-off), filtration of air pollutants by plants, biomass provision (wood), and physical recreational activities promoting health.

On-going efforts of the Nature4Cities team developing integrated NBS models for UES valuation (in WP7) are dedicated to tailoring the advancement and application of such an urban forest model to other areas in Europe, such as the four pilot cities of Nature4Cities. Through the Valdebebas Park case, the proof-of-concept proposed and validated in the present work is provided with a set of default soil and species growth parameters. These parameters can be used – with the duly considerations on uncertainty and data model representativeness – in cases where site-specific environmental and economic contextual data are not available. Moreover, the quantification functions and monetary valuation properties of this model will be incorporated both in a decision support tool called NBenefit$ (developed in the framework of the Task 4.4) and into the socio-economic assessment module of the Nature4Cities Platform. Accordingly, the tool will be further expanded with test-bed cases by designing, constructing and implementing additional system dynamics based MIMES-NBS models (i.e. for urban green corridors and green roofs, for urban ponds, etc.).

The proof-of-concept model developed in the Task 4.2 of Nature4Cities shows that it is possible to develop a methodology, and validates its analytical framework, to characterize NBS and assess their cost-effectiveness, taking into account both benefits, co-benefits and possible negative externalities. This study also highlights that there is a widespread lack of contextual and site-specific knowledge on the environmental and economic characteristics underpinning the implementation projects of NBS, which is necessary to build representative MIMES-NBS models.

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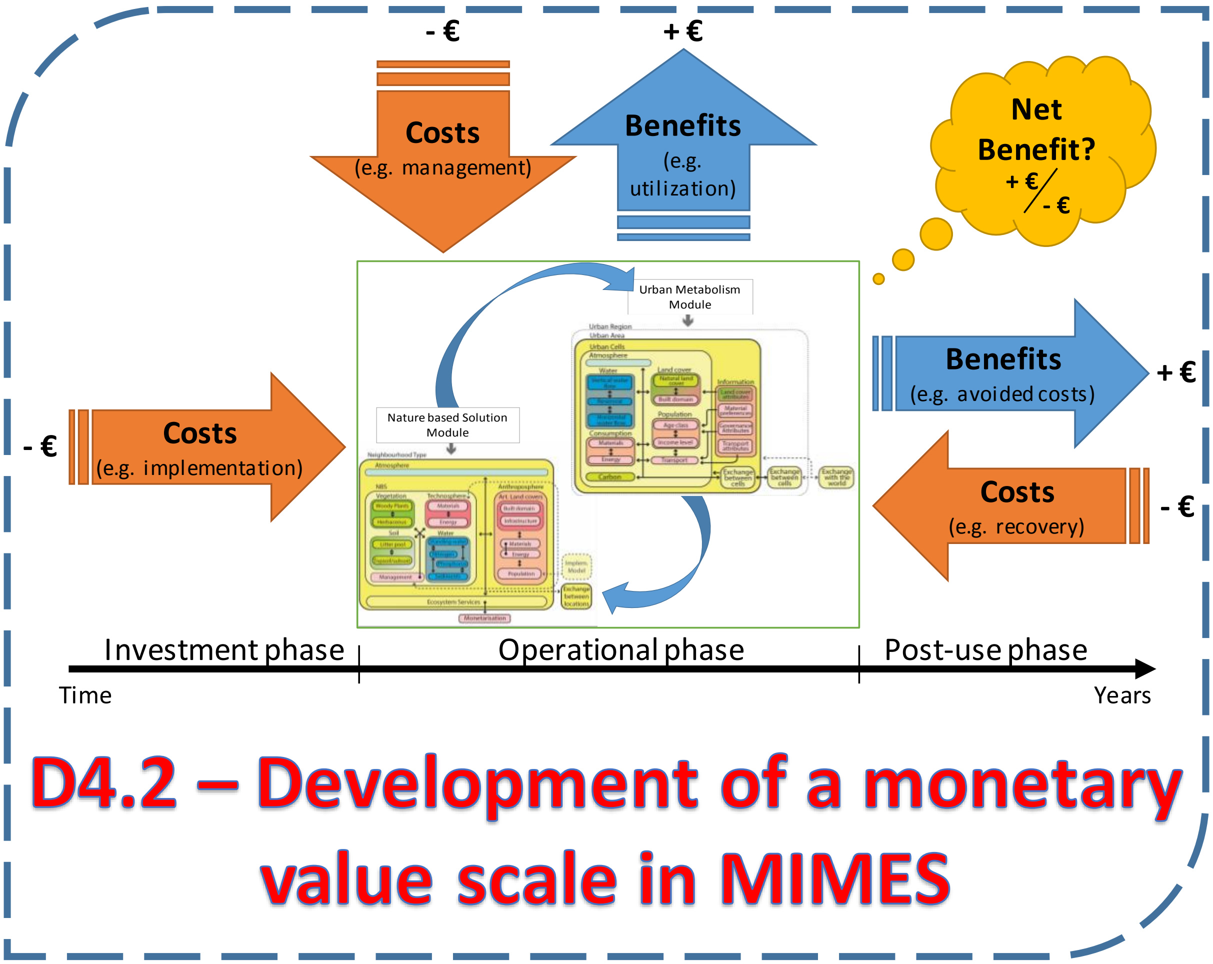
With the work performed in this Nature4Cities task, the team further proves that the design and application of a systemic thinking is very promising to foster the multi-stakeholder involvement through participatory processes. Furthermore, more evidence on NBS cost-effectiveness made available with the use of monetary value scales (as proposed in this report) might support the system integration of NBS into a sustainable urban planning.



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