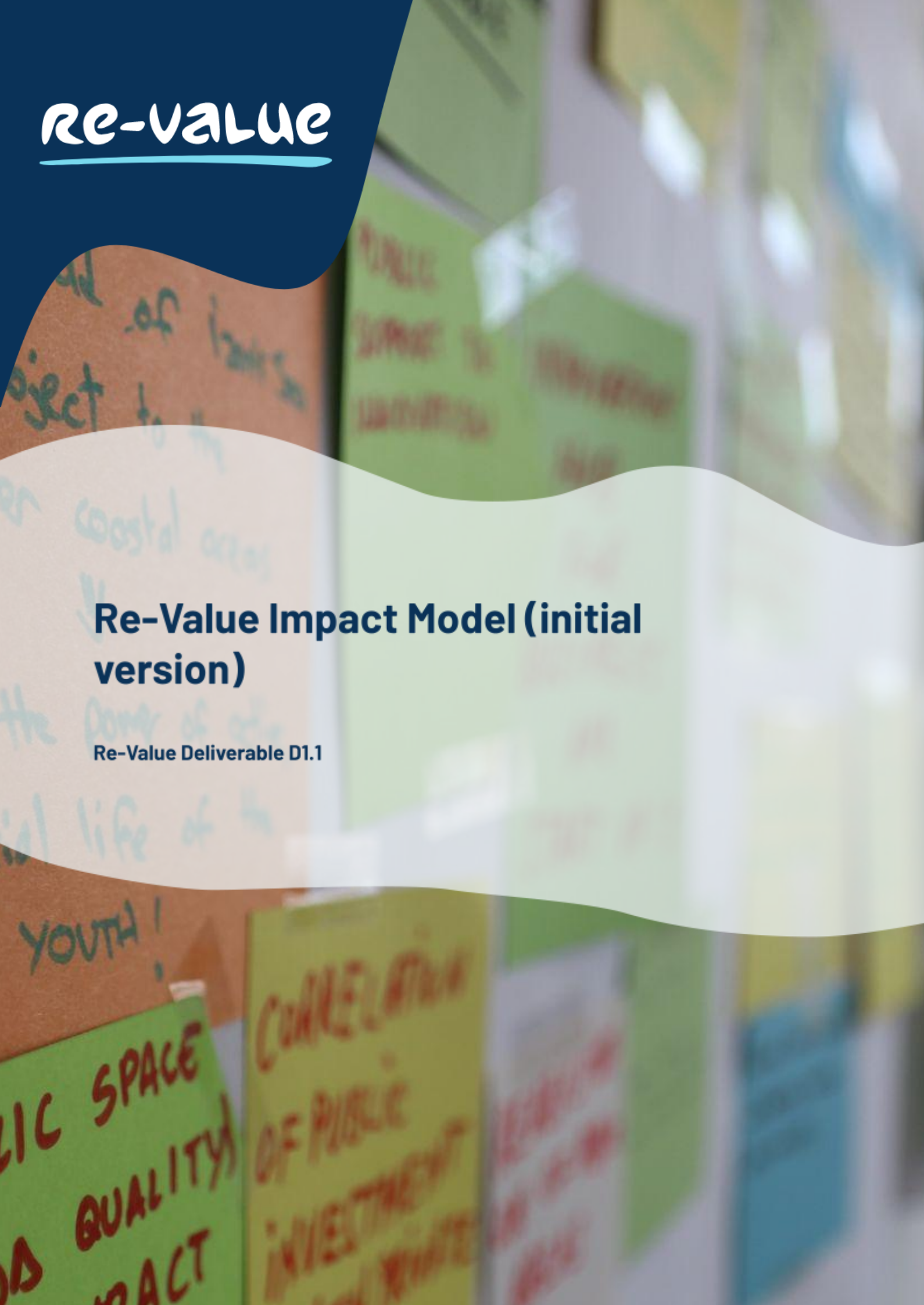
Re-Value

Re-Value Impact Model (initial version)

Re-Value Deliverable D1.1



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Executive Summary

Re-Value contributes to the creation of a New European Bauhaus-inspired Impact Model (NEB Impact Model), in cooperation with CrAFt, with 70+ CrAFt Cities[1], and the NEB-STAR NEB Lighthouse project[2] with Stavanger, Utrecht and Prague. The NEB Impact Model is an autonomous deliverable in each of the three projects, adapted to the specific project scope, and the needs and priorities of the participating cities.

Figure: The NEB Impact Model[3] with 5 pillars, 17 impact categories and 46 suggested indicators

[1] The CrAFt CSA project started on 1 May 2022 and it responds to the HEU call on "Collaborative local governance models to accelerate the emblematic transformation of urban environment and contribute to the New European Bauhaus initiative and the objectives of the European Green Deal", https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-miss-2021-cit-01-02

[2] The NEB-STAR project started on 1 October 2022 and it responds to the HEU call on "Support the deployment of lighthouse demonstrators for the New European Bauhaus initiative in the context of Horizon Europe missions", https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-miss-2021-neb-01-01?tenders=false&openForSubmission=false&closed=true&callIdentifier=HORIZON-MISS-2021-NEB-01

[3] D1.1 CrAft NEB Impact Model updated, 14.07.2023. https://craft-cities.eu/wp-content/uploads/2023/07/D1.1-CrAFt-NEB-Impact-Model-updated.pdf

In Re-Value, the cities will use the NEB Impact Model to operationalise and document the co-benefits of simultaneously reducing greenhouse gas emissions and increasing urban quality - for, by and with more groups of inhabitants and professionals, towards six systemic challenges in terms of value-based urban planning and design, aligned with the Cities Mission's key enablers[4]:

- Systemic changes in governance, regulatory structures, advocacy
- Societal and spatial quality
- Financial and circular value chains
- Data-driven co-creation, digital twins
- Energy and mobility
- Nature-based solutions

Within Re-Value, our target for the NEB Impact Model is to help the Re-Value cities build evidence for how increased quality in urban planning and design can contribute to their ambitions to become climate-neutral and resilient. The Impact Model is intended as a tool to negotiate between different types of stakeholders, priorities and interests, mitigate potential conflicts of interest, and identify potential co-benefits of cross-sectoral measures that will increase the willingness of politicians, property developers, civic communities and other stakeholders to invest in these measures. The Impact Model also aims to help the Re-Value cities identify blind spots and fill gaps in their existing indicator systems, and strengthen their capacity for integrated urban planning and design measures that address technical-environmental as well as social, cultural, governance, quality of life and economic perspectives.

After having tested the Impact Model in their demonstration areas and long-term Territorial Transformation Plans, the ultimate aim is for the Re-Value cities eventually to integrate the Impact Model rationale, Key Performance Indicators and co-benefits into their standard day-to-day procedures, adapt them to local context, and regard it as their own.

This report contains the initial version of Re-Value's NEB Impact Model for value-based urban planning and design, as of November 2023 (M11). The Impact Model will support Re-Value cities to develop and implement integrated urban planning and design approaches for urban transformation areas that value quality, inclusion, and other non-monetary benefits, in addition to financial and greenhouse gas emission impacts. In this manner, the Impact Model becomes an instrument to support integrated sustainable urban development by providing a whole systems understanding.

Re-Value's work with the NEB Impact Model was initiated during the kick-off meeting in Bruges from 31 January to 2 February 2023, to gain insight into what role the cities and cross-cutting partners think the Impact Model can play in their work. These insights are summarised in Chapter 2 of this report, as the basis for further detailed mapping of Key Performance Indicators and indicator systems within and connected to the Re-Value cities (Chapter 3). Through two rounds of City Dialogues, several hundreds of indicators were identified by the Re-Value cities in their current states of practice.

Technical-environmental performance is by far the most monitored dimension , with about 40% of the collected indicators. Healthy outdoor environment is the dimension most often monitored by the cities,

[4] Proposed Mission: 100 Climate-neutral Cities by 2030 – by and for the Citizens. Report of the Mission Board for climate-neutral and smart cities (2020), https://op.europa.eu/en/publication-detail/-/publication/bc7e46c2-fed6-11ea-b44f-01aa75ed71a1/language-en/format-PDF/source-160480388

with all the cities having some sort of monitoring processes in place regarding urban heat island, noise levels, air pollution and safety. Circularity, despite being high in the ambitions of several cities, is a topic not yet sufficiently explored and often covered only by indicators related to waste management. The overall aim within Re-Value is to generate a balanced, select set of indicators and supportive procedures, among which we can prioritise those that are the best fit for Re-Value and other cities, duly covering the 17 impact categories while, for example, not overly focusing on environmental or economic indicators, or losing out on socio-cultural indicators.

Common issues identified by the cities regarding their indicator systems and monitoring processes include time-consuming procedures, challenges in coordinating different departments, and differences in monitoring timelines. These issues can arise due to bureaucratic cultures and siloed organisational structures. The Impact Model's goal is to support cities to define their own integrated monitoring frameworks, taking into account the unique characteristics of each city and the differences in data collection and interpretation. By doing so, the Impact Model can provide valuable insights into the effectiveness of interventions and the progress towards achieving the desired outcomes.

Chapter 4 identifies and categorises co-benefits and negative externalities of urban planning and design interventions towards climate neutrality in relation to the main pillars of the Impact Model. An initiative to collect more evidence on socio-cultural co-benefits, and to identify the methods and tools available for quantification and monetisation, is in progress.

In addition to these summary chapters, this report contains three Appendices that show the detailed overviews of Key Performance Indicators and co-benefits.

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1 Scope

Re-Value deliverable 1.1 'Impact model for value-based urban design and planning' (WP1) will help Re-Value cities and their partners develop and implement balanced integrated urban planning and design approaches for urban transformation areas that value quality, inclusion, and other non-monetary benefits in addition to financial and greenhouse gas emission impacts. By jointly building and fine-tuning the Impact Model (IM), they will be able to identify co-benefits and, at the same time, potential conflicts between these perspectives in their own city context.

The Impact Model will be populated by the best and aspiring practices from the Re-Value Cities through the following three Innovation Cycles (ICs, Tasks 1.2-1.4), with the cities, local and cross-cutting partners, to build Stories, data-driven Scenarios, Investments and Partnerships:

- IC 1 Story-building
- IC 2 Scenario-building
- IC 3 Investment and Partnership building

These Innovation Cycles will support the cities as they document and capture different values in urban complexity, synthesise them into systemic urban design and planning approaches and re-value investments for their Waterfront Pilot Detailed Roadmaps and Territorial Transformation Plans.

In each Leading City (Ålesund, Bruges, Burgas, Rimini), the municipality, local partners, associates and stakeholders will jointly implement the Impact Model, identify prioritised urban design and planning approaches, define Detailed Roadmaps, and initiate Full-Scale Deployment. In each Replication City (Cascais, Constanța, İzmir, Písek, Rijeka), the municipality, local partners, associates and stakeholders will jointly implement the Impact Model (WP1), identify prioritised urban design and planning approaches, and develop Detailed Roadmaps for their Waterfront Pilots, with feasibility studies to prepare for full-scale deployment.

These experiences will be shared in the Community of Practice (WP6) to learn from, and mutually improve, each other's practices. The Leading Cities (LCs) will cooperate with the Replication Cities (RCs), local and cross-cutting partners throughout the entire project duration to ensure the necessary expertise and capacity to support integration and long-term sustainability of the Waterfront Pilots into long-term Territorial Transformation Plans (TTPs). The Impact Model is intended to help facilitate these processes by providing an overarching framework and 'a tool to talk' across disciplines and competences.

The Impact Model will be evaluated and updated annually with cities and stakeholders, disseminated to the Cities Mission and NEB communities and other relevant platforms (WP8), and form the basis for advocacy (WP9). It will further inform the development and application of Re-Value's Monitoring and Evaluation (M&E) Model (WP7) for climate neutrality, urban co-benefits and negative externalities, aligned with the requirements of the Cities Mission Platform (NetZeroCities).

2 Co-Creating Re-Value's NEB Impact Model

2.1 What we aim to achieve

In Re-Value, the cities will use a New European Bauhaus-inspired Impact Model to operationalise and document the co-benefits of simultaneously reducing greenhouse gas emissions and increasing urban quality - for, by and with more groups of inhabitants and professionals. The Impact Model supports:

- Whole systems understanding of complex sustainability challenges (for example, an urban renewal project, a city's decarbonization roadmap) by clarifying functional links between the different aspects of an intervention, beyond the traditional disciplinary boundaries;
- Mapping relevant decision support tools (like indicators) and identifying related knowledge gaps;
- Identifying, qualifying and, where possible, quantifying co-benefits of interventions. Coupling opportunities to arrive at better integrated projects that realise higher added value;
- Accelerating awareness raising and enhanced decision making in cities, by effectively connecting all concerned departments and stakeholders.

CrAFt's NEB Impact Model[5] will be used as a base for this work, fine-tuned towards Re-Value's Cities' six systemic challenges of urban planning and design for climate neutrality, and aligned with the Cities Mission's levers of change:

- Systemic changes in governance, regulatory structures, advocacy
- Societal and spatial quality
- Financial and circular value chains
- Data-driven co-creation, digital twins
- Energy and mobility
- Nature-based solutions

Story-building methods and tools will make the Impact Model appealing for stakeholders to apply in different types of situations and project stages. These stories are based on concrete work with the Re-Value Cities and Community of Practice, and connected with CrAFt's NEB Guidance Package[6].

2.2 State of the Art: CrAFt's NEB Impact Model

CrAFt's original NEB Impact Model considers five main intervention domains, called 'pillars', and 17 impact categories. In this Section, we summarise the original NEB Impact Model as a foundation for its further development and adaptation within the Re-Value project. The text is based on CrAFt's Deliverable 1.1 CrAFt NEB Impact Model[7].

[5] D1.1 CrAft NEB Impact Model updated, 14.07.2023.
https://craft-cities.eu/wp-content/uploads/2023/07/D1.1-CrAFt-NEB-Impact-Model-updated.pdf
[6] D2.1 Climate-Neutral and Smart Cities Guidance Package: NEB Edition (Initial Version), CrAFt, to be published
[7] D1.1 CrAft NEB Impact Model updated, 14.07.2023.
https://craft-cities.eu/wp-content/uploads/2023/07/D1.1-CrAFt-NEB-Impact-Model-updated.pdf

Figure 1: CrAFt's NEB Impact Model with 5 pillars, 17 impact categories and 46 suggested indicators (source: CrAft project[8])

The five pillars consist of the well-known triple bottom line for sustainable development (planet, people, prosperity) complemented by pillars on quality of life and governance.

The 17 impact categories refer to essential aspects of integrated sustainable development (ecological, infrastructural, social, cultural, economic, aesthetical, legal, etc.). In order to achieve a balanced approach towards integrated sustainability, inclusivity and beauty, we recommend that all 17 categories are always taken into consideration.

Within the 17 impact categories, a variety of relevant indicators are identified, based on both methodological research and dialogues with the CrAFt, Re-Value and NEB-STAR Cities and their

[8] D1.1 CrAft NEB Impact Model updated, 14.07.2023.
https://craft-cities.eu/wp-content/uploads/2023/07/D1.1-CrAFt-NEB-Impact-Model-updated.pdf

stakeholders. The Impact Model suggests a list of 46 indicators, intended as an indicative set of primary Key Performance Indicators (KPIs) that are already largely known and used by most cities. The list is not compulsory, but rather intended to guide cities and projects in their selection of indicators from existing sets and reporting tools. At the same time, the pillars, impact categories and suggested indicators help to detect possible gaps as well as additional opportunities.

An important feature of the Impact Model consists of supporting the identification of direct benefits, co-benefits and wider societal benefits, by displaying the complete range of aspects that an intervention affects throughout all the impact categories. Practically speaking, this can be visualised by linking indicators that represent the direct benefits of a given intervention to those that represent co- or societal benefits. Inventorying these linkages and subsequently leveraging them supports the stated main goal of Re-Value: 'a holistic approach to urban development, considering not only the physical infrastructure but also the well-being of communities while laying a path towards achieving climate neutrality in urban areas.'

2.3 City Dialogues to identify gaps, needs and priorities

Re-Value's work with the NEB Impact Model was initiated during the kick-off meeting in Bruges from 31 January to 2 February 2023. VITO and NTNU organised a workshop session with the Re-Value Cities and cross-cutting partners to introduce CrAFt's NEB Impact Model and gain insight into the role they think the NEB Impact Model can play in their work. We asked them:

- What are your personal motivations for engaging in Re-Value? What is the impact you wish to create?
- What are your organisation's motivations for engaging in Re-Value?
- How do we unnerve the 100 reasons for not undertaking climate action?
- Which tools, collaborations, business models,… lift us out of the problem and thus allow us to create impact?
- Which specific actions do you think have the most impact towards reaching climate neutrality (and so, should be prioritised)?

In this section, we summarise the answers of the participants to these five questions and describe how they have been used to create the next steps to further develop Re-Value's Impact Model.

2.3.1 What are your personal motivations for engaging in Re-Value? What is the impact you wish to create?

Contributing to a positive change for the future and for the next generation - both individually and as organisation - is a main theme in most answers to this question: generating a better and healthy way of life, reducing overconsumption of natural resources, demonstrating nature-based solutions, integrating circular and climate neutrality elements in construction and urban planning, developing data-based decision making, achieving climate neutrality, and getting other sectors such as mobility and the public housing sector engaged.

A second theme is the desire to learn and experience together with others: making this commitment together with nine waterfront cities and cross-cutting partners, being inspired and motivated by a European challenge together with a large network of like-minded professionals and changemakers, gaining knowledge

and experience, getting to know other points of view, opening the mind to the possibility of different solutions and ultimately making a change in public space – more sustainable in appearance, substance and process.

A third theme deals with the ability to convince others of this way of working. We have the necessary expertise and have ideas and models to share. By experimenting with measures in our own cities, we will be able to share knowledge, offer already applied solutions to others, and help create beautiful and inclusive (waterfront) cities.

As summarised by one of the participants: “Co-creation is what truly can create change and Re-Value can take this to the next level”.

Based on these answers, we will further develop the Impact Model to be able to handle individual sectoral outcomes as well as cross-cutting co-benefits, and to produce narratives that can be shared and discussed in and between cities and their partners.

2.3.2 What are your organisation’s motivations for engaging in Re-Value?

The main reasons for the organisations to participate in the Re-Value project are to positively contribute to addressing global issues, cutting emissions and safeguarding liveability. The project enables the partners to do research for a better world and empowers cities to navigate the immense challenges of achieving climate neutrality in a just and inclusive way.

The partners want to work in a cross-cutting way to bring everyone together, expand networks and partnerships, share best (European) practices, network, collaborate between transdisciplinary teams, improve processes, and acquire new experiences. They want to foster mutual learning and leverage expertise and knowledge to build stories that make the results of climate action tangible, with sustainable economic opportunities and robust data for data-based decision making.

Ultimately, the Re-Value partners believe that this way of working will help them in creating climate-neutral cities, and in supporting long-term municipal policies towards achieving the objectives of the Green Deal and the Cities and Adaptation Missions.

The strong connection between the Impact Model, Story-Building, Data-Driven Co-Creation and Financial and Partnership Models in Work Package 1 fits well with these ambitions, but will require a lot of support to build these narratives, especially when partners are not gathered in one site. Based on these answers, we decided to organise regular online City Dialogue sessions within and across cities.

2.3.3 How do we unnerve the 100 reasons for not undertaking climate action?

Walking the talk and pulling others in is the favourite method of the Re-Value partners. They want to use the project to show how climate action can be undertaken can be better; showcase local examples and climate champions; display successful stories and sustainable and liveable solutions; keep moving and proving that things work; prove that actions make a difference.

The cities want to engage and involve more people and stakeholders. They want to discuss with them if they are happy with how things are going now, convince people not to be selfish, and work both on the next and the older generation’s mindset. They want to challenge people to reflect on extreme weather and its

consequences. Above all, they want to take time to build a common ground, increase public awareness and ensure public participation via online tools and focus group meetings to the decision making process. Ultimately, they would like to make the children's voices louder than the politicians', and bet on education and revaluation.

Using the Impact Model, the cities and cross-cutting partners will be able to co-create the most impactful solutions, and build a foundation for making them accessible and achievable.

2.3.4 Which tools, collaborations, business models,... lift us out of the problem and thus allow us to create impact?

Setting up the appropriate process, with participation and empowerment, is the red thread throughout all of the answers. The cities aim to develop policy and action in a truly mission-oriented way: aspirational, mandated, and engaged. They aim to set up local climate alliances with multi-stakeholder composition, cross-cutting and transdisciplinary approaches. This will include identifying and involving the right stakeholders (different social groups, children, teenagers, adults, teachers, professionals,…), appropriately discussing and planning, and subsequently, doing. We envision that the Climate City Contracts[9] organised by the Cities Mission Platform will be a major source of inspiration, and will seek to reinforce cooperation with NetZeroCities on this topic in the Re-Value Community of Practice.

In order to learn faster together, good practice examples matter, with easy, understandable, adaptable methods, models and tools. The cities also asked for support to undertake concrete actions and implement innovative solutions on the ground.

Work Package 1 and the Re-Value Community of Practice will help the cities explore public-private-people partnerships with the potential for co-creation and social innovation, interdisciplinary collaborations, and connections to regional and national policy making. The Impact Model will, through its integrated design, support co-design practices with circular economy, nature-based solutions, and New European Bauhaus values and principles as implementation criteria.

2.3.5 Which specific actions do you think have the most impact towards reaching climate neutrality (and so, should be prioritised)?

Re-valuing mindsets and operational frameworks is a recurring priority, including finding ways to effectively reach and motivate all members of the community by means of:

- Strong, mandatory renovation policy in dialogue with the construction sector and financial actors
- Localisation of facilities and services to bring everything closer (food, travel, nature, culture, work and products), combined with shared mobility, removing cars from historic/heritage city centres, and making all home-work journeys carbon-free
- Circular economy, and making sustainability and climate neutrality part of a viable business model. Decreasing consumption, making it easier to fix products such as phones and clothing, using less resources and improving access to recycling. Prioritising renovation of existing buildings, brownfield and regeneration areas (with reused materials)

[9] Cities Mission Climate City Contract (CCC) is a governance innovation tool to help cities collaboratively address their barriers to reaching climate neutrality by 2030. https://netzerocities.app/QR-CCC

- Nature-based solutions and ecological landscaping. More green spaces and trees. Renaturing the planet by enhancing ecosystems and diversity. Green and blue network expansion and integration
- Changing behaviour and mindsets, and empowering people to take an active role in the transition. Identifying actions that are less expensive and involve large(r) audiences and the general public. Expanding awareness in an easy and understandable way for citizens
- Creating better information (where energy is consumed, where urban heat islands appear, etc.) and sharing tools and best practices to solve these problems (e.g. ecosystem services, sustainable procurement). Develop transformative learning , capacity building and collaboration

Based on these answers, we will further develop the Impact Model as a good base to knit these different elements together and identify co-benefits as well as potential sources of conflict. Furthermore, the 'integrity'/'reflexive governance' category of the Impact Model is particularly suited to address the challenge of changing people's mindsets and value systems as a primary matter of concern.

2.3.6 A foundation for City Dialogues

Based on the results of the kick-off session, a first series of individual City Dialogues with each of the nine Re-Value Cities and their local partners was organised in February - March 2023 to discuss the anchoring of each city in the project. This first round was initiated by the Project Coordinator and extended towards the Impact Model for value-based urban design and planning (WP1), Replication and Learning in the Replication Cities (WP6) and Monitoring and Documenting Impact (WP7) to support integrated dialogue with the cities.

The outcomes of these City Dialogues that are relevant for the Impact Model are presented in Chapters 3 and 4. The outcomes related to the Innovation Cycles are presented in Deliverable 1.2 Re-Value Innovation Cycles experience-based report 1[10]. The outcomes related to the Re-Value Capacity Development and Exchange Programme are presented in Deliverable 6.1. - Re-Value Capacity Building and Exchange Programme 1.

[10] D1.2 Re-Value Innovation Cycles experience-based report 1, to be published

3 Re-Value's NEB Impact Model indicator system: State of the art and gap analysis in the Re-Value cities

3.1 Scope

This Chapter describes the state of the art in the Re-Value Leading and Replication Cities in terms of Key Performance Indicators (KPIs) that can be plugged into CrAFt's NEB Impact Model. Based on the state of the art, a gap analysis has been performed, and potential indicator sets were identified that can be used to complement the cities' current processes for monitoring and evaluation.

Data on current KPIs being used in practice was collected with Leading and Replication Cities via e-mail, on February 22nd 2023. The nine cities were contacted with an open question regarding their current monitoring indicators: "Which indicators (or indicator sets, reporting formats) are you currently using to assess these impacts in your local contexts?".

Following the first approach via email, online interviews were conducted with Cities' representatives of the four Leading Cities (Bruges, Ålesund, Burgas, and Rimini), and with one replication city (Písek). The online interviews were conducted between March 1st 2023 and March 10th 2023 and explored the following topics:

- Processes for identifying current indicators across multiple sectors and stakeholders;
- Local or international indicator sets for impact assessment and reporting;
- National and local urban data platforms.

In April - June 2023, a second round of City Dialogues with the cities and their local partners was organised:

- to go into further detail regarding their capacity needs and their expertise (WP6),
- to discuss the Impact Model (WP1), and
- to discuss in depth project financing (IC 3), data-driven project scenarios (IC 2), and storytelling opportunities (IC 1) for their Waterfront Pilot with the Innovation Cycle Leads (WP1)

In the second round of City Dialogues, participants were encouraged to share hypothetical case study examples, explore co-benefits and implications within the comprehensive Re-Value Impact Model, and critically assess any gaps in their existing indicator sets.

The results of the local indicator sets were qualitatively analysed with content and thematic analysis methods, including: 1) familiarisation with the data; 2) coding indicators according to the Impact Model (WP1) defined categories; 3) identifying patterns in the indicator sets across the different cities and identification of thematic gaps.

Together with the analysis of the data provided by the Re-Value cities, the same thematic and content analysis steps were applied to the review of existing literature and guidelines on monitoring and reporting indicators identified as relevant by the different stakeholders, namely:

- EU Covenant of Mayors reporting on Sustainable Energy and Climate Action Plan (SECAP)[11];
- NetZeroCities (NZC) impacts and co-benefits categories[12] (currently available materials in anticipation of the Comprehensive Indicator Framework);
- United for Smart Sustainable Cities (U4SSC) Key Performance Indicators[13];
- Green City Accord (GCA) monitoring indicators[14];
- Circular Cities Declaration report[15].

Based on the analysis of current sets of indicators, and underlying indicator sets and reporting guidelines common to the cities in the project, recommendations for the Impact Model are proposed and adapted to local realities and ambitions, in a flexible and adaptable way.

3.2 State of the art in the Leading Cities

These Sections combine text from the project's Description of Action, with new data provided by the Re-Value Cities.

3.2.1 Ålesund (Norway)

Ålesund plans to be a zero-emissions community in 2050. By 2030, greenhouse gas emissions should be reduced by 60 per cent compared to 2009 (direct emissions)[16]. In the scope of Re-Value, the focus of Ålesund is on the development of the Sørsida waterfront district integrating a complex ecosystem of real estate developers, infrastructure developers, citizens and communities, artistic and cultural organisations, and other stakeholders. The aim for Ålesund is to combine an ambitious climate-neutrality strategy with the existing cultural and engagement activities to empower citizens and other local stakeholders. Key aspects for the Sørsida Pilot are sustainable mobility (connections between the city centre, the waterfront, and the suburban areas, accessibility for walking and cycling, zero-emission mobility), integrated with sustainable infrastructure solutions for the local harbour and circular wastewater treatment systems.

Between 2019 and 2020, Ålesund reported according to the Key Performance Indicators of the United For Sustainable and Smart Cities Program[17] (see also Section 4.5.3), a long process that required external expertise. Ålesund, like all municipalities in Norway since 2001, reports yearly at a national level through a national information system: KOSTRA - Municipal State Reporting[18]. This reporting system aims to provide up-to-date information about allocation of resources, priorities, and municipal targets. It includes, but is not limited to, statistical data reported to Statistics Norway, on topics such as finance, schools, health, culture, the environment, social services, public housing, technical services and transport and communication.

[11] Covenant of Mayors for Climate & Energy Europe. (2020). Covenant of Mayors EU: Reporting Guidelines.
[12] Kiernicka-Allavena, Joanna & Wade, Will. (2021). NZC: Pilot Cities Programme Guidebook (Net Zero Cities)
[13] U4SSC. (2017). Collection Methodology for Key Performance Indicators for Smart Sustainable Cities
[14] European Commission. (2022b). Green City Accord Indicators Guidebook. https://environment.ec.europa.eu/publications/green-city-accord-indicators-guidebook_en
[15] ICLEI & Ellen MacArthur Foundation. (2022). Circular Cities Declaration Report 2022. Circular Cities Declaration
[16] https://pub.framsikt.net/plan/alesund2020/plan-1630d740-a4e7-4ce1-9a24-db3e594a4192-12064#/generic/summary/f38d531f-dc30-434e-8869-6cdbdb974acd
[17] Alesund Kommune. (2020). U4SSC KPIs Verification Report: Alesund, Norway. U4SSC (United 4 Smart Sustainable Cities).
[18] Statistics Norway. (n.d.). KOSTRA. SSB. Retrieved 6 June 2023, from https://www.ssb.no/en/offentlig-sektor/kostra

The indicators currently reported by Ålesund are presented in Appendix 2, Table 3, organised according to the Re-Value Impact Model categories. Some of the reported indicators are overarching and integrate multiple indicators.

Social performance and technical environmental performance are the dimensions that concentrate most of Ålesund's indicators, in particular with indicators on affordability, cultural sustainability and sustainable mobility. These indicators are aligned with Ålesund's priorities regarding climate neutrality, sustainable mobility and cultural sustainability. While indicators related to mobility are covered by current indicators, Ålesund can benefit from further support to develop indicators to monitor citizen empowerment. Regarding climate neutrality, a repository based on the Norwegian Environment Agency's municipality-distributed statistics, collects yearly emission data[19].

3.2.2 Bruges (Belgium)

The city of Bruges aims to halve its local CO2 emissions compared to 2011 by 2030, making the city climate-proof, deploying nature-based solutions and smart water management. The Kaaidistrict (Quay District), located alongside the Ghent-Ostend channel, connects the city centre with the harbour, and will be developed as a structuring element in its climate-neutrality strategy, with a focus on optimising the interweaving between functions, spatial efficiency, and economic profitability as drivers for sustainable lifestyles. This will be the focus of the Re-Value project. One of the challenges for Bruges is extending the concept of circularity to broad functions such as mobility, energy, waste, water, food, and maker spaces. Bruges will prioritise a modal shift in the Quay District, with emphasis on biking and walking, sharing systems, communal transport and distribution, and emission-free urban freight transport by road and via water, in combination with the circular and sharing value chains.

To substantiate and strengthen the strategic policy of municipalities, the Flemish government developed an online monitoring tool for all Flemish cities. The Stadsmonitor[20] includes around 300 indicators, mostly of registered statistical data. A third of these indicators are collected through a triennial citizen survey with inhabitants of the cities. The Stadsmonitor covers topics such as poverty, culture, demography, economy, mobility, education, work, care and health, etc. Data is collected at the municipal scale and is not disaggregated in urban areas or neighbourhoods. Although this tool can be highly beneficial in aiding decision-making processes, it was not incorporated into the table as it is not currently being utilised by the city department responsible for the climate plan. Also at a local level, the Flemish Department of Policy Development and Legal Support, proposes a framework for optimal environmental management within the scope of the Flanders Spatial Policy Plan: the 10 Core Qualities (10 Kern-kwaliteiten). The 10 Core Qualities model[21] is not mandatory, and the indicators are not used for monitoring purposes. Rather, it works as a user-friendly tool to engage stakeholders in decision-making processes. Understanding the experiences of Bruges with this instrument can inform the Re-Value Impact Model, customise it to local realities, and improve process quality, so this was analysed separately in Section 4.5.5.

[19] https://pub.framsikt.net/2022/alesund2020/bm-2022-budsjett_2022,_%C3%B8konomiplan_og_handlingsplan/#/generic/summary/climatesummary

[20] Flemish government. (n.d.). Municipality-City Monitor. Retrieved 21 June 2023, from https://gemeente-stadsmonitor.vlaanderen.be/

[21] Environment Department - Flemish government. (n.d.). Get started with the 10 core qualities of the environment. Retrieved 15 March 2023, from https://omgeving.vlaanderen.be/nl/aan-de-slag-met-de-10-kernkwaliteiten-van-de-omgeving

Appendix 2, Table 4, presents the indicators currently identified by Bruges. Some indicators present ambitions for, or have already been partially integrated in the Re-Value pilot area. Examples of these are the "functional mix" that was determined as a mandatory pre-requirement for developers in the Quay District, and the "community supportive business models" to support the makers' district. Also specific for the pilot area and aligned with the city's ambition in the Re-Value project, is the indicator related to circularity,, which goes beyond the concept of waste to assess the durability and adaptability of the projects to be implemented.

On the one hand, Bruges currently has an extensive number of indicators on technical-environmental performance, particularly on climate neutrality and energy. Economic performance and social performance, on the other hand, are only touched upon in a limited manner. As economic development and circularity across the value chain are essential aspects of Bruges' commitment in Re-Value these are gap areas to be further explored in the next stages of the project.

3.2.3 Burgas (Bulgaria)

In Re-Value, the ambition of Burgas is to regenerate its waterfront areas, connecting the urban node with peripheral residential areas in a climate-neutral and integrated intelligent urban systems context. The city aims to extend its climate neutrality strategies to other sectors and municipal units while identifying co-benefits and potential negative externalities, by implementing local collaborative governance models. A key focus area for Burgas is to induce positive changes in citizens' attitudes and behaviours through informational campaigns, and activities to encourage engagement and empowerment of inhabitants. Burgas aims to improve and expand digital urban solutions and services through its intelligent urban systems and by developing and introducing a digital twin of its pilot waterfront area while also leveraging its digital innovation hub for testing circular and bio-based solutions. Additionally, the city prioritises a modal shift in transportation and intends to increase accessibility, connectivity, and further promote sustainable mobility in the waterfront area by identifying opportunities to connect and expand into a network of green and blue corridors and infrastructure. The Waterfront Pilot project will serve as a catalyst for the climate neutrality of Burgas as a whole and align with the city's Expression of Interest to the EU Cities Mission and its local Climate Adaptation plan set in the SECAP of Burgas 2023-2030.

As part of its digitalization and smart city strategy, Burgas has since 2015 developed the platform SmartBurgas[22]. This is an integrated platform which collects data from various smart devices and systems to provide real-time information on mobility, waste management, environmental (air and noise quality) and flood risk control, green system,live video surveillance of urban spaces, and real-time alerts. Burgas Municipality expands access electronic services in the eGIS platform. The links to the platform are available on its website and on the SmartBurgas platform[23]. The eGIS platform is the specialised web application of the Municipality of Burgas for providing data from the city's geographic information system through remote access to the specialised digital arrays. Through it, registered users are provided with the opportunity to access paid and free digital services. Along with the data in the dynamic map of the city with the current regulatory and construction plan, you can also find data from the city's intelligent systems, as well as other specialised information. Requests are processed automatically, online, without the need to go to a counter.

[22] Smart Burgas—Интегрирана градска платформа на Бургас. (n.d.). Retrieved 6 June 2023, from https://smartburgas.eu/bg

[23] https://www.burgas.bg/bg/elektronni-uslugi/ https://egis.smartburgas.eu

Electronic services are performed automatically, through the functionalities of the web-based eGIS application. To use the services, individual registration of a profile in the system is required. SmartBurgas can be used to provide up-to-date information for monitoring and decision-making.

When challenged to compile a list of indicators currently being used in the municipality, Burgas went a step further and identified aspects that, while not being currently monitored, would be important to measure the success of implementation of the pilot project. These represent target goals for the Re-Value project, such as: ensuring hiking trails and birdwatching facilities along the coastal wetlands and pedestrian tracks using recycled pavement and materials in the pilot area, implementing energy efficient park lighting, and achieving behavioural change of its community in relation to climate mitigation and adaptation. Appendix 2, Table 5, presents the indicators currently reported by Burgas; the target indicators for the pilot area are included in italic.

The priority areas for the Burgas pilot are, besides climate neutrality, sustainable mobility, digitalisation, and collaborative governance models. The inventory of indicators demonstrates that Burgas is currently collecting data to monitor technical-environmental performance, in specific towards objectives of climate neutrality and sustainable mobility, while indicators related to social and economic performance and governance are still lacking. Considering the ambitions of Burgas for the implementation of the pilot some fragilities are identified related to monitoring of collaborative governance models and use of digital tools, where lessons can be learned from other Re-Value cities in the next stages of the project.

3.2.4 Rimini (Italy)

Rimini has the ambition to embed climate-neutrality across municipal units and policies. In the Re-Value project, the focus is on the full development of the seafront Parco del Mare as well as riverfront Parco Marecchia, the largest urban park area in Rimini. The pilot project aims at regenerating local ecosystems with nature-based solutions to improve urban drainage systems and create a catalyst for climate-neutrality in the city, resulting in an attractive and inclusive destination for tourists while improving the quality of life of its citizens. In Re-Value sustainable mobility solutions will be developed, contributing to implement a 15-minute city concept. Furthermore, the city will focus on fine-tuning the recently completed car-free waterfront district, Parco del Mare, with an emphasis on nature-based solutions and biodiversity.

As part of the Green City Accord[24] Rimini regularly reports on technical-environmental performance. This is the basis of the current indicators provided by the city, with some additional indicators, as shown in Appendix 2, Table 6. One of the challenges highlighted by Rimini in the process is that data is currently collected by different municipal or national bodies, with different methods and timeframes. Some examples are the air quality data that are provided monthly by ARPAE (Agenzia Prevenzione Ambiente Energia)[25], waste data provided annually by waste service manager HERA[26], or nature and biodiversity data with irregular updates from the intermunicipal company ANTHEA[27].

[24] European Commission. (2022a). GCA: Explanatory Note on Monitoring and Reporting & Set of Mandatory Indicators. Publications Office.
[25] Arpae a Rimini. (n.d.). Arpae Emilia-Romagna. Retrieved 21 June 2023, from https://www.arpae.it/it/sedi-e-contatti/arpae-rimini
[26] Gruppo Hera: La tua Multiservizi. (n.d.). Retrieved 21 June 2023, from https://www.gruppohera.it/
[27] Anthea società multiservizi. (n.d.). Anthea Rimini. Retrieved 21 June 2023, from https://www.anthearimini.it/

At present, the municipality of Rimini provides a comprehensive range of measures to assess technical and environmental performance, especially with regards to sustainable land use and sustainable mobility. In order to achieve the goal of creating a waterfront that fosters inclusivity and enhances the well-being of its residents, the next steps will involve incorporating indicators that measure social performance and governance alongside the existing ones.

In the scope of the Re-Value project, the city of Rimini and its scientific partners have elaborated on additional indicators that can be implemented in the future. These indicators are based on data already collected during a past EU Interreg project[28], but also on literature on the Healthy Streets indicators[29], and the Sustainable Urban Mobility (SUMI) framework[30]. As these indicators may be relevant for other Re-Value cities and to inform the development of the Impact Model, they are further discussed in Section 3.5 "Supporting indicator models and monitoring frameworks".

3.3 State of the art in the Replication Cities

3.3.1 Cascais (Portugal)

Cascais aims to transform its waterfront into a catalyst for climate neutrality and to accelerate its plans to become climate-neutral by 2050. In its Waterfront Pilot, Cascais aims to test participatory interventions for nature-based solutions and urban spaces, increase accessibility through walkability and cycle lanes, improve resilience and biodiversity through nature-based solutions, and boost local energy communities in cooperation with local residents' associations, schools, and art and culture organisations. One of the key challenges for Cascais is to strengthen public-private partnerships for energy communities with a focus on local renewable energy, specifically to fight energy poverty in social housing areas. Accessibility and inclusivity are key aspects for the redesign of its waterfront to facilitate more social and cultural activities and provide better accessibility to vulnerable groups and areas along the waterfront.

Cascais has been strongly investing in digitalisation to facilitate transparency and communication with its citizens. Main digital tools highlighted by the municipality are DataCascais, GeoCascais, FixCascais, and City Points Cascais. City Points[31] is a reward program to encourage sustainability practices, that allows citizens to collect points by performing actions such as recycling, using public transport, volunteering, or donating blood, for instance; points can then be exchanged for tickets for cultural events, local cultural facilities, and local commerce. City Points Cascais is not designed as a monitoring tool, but it can provide data about community engagement, participation, mobility choices, or recycling habits. Fix Cascais[32] is an app that empowers citizens to report damages in public space, traffic issues, or cleanliness of public areas, for instance. Citizens can share geolocated pictures of the situation, facilitating centralised communication of the citizens with the municipality, and streamlining the process for resolving the problem. GeoCascais[33] is

[28] FRAMESPORT. (2022). New opportunities for the Small Ports of the Adriatic Sea. Framesport. https://framesport.eu/
[29] Healthy Streets. (n.d.). Healthy Streets Indicators. Healthy Streets. Retrieved 21 June 2023, from https://www.healthystreets.com/what-is-healthy-streets
[30] Ruprecht Consult. (2020). Technical support related to sustainable urban mobility indicators (SUMI). https://transport.ec.europa.eu/system/files/2020-09/sumi_wp1_harmonisation_guidelines.pdf
[31] CITY POINTS CASCAIS | Câmara Municipal de Cascais. (n.d.). Retrieved 6 June 2023, from https://www.cascais.pt/citypoints
[32] Fix Cascais | Câmara Municipal de Cascais. (n.d.). Retrieved 6 June 2023, from https://www.cascais.pt/fixcascais
[33] GeoCascais. (n.d.). Retrieved 6 June 2023, from https://geocascais.cascais.pt/

the GIS system of Cascais, and provides citizens with open access geographic information. Finally, the platform DataCascais[34] aggregates smart data collected by the city regarding demography, territory, health, mobility, education, economy, or culture, for instance. While this data is currently not used in a systematic way, it is available for consultation and has the potential to be used for monitoring processes and to support decision-making.

Besides the data collected through these functionalities Cascais is currently monitoring, for purposes of the climate mitigation strategy, the indicators presented in Appendix 2, Table 7. Selected indicators from the databases previously mentioned were also integrated in the table in italic, as they can support Cascais in its governance strategy and contribute to achieve the city's goals towards accessibility and inclusivity. While Cascais has in place several projects and tools on digitalization and citizen empowerment, indicators on climate neutrality to support energy communities are yet to be refined.

3.3.2 Constanța (Romania)

Constanța is developing a climate-neutrality strategy that builds on its existing policies and networks, such as smart city initiatives, sustainable transport, energy-efficient building renovations, and urban regeneration. The city centre, located at the port and seashore, is the pilot location for promoting climate neutrality and improving quality of life. Constanța plans to foster communication between public authorities, citizens and stakeholders to improve administrative capacity, and to target the needs of local communities. A key objective in the scope of Re-Value is to explore how interactions between the metropolitan region and the municipality can be optimised towards achieving climate neutrality, promoting efficient management and administrative processes.

In Romania, public entities manage various sets of indicators, which are often difficult to locate. Although the National Institute for Statistics collects a wealth of data, it is not specific to cities due to the county-based administrative structure. At present, there is no continuous data collection process at the city or metropolitan area level, and data is often collected through pilot projects, investment projects, or local development strategies. However, the implementation of the National Plan for Recovery and Resilience presents an opportunity to establish a monitoring system under the Romanian Urban Policy, which has been developed with the assistance of the World Bank. Recent changes in national legislation have established clear data collection obligations for public bodies, including cities and metropolitan areas. The collected data will be managed in a centralised manner by the National Government and made publicly available, presenting a clear opportunity for the implementation of a New European Bauhaus-inspired set of indicators.

Appendix 2, Table 8 presents the indicators currently identified in Constanța, being collected by different authorities, such as the state police, the port authority, or the municipality. Most indicators currently collected by Constanța focus on sustainable mobility, safety, and sustainable tourism. No indicators were identified on Governance, a key dimension to achieve Constanța's ambitions to improve management and administrative processes.

[34] Cascais Data. (n.d.). Retrieved 6 June 2023, from https://data.cascais.pt/

3.3.3 İzmir (Turkey)

The city of İzmir is committed to becoming climate-neutral by 2050 and has identified actions to address biodiversity, air, soil, and climate change. In partnership with Re-Value, İzmir aims at boosting the development of its İzmirSea Waterfront Pilot and its connection to the historic city and its heritage. A main goal for İzmir is to support its vision of Mediterranean cities of culture, art, and design through democratic and participation practices involving co-creation with citizens. The city will further develop its blue-green infrastructure to regenerate the waterfront, improve connections to the city centre, and improve urban flood risk mitigation, while supporting citizens' interaction with the sea.

İzmir is currently collecting data on the indicators presented in Appendix 2, Table 9. More details on the specific measures will be discussed in the following stages of the project. Besides identifying the indicators currently reported, it is important to indicate which legal bodies and instruments are linked to specific areas of the impact model. Particularly important to highlight at this stage are the Public Spaces Atlas and the co-creation of Public Green Zones throughout İzmir, as these will allow for a broader coverage of the Impact Model, including techno-environmental performance aspects and aspects related to cultural sustainability, servicing effectiveness and inclusivity.

Democratic participation and co-creation and cultural sustainability are key priorities in the ambition of İzmir in the Re-Value project, and while they are currently identified as areas being monitored, the indicators are not yet specific enough to be actionable. Several initiatives on co-creation are taking place in İzmir. Indicators to monitor their inclusivity and effectiveness can support İzmir in the next steps of the project, improving on defining measures and methodologies to foster implementation and support decision-making.

3.3.4 Písek (Czech Republic)

Písek has strong ambitions for climate neutrality, climate change adaptation, and urban quality, including sustainable urban mobility, flood control, and cultural heritage. In Re-Value, Písek aims to upgrade its regeneration plans for the waterfront along two rivers (the Otava and Vltava) and explore how a living cultural centre, value systems, ethics and social integrity can be firmly embedded into the cities' climate neutrality ambitions. The city aims to fine-tune regeneration plans for its waterfront area and build a cycling and walking path along the riverbank to connect key cycling routes, improve riverbeds with nature-based solutions to improve resilience and biodiversity, and make the area more attractive and comfortable for an optimal quality of life for citizens and tourists.

To fulfil its objectives to become a smart city, Písek has initiated, in 2015, the SmartPísek initiative[35] using modern technologies to collect data systematically and provide information to its citizens. The online portal includes GIS information on urban mobility, smart buildings and neighbourhoods and integrated energy infrastructures and processes.

Appendix 2, Table 10 presents the indicators currently identified by Písek. Sustainable mobility, cultural heritage, and governance integrity are high in the priorities of Písek in Re-Value, and for which gaps are identified in the current monitoring framework. Recommendations with the potential of being integrated with the platform SmartPísek can be learned from other Re-Value cities.

[35] Home | Smart Písek (n.d.). Retrieved 8 June 2023, from https://smart.pisek.eu/index.html

3.3.5 Rijeka (Croatia)

Rijeka has the ambition of connecting climate neutrality with models for urban regeneration, circular nature-based solutions, sustainable mobility, and health corridors. In Re-Value, Rijeka will identify how its existing infrastructures, prepared for its role as European Capital of Culture in 2020, can be used to boost the implementation of its climate neutrality ambitions, establishing the waterfront as a catalyst for climate neutrality. Rijeka will focus on applying circularity principles to cultural assets and vacant spaces in the city and identifying the co-benefits of nature-based solutions, circular economy, and heritage with climate neutrality and urban quality. Rijeka will also integrate urban innovative and inclusive nature in its urban planning and design, aligning these practices with climate neutrality.

Appendix 2, Table 11 presents the indicators currently monitored by Rijeka. Most of the indicators target technical-environmental performance, and specifically sustainable mobility and climate neutrality. Aligned with the ambition towards heritage, Rijeka has the goal to keep mapping its heritage values, an aspect that can be further developed and shared with the community of practice. Gaps are identified on circular economy aspects and nature-based solutions, currently absent from the city's monitoring framework.

3.4 Analysis of gaps and opportunities

Several hundred indicators were identified by the Re-Value cities in their current states of practice. Technical-environmental performance is by far the dimension most monitored, with about 40% of the collected indicators. The Leading Cities have substantial ongoing monitoring processes; Bruges presented a list of 120 indicators, and Rimini one of 158, for instance.

Together, this has resulted in a comprehensive pool of indicators. In a next step, the amount of relevant indicators will be substantially reduced, as several of the listed indicators are each other's proxies. However, removing indicators from the list will require negotiations with the cities, to understand the underlying reason for the differences between indicators and the potential consequences of removing them.

The overall aim is to generate a balanced, select set of indicators among which we can prioritise those that are the best fit for Re-Value and other cities, duly covering the 17 impact categories while, for example, not overly focusing on environmental or economic indicators, or losing out on socio-cultural indicators. Furthermore, we will help the cities select indicators by creating a hierarchy of indicators and their sub-indicators, making the comprehensive pool of indicators more insightful and workable.

The main indicators collected by most of the cities are CO_2-emissions, energy efficiency, share of renewables, drinking water quality, use of shared bicycles, air quality measures (namely $PM_{2.5}$ and NO_2 concentration levels), noise levels, safety, urban heat island, cultural events, and local employment. Governance, cultural sustainability, and inclusivity are general areas of attention in future steps, since most of the indicators are highly abstract and will require further concretisation in order to be actionable in practice (for instance: "ethics", or "sociability"). Also, circularity, despite being a high ambition for several cities, is a topic not yet sufficiently explored and often covered only by indicators related to waste management.

The analysis of the data collected showed several structural differences across the cities. Often indicators refer to registered statistics at municipal, county, or regional level, not directly applicable to the pilot areas.

This is the case with CO_2-emissions, employment, municipal and county accounts, or waste management. There are also differences in methodology or definition of scope: for instance, cities often present indicators on “clean energies” that are not necessarily “renewable” as categorised by the impact model; or CO_2 can be accounted for by indicators on GHG emissions or total carbon emissions in CO_2-equivalents.

Common issues identified by the cities regarding their indicator systems and monitoring processes include time-consuming procedures, challenges in coordinating different departments, and differences in monitoring timelines. These issues can arise due to bureaucratic cultures and siloed organisational structures. In many cases, the process of collecting and analysing data can be time-consuming, requiring significant resources and expertise. Often cities have monitoring processes and digital data platforms in place that are not necessarily used to facilitate decision-making in the scope of climate action plans. The involvement of multiple departments within a city can lead to challenges in coordinating efforts and ensuring that everyone is working towards a common goal. This can be exacerbated by siloed organisational structures, where different departments may have their own priorities and objectives, making it difficult to align efforts and share information. Overall, addressing these issues requires a commitment to collaboration, transparency, and accountability, highlighting the importance of governance, and in particular, integrity assessments.

Despite these challenges, it is important to note that the goal of the Impact Model is not to ensure standardisation but rather to support cities to define their own integrated monitoring frameworks that accurately represent their local realities. Therefore, the Impact Model needs to be designed with flexibility in mind, taking into account the unique characteristics of each city and the differences in data collection and interpretation. By doing so, we hope that the Impact Model will be able to provide valuable insights into the effectiveness of interventions and the progress towards achieving the desired outcomes.

3.5 Supporting indicator models and monitoring frameworks

3.5.1 Scope

Besides the indicators identified in the current state of practice, Re-Value cities are involved in other European and global initiatives towards achieving climate-neutrality and sustainable development goals that include indicator models and monitoring frameworks, as presented in Table 1. All cities are signatories of the European Covenant of Mayors and, thus, also part of the Global Covenant of Mayors. Additionally, İzmir is part of EU Mission for 100 Climate-Neutral and Smart Cities by 2030[36], managed by the NetZeroCities Mission Platform; Ålesund participates in the UN global initiative U4SCC; Burgas, Cascais, and Rijeka are signatory cities of the European Green City Accord; Burgas and Bruges are signatory cities of the Circular Cities Declaration.

Therefore, Re-Value cities are already monitoring and reporting progress in their sustainability ambitions in a diversity of formats that can be linked to the Re-Value Impact Model, to verify progress and inform integrated decision-making. The following section briefly describes the scope of these initiatives and analyses the proposed indicators and their coverage of the Re-Value Impact Model ambitions. In parallel

[36] EC Research and Innovation: EU Mission - Climate-neutral and Smart Cities: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/climate-neutral-and-smart-cities_en

with the international initiatives identified in Table 1, this section will also consider the 10 Core Qualities[37], the Healthy Street Indicators[38], the Sustainable Urban Mobility Indicators[39], and the Framesport[40] reference indicators.

Table 1: Engagement of Re-Value cities in other European and global initiatives with indicator models and monitoring frameworks

	Ålesund	Bruges	Burgas	Rimini	Cascais	Constanța	İzmir	Písek	Rijeka
EU Covenant of Mayors (SECAP)	X	X	X	X	X	X	X	X	X
EU Mission for Adaptation to Climate Change			X		X				
United for Smart Sustainable Cities	X								
Green City Accord			X		X				X
Circular Cities Declaration		X	X						
EU Mission Cities							X		

3.5.2 EU Covenant of Mayors (SECAP)

In the scope of the European Covenant of Mayors[41], signatories develop their Sustainable Energy and Climate Action Plans (SECAP), which includes applying the Covenant's monitoring and reporting framework. Since 2019, the EU Covenant of Mayors is aligned with the Common Reporting Framework from the Global Covenant of Mayors. The SECAP includes three major parts: the Strategy definition, the Baseline Emission Inventory (BEI) and a Risk & Vulnerability Assessment (RVA). In the Strategy, mitigation and adaptation goals are defined; this section also includes administrative aspects (such as staff capacity, stakeholders' engagement, and budget). The Emission Inventory considers final energy consumption, energy supply, and CO_2-emissions. The Risk & Vulnerability Assessment considers climate hazards, vulnerable sectors, adaptive capacity, and vulnerable population groups. Further, the SECAP includes detailed actions on monitoring to

[37] Environment Department - Flemish government. (n.d.). Get started with the 10 core qualities of the environment. Retrieved 15 March 2023, from https://omgeving.vlaanderen.be/nl/aan-de-slag-met-de-10-kernkwaliteiten-van-de-omgeving
[38] Healthy Streets. (n.d.). Healthy Streets Indicators. Healthy Streets. Retrieved 21 June 2023, from https://www.healthystreets.com/what-is-healthy-streets
[39] Ruprecht Consult. (2020). Technical support related to sustainable urban mobility indicators (SUMI). https://transport.ec.europa.eu/system/files/2020-09/sumi_wp1_harmonisation_guidelines.pdf
[40] FRAMESPORT. (2022). New opportunities for the Small Ports of the Adriatic Sea. Framesport. https://framesport.eu/
[41] Covenant of Mayors for Climate & Energy Europe, https://eu-mayors.ec.europa.eu/en/home

achieve the implementation of the defined strategy. Appendix 3, Table 12 presents the main data recommendations for a SECAP organised according to the Re-Value Impact Model categories.

3.5.3 United for Smart Sustainable Cities (U4SCC)

United for Smart Sustainable Cities[42] is a global initiative that aims to support and encourage cities to use digital technologies to facilitate and achieve the UN Sustainable Development Goals. The initiative is coordinated by the International Telecommunication Union (ITU), United Nations Economic Commission for Europe (UNECE), and UN-Habitat. Reporting is not mandatory: the KPIs can be used for self-assessment and monitoring. However, cities can voluntarily request a verified assessment.

The reporting framework is organised in three dimensions: environment, society, and economy. KPIs in this methodology are divided into Core KPIs and Advanced KPIs. KPIs are organised according to 22 categories; some categories such as water and sanitation and waste are reported both in the economy and environmental dimensions, while they might consider different indicators.

The analysis shows that despite the structure differences and the stronger focus on digitalisation and ICT, the U4SSC framework includes good coverage of the Re-Value impact model categories, with indicators that can be implemented by other cities. As U4SCC also proposes a scoring methodology to benchmark and evaluate cities' performance in relation to target values, these can be replicated to ease the process and provide a standardised and consistent approach to data collection. Appendix 3, Table 13 presents the U4SSC KPIs organised according to the Re-Value impact model categories. It illustrates the diverse impacts of multiple indicators and their interconnected contributions to various categories of impact. For example, the travel time index is associated with mobility as well as service effectiveness and social performance. The convenience of the public transport network is linked not only to inclusivity and accessibility but also to service effectiveness. Access to electricity, although primarily reflecting affordability and inclusivity, also affects environmental performance. Furthermore, the indicators related to digitalisation contribute to both technical-environmental performance and service effectiveness.

3.5.4 Green City Accord (GCA)

The Green City Accord[43] is a European Commission initiative aiming to make cities greener, cleaner, and healthier. Cities joining this initiative commit to address five environmental focus areas: air, water, nature & biodiversity, waste & circular economy, and noise. The requirements for monitoring and reporting of this initiative partially cover the categories of healthy physical environment and technical-environmental performance of the Re-Value Impact Model, as identified in Appendix 3, Table 14. Cities in the GCA report their baseline situation two years after signing the accord and report their progress every three years after that.

3.5.5 10 Kernkwaliteiten

At a local level, the Flemish Department of Policy Development and Legal Support proposes, in the scope of the Flanders Spatial Policy Plan, established a framework for optimal environmental management

[42] U4SSC. (2017). Collection Methodology for Key Performance Indicators for Smart Sustainable Cities
[43] European Commission. (2022b). Green City Accord Indicators Guidebook

considering 10 categories of environmental qualities[44]. While this framework is only locally applied by Bruges, valuable insights can be obtained to support the development of the Re-Value impact model. The ten core qualities (10 Kernkwaliteiten) define ten environmental categories, to facilitate dialogue and decision-making regarding spatial developments and quality of living. The categories are: shared and multiple space usage; robustness and adaptability; recognizability, readability, and attractiveness; heritage and landscapes; biodiversity, ecological coherence, and soil quality; energy aspects; climate resilience; health; coexistence and inclusion; and economic vitality. These categories are related to the impact model categories climate neutrality, outdoor environmental performance, circularity, land use, cultural sustainability, servicing effectiveness, and affordability. The 10 core-qualities indicators are presented in Appendix 3, Table 15.

Similar to the Re-Value impact model, the ten core qualities framework offers a comprehensive approach to effectively map current situations and foster inclusive engagement among diverse stakeholders through participatory processes and consultations. Unlike traditional monitoring approaches, this framework presents indicators as recommendations and guidelines to support design strategies, allowing stakeholders to apply them according to their specific contexts and needs. This can be an important strategy for the Re-Value impact model, as it can empower stakeholders to engage actively in the model's implementation, resulting in more effective strategies and ultimately maximising its positive impact.

3.5.6 Framesport (FRAMEwork Initiative Fostering the Sustainable Development of Adriatic Small PORTs)

The FRAMESPORT project[45], developed in the scope of the EU Interreg Italy-Croatia Cooperation Programme, is an initiative aimed at supporting the overall and sustainable growth of small ports in the Adriatic Sea through a long-term strategy, enhancing their socio-economic role in coastal area development. Overall, the FRAMESPORT project's objective is to promote sustainable growth in small ports in the Adriatic Sea by minimising ecological impacts, promoting soft mobility, and enhancing their socio-economic role in coastal area development. The method includes a set of indicators and SWOT and ANP analyses, with a custom matrix based on significant indicators. This was applied to the city of Rimini and then generalised to other ports.

To identify priority actions for redevelopment, indicators were selected based on their detectability and availability of information, reliability and accuracy of data and sources, comprehensibility and ease of reading and interpretation, validity and completeness of output information, and relevance in relation to the established objectives. The custom matrix created using the identified indicators includes environmental, economic, infrastructural, urban and social aspects, providing an overview of the current situation and highlighting its strengths and weaknesses. The indicators from the Framesport project are presented in Appendix 3, Table 16.

[44] Environment Department - Flemish government. (n.d.). Get started with the 10 core qualities of the environment. Retrieved 15 March 2023, from https://omgeving.vlaanderen.be/nl/aan-de-slag-met-de-10-kernkwaliteiten-van-de-omgeving

[45] FRAMESPORT. (2022). New opportunities for the Small Ports of the Adriatic Sea. Framesport. https://framesport.eu/

3.5.7 Healthy Streets

The Healthy Streets Indicators[46] serve as the fundamental framework for the Healthy Streets Approach, encompassing vital elements that shape the human experience while navigating urban streets. These indicators play a significant role in both the design and evaluation of projects, emphasising the need for a comprehensive approach to street improvement. The Healthy Streets framework was developed to ensure a holistic perspective in enhancing street environments for the benefit of individuals, regardless of their motivation. It has been widely adopted by Greater London and various other towns and cities, all striving to achieve similar outcomes. Its goal is to create streets that are healthy, safe, and inclusive, welcoming to all individuals. The Approach is anchored in ten Indicators of a Healthy Street, with a primary focus on two main indicators: "Pedestrians from all walks of life" and "People that choose to walk, cycle, and use public transport". Eight additional indicators complement these main indicators, representing essential elements necessary to support the overarching goals. As the experience of being on a street encompasses multiple human senses, all the indicators (Appendix 3, Table 17) are interconnected.

3.5.8 SUMI (Sustainable Urban Mobility Indicators)

A consortium led by Rupprecht Consult – Forschung & Beratung GmbH (Germany) and composed of TRT Trasporti e Territorio (Italy), Transport & Mobility Leuven (Belgium), Polis (Belgium), Eurocities (Belgium) and UITP, Union Internationale des Transports Publics (Belgium), has been selected by the European Commission – DG MOVE to support the testing of Sustainable Urban Mobility Indicators (SUMI) within the "Service Contract: Technical support related to sustainable urban mobility indicators" (MOVE/B4/2017-358). The starting point for the SUMI[47] project was the "SMP2.0 Sustainable Mobility Indicators" developed by WBCSD, the World Business Council for Sustainable Development. These have subsequently been revised by the SUMI consortium for use by European cities. The common development and use of a methodologically sound, practically feasible and harmonised indicator set on sustainable urban mobility is fundamental for European urban areas in order to analyse progress towards their goals and policy objectives as well as to identify deficiency areas where additional action may be required. Appendix 3, Table 17 provides an overview of the SUMI indicators, indicating whether they are a core indicator (in bold) or not. Within the SUMI project, the cooperating urban areas were requested to gather all necessary data to calculate at least the core indicators. The calculation of the non-core indicators was voluntary.

3.5.9 Circular Cities Declaration (CCD)

The Circular Cities Declaration[48] is a project funded by the European Union's Horizon 2020 research and innovation programme, designed to accelerate the transition from a linear to a circular economy in Europe. The signatory cities of the declaration commit to align their efforts to decouple economic growth from resource use, and achieve a climate neutral, fair, and prosperous society.

The CCD 2022 report collected data from signatory cities on projects and activities related to the circular economy. The first annual report relied primarily on qualitative data, with a focus on identifying strategies,

[46] Healthy Streets Indicators. Healthy Streets. Retrieved 21 June 2023, from https://www.healthystreets.com/what-is-healthy-streets
[47] Ruprecht Consult. (2020). Technical support related to sustainable urban mobility indicators (SUMI)
[48] ICLEI & Ellen MacArthur Foundation. (2022). Circular Cities Declaration Report 2022. Circular Cities Declaration

targets, and governance structures. Signatories were asked to report on whether they had a strategy in place, what their targets were, and what ongoing projects they were undertaking.

While the CCD does not currently propose a standardised monitoring framework, more indicators will be included in the next yearly report. In future iterations of the Re-Value Monitoring & Evaluation framework, the development of the CCD reporting framework will be taken into account, as circularity is a key challenge for Re-Value cities. By incorporating the CCD reporting framework into the Re-Value Monitoring & Evaluation framework, namely for the participant cities – Bruges and Burgas, they can better track their progress towards achieving their circular economy goals. This can help ensure that resources are being used effectively and efficiently, while also promoting knowledge-sharing and collaboration among signatory cities.

3.5.10 NetZeroCities

NetZeroCities is a Horizon 2020 Research and Innovation Programme project that supports European cities engaged in the EU Mission on Climate-Neutral and Smart Cities. Hereby cities commit to achieve climate neutrality by 2030, by significantly cutting down greenhouse gas emissions, in line with the objectives laid down on the European Green Deal. A key aspect of the NZC project is to achieve climate goals in a socially inclusive way. The project involves the collaboration of various stakeholders, including governments, organisations, researchers, and local communities, to develop strategies, policies, and actions that support the goal of reaching net-zero emissions. The project involves assessing current emissions, identifying areas for improvement, implementing sustainable practices, and tracking progress over time to support cities in the transition. While several of the Re-Value cities sent an Expression of Interest to join the Mission, currently İzmir is the only city from the Re-Value project that is also part of the NZC platform. The continuous connection between Re-Value and NetZeroCities is taken into account through Re-Value Work Package 6: Community of Practice for the cities, led by ICLEI, and strategic alignment between the Re-Value project and the Cities Mission, the NetZeroCities Mission Platform, the New European Bauhaus initiative and other NEB / Mission communities in Work Package 9, led by NTNU.

Considering the shared objectives, close communication, and alignment of outcomes, NZC is a key adjacent project for Re-Value, and this will be reported on in the forthcoming reports on Re-Value Impact dialogues with NetZeroCities (D7.4, D7.7, and D7.11). As the NZC indicators are currently undergoing revision, they have not been included in this report. We have opted to await the final version of these indicators before incorporating them into the following iterations of this Impact Model report. This decision ensures that our reporting remains objective and reflects the most accurate and up-to-date information regarding the progress towards achieving climate-neutral cities (as defined in the Cities Mission).

3.6 Implications for the Re-Value Impact Model

An initial, comprehensive mapping of potential indicators for each category of the Impact Model, considering the theoretical framework, the state of practice in the Re-Value cities, and other relevant indicator models and monitoring frameworks, is presented in Appendix 3. The purpose of this mapping is to serve as a valuable resource for the subsequent stages of the Re-Value project, empowering the cities to identify the most fitting set of indicators aligned with and complementary to their local ambitions and frameworks.

As stated higher, the comprehensive pool of indicators under development is intended to:

- present an inspirational set of indicators that duly covers all impact categories, addressing the many identifiable sub-aspects that matter (**completeness**)
- while clustering indicators that are each other's proxy into a single relevant indicator. This may imply having several possible system boundaries or measurement techniques for one indicator (**slenderness**)
- assuring that all 17 impact categories are covered in balanced a way, in order to not overly focus on certain categories while neglecting other ones (**balance**)
- organising the indicators into a structure and hierarchy that facilitates their structured and insightful use (**comprehensibility**)

In addition to the indicators used locally by the cities, all Re-Value cities also report to the Covenant of Mayors framework, while three cities report to the Green City Accord. This has made these frameworks particularly useful in identifying common reporting opportunities among the cities. By aligning their reporting efforts with these frameworks, the Re-Value cities can ensure greater consistency and comparability in their monitoring and evaluation processes. This can facilitate knowledge-sharing and collaboration among the participating cities, while also promoting a more comprehensive and effective approach to sustainability.

Healthy outdoor environment is the dimension most often monitored by the cities, with all the cities having some sort of monitoring processes in place regarding urban heat island, noise levels, air pollution and safety. Regarding climate neutrality all the cities report through their SECAPs on city-wide CO2-emissions, however these are hard to quantify and accurately correlate to the localised pilot project areas. To monitor the effectiveness of the cities' strategies beyond the scope of the Re-Value project, this indicator can be optionally included, to be reported in the same timeframe as the biennial updates on the SECAP. Regarding the technical-environmental performance, most cities collect data on energy efficiency of the built environment (either referring to public buildings or the overall energy certification rates) and quantify the share of renewables; active and public transport and modal split are also often considered, specifically in relation to the use of rent-a-bike systems and public transport. Regarding social performance the indicators more commonly included are the counting of cultural events and mixed living environments (15-minute city).

This initial version needs further refinement and still evidences gaps on key topics of the Re-Value strategy regarding circularity, cultural sustainability, inclusivity, and economic performance. Future iterations of the Impact Model will further assess the possibilities of its implementation in the cities and the alignment with their specific strategies to bridge the identified gaps.

The indicator set of Appendix 3 will moreover be refined according to the following basic principles:

- Avoiding as much as possible double or very similar indicators ('cleaning up the set') - grouping similar indicators in one 'mother' indicator;
- While at the same time making sure that indicator (systems) in use in the cities remain present as such.

4 Co-Benefits

4.1 Milestones & Targets

The aim of this Chapter is to identify, classify and if possible, quantify and monetize co-benefits and negative externalities of urban planning and design interventions towards climate neutrality.

Through a comprehensive literature study, the co-benefits and negative externalities have been analysed, classified in relation to the main pillars of the Impact Model, and the methods and tools available for quantification and monetisation will be identified. A first assessment being done, an initiative to collect more evidence on socio-cultural co-benefits is in progress.

To operationalise the results of the literature study and analysis, the findings are intended to form an online tool that can help cities in decision making towards creating more beautiful and sustainable cities in line with the New European Bauhaus initiative. The tool will allow decision makers to visualise the potential co-benefits of various interventions and draw inspiration from best practices as well as linked resources and tools.

The targets of this work are to:

- Map state-of-the-art of co-benefits
- Create a simple online tool for co-benefits or incorporate into the existing Impact model

4.2 Mapping the State of the Art

Co-benefits are an important part of the Impact Model, as they can help to exploit new value chains and business opportunities. However, co-benefits are often overlooked and hence not included in policy making where they could contribute to increase in climate mitigation action strategies[49].

In literature, several terms are used, often interchangeably, to denote the outcomes of an action, other than the main intended result. For example, the terms ‘multiple impacts’, ‘co-benefits’, ‘multiple benefits’, ‘non-energy benefits’, ‘ancillary benefits’, ‘wider benefits’, ‘hidden benefits’, ‘indirect costs’ and ‘adverse side-effects’ are reported by a review in the context of energy efficiency.

The outcomes of interest are mostly positive in these studies, as denoted by the word ‘benefit’, but they can also be negative unintended outcomes. The term ‘multiple impacts’ is in that sense more neutral, as it may also include negative impacts or costs. The analysed literature, however, overwhelmingly mentioned benefits, with only few references to potentially negative impacts—see for instance Urge on negative effects of rapid renewable deployment[50]. Without neglecting the existence of potentially negative unintended impacts, we maintain here the term ‘co-benefit’, as it serves better the purpose of motivating cities and investors to take a holistic approach in the impact assessment of urban development projects.

[49] Finn and Brockway, 2023. Much broader than health: Surveying the diverse co-benefits of energy demand reduction in Europe, Energy Research and Social Science https://doi.org/10.1016/j.erss.2022.102890
[50] Ürge-Vorsatz et al. (2014). Measuring the Co-Benefits of Climate Change Mitigation https://doi.org/10.1146/annurev-environ-031312-125456

The preliminary findings of this literature study already reveal that co-benefits constitute a growing topic of interest in climate and energy efficiency related literature, albeit with a lot of gaps when it comes to quantification and monetization of the benefits. The majority of studies investigate co-benefits at the national or even supra-national level (e.g. for the European Union), focusing on climate policies or energy efficiency policies more specifically, with the building sector having a prominent place. Some studies also investigate policies for the transport sector in particular. At the (supra-)national level there is some available material to help quantify co-benefits.

However, urban development interventions can produce co-benefits for the local environment, society and stakeholders that can greatly depend on the local context. These impacts at the city scale are often harder to address because they necessitate the collection and analysis of appropriate data, which requires resources that are generally unavailable. A few studies have focused on this level, such as the one by Becchio et al.[51] and by Material Economics[52], who have built a tool to help cities understand the socioeconomic implications of different climate actions. Ongoing research in the EU-funded project syn.ikia further focuses on the development of a tool that quantifies and monetises multiple benefits for Sustainable Plus Energy Neighbourhoods. The tool is set to be launched in 2024, when also more details about the included benefits and methods will become available.

Classification of co-benefits in literature depends to some extent on the level of intervention and the evaluation perspective, but they cover in general environmental, social and economic impacts.[53,54] Other studies further use the following categories: macroeconomy, employment, air pollution, social welfare, health and wellbeing, poverty alleviation, resources, energy system/energy delivery, industrial productivity, public budgets.[55,56] Co-benefits may be also classified based on the recipient, such as for instance in the case of building renovations the building owner, building user, technology providers, the local community or the society as a whole.

Including impacts on the climate, even though these are often considered as the main intended impacts and not a co-benefit, this literature analysis has identified the following classes of impacts, which try to encompass all different beneficiaries:

- Climate change impacts
- Ecosystem impacts
- Impacts on material resources and water
- Air pollution (links to health and environmental impacts)
- Impact on health (including from air pollution, thermal comfort and noise)

[51] Becchio et al. (2018). Decision making for sustainable urban energy planning: an integrated evaluation framework of alternative solutions for a NZED (Net Zero-Energy District) in Turin https://doi.org/10.1016/j.landusepol.2018.06.048
[52] Material Economics (2020). Understanding the Economic Case for Decarbonising Cities - Why Economic Case Analysis for City Decarbonisation is Crucial.
https://materialeconomics.com/latest-updates/understanding-the-economic-case-for-decarbonizing-cities
[53] European Commission (2016). The Macroeconomic and Other Benefits of Energy Efficiency.
https://energy.ec.europa.eu/publications/macroeconomic-and-other-benefits-energy-efficiency_en
[54] Reuter et al. (2020). A comprehensive indicator set for measuring multiple benefits of energy efficiency.
https://doi.org/10.1016/j.enpol.2020.111284
[55] COMBI (2018) D8.2 Policy report on COMBI results
https://combi-project.eu/wp-content/uploads/D8.2_COMBI_policy_report.pdf
[56] IEA (2015) Capturing the Multiple Benefits of Energy Efficiency
https://www.iea.org/reports/capturing-the-multiple-benefits-of-energy-efficiency

- Impact on other occupant comfort (e.g. ease of use, reduced outages)
- Social and cultural impacts
- Employment impacts
- Impact on asset value
- Energy poverty impacts (links to health and social impacts)
- Productivity impacts (human, agricultural, industrial)
- Macro-economic impacts (on economic growth, trade effects,…)
- Energy system impacts (including energy security, energy infrastructure costs)
- Impacts on public budgets (tax revenues, healthcare costs)
- Innovation and competitiveness impacts

The different impacts may further be linked to each other, as indicated in the description above. The conceptual framework developed by Ürge-Vorsatz et al. clearly highlighted this interdependence of co-impacts. For example, a certain policy or project may reduce air pollution. In turn, this change can make a difference in human health, in crop yields but also in the ecosystem functioning, with consequences on biodiversity as well as the services these ecosystems offer society.

It may be noted that the impact classes (to be distinguished from the Impact Model impact categories) commonly used in literature overlap with the main pillars of the Impact Model, but do not correspond entirely. The following figure shows the correspondence of these above impact classes with the Impact Model pillars. Some classes may relate to more than one pillar, for instance both related to economic performance and social-cultural performance. Such are for example impacts related to energy poverty or employment. Additionally, it becomes clear that when it comes to social and cultural aspects, the literature where co-benefits are addressed in general terms provides little further distinction. Finally, governance aspects are rarely addressed, especially because of the different scales on which the literature focuses and this is a particular aspect of urban scale interventions. Subsequent research will seek to better align the findings from the literature on co-benefits and the structure of the Impact Model, while also focusing on gathering more information on the less represented domains of governance and social-cultural performance.

Figure 2: Graphical representation of the correspondence between the Impact Model pillars (upper layer) and the impact classes for co-benefits addressed in the literature (lower layer)

In order to take co-benefits into account in decision making, several methods can be used. The most common include:

- Cost-benefit analysis (CBA): Monetary valuation of all impacts
- Multi-criteria analysis (MCA): Weighing all impacts expressed in physical units
- Life-Cycle Assessment (LCA): Environmental impact of product, service or policy
- Other frameworks reviewed by the COMBI project[57].

CBA requires that all impacts are expressed in monetary values, while MCA can work with quantitative as well as qualitative criteria. The latter, however, is heavily based on stakeholder involvement, which requires significant time and resources, while it also leads to a significant degree of subjectivity. CBA, on the other hand, often also demands a lot of effort to obtain monetised values of sufficient accuracy, and it also entails ethical concerns due to the monetisation of human life, among others[58].

For all methods, specific indicators need to be used for the assessment of co-benefits. In the literature, some of the co-benefits are merely mentioned in general terms, in particular when discussing cultural effects or governance issues. Others are represented by physical indicators, such as energy savings, emissions of specific particles avoided, avoided diseases, number of households in energy poverty, etc. Some of them are further monetised, in order to be used in decision making. Monetisation of co-benefits can be done with different valuation techniques, such as with hedonic pricing and contingency valuation using a willingness-to-pay approach, among others (see the COMBI project review[59] for details)

Among all classes of co-benefits, those related to air-pollution and the resulting health impacts are the most researched, especially in terms of quantification and monetisation. For the impact of indoor and outdoor air quality on human mortality and morbidity, several indicators and monetisation approaches as well as data are available. Other monetised co-benefits, aside from energy savings and emission reduction, include workforce productivity, employment creation, impact on asset value, savings on material resources, impact on GDP, and impact on public budget. However, they are often only assessed at a country level, wherever relevant data are available. Such an example is the COMBI tool[60].

4.3 Anchoring with partners and stakeholders

Since the beginning of the project, Key Performance Indicators and co-benefits have been discussed with the Re-Value Cities within the frame of the City Dialogues. In Spring 2023, mapping the Key Performance Indicators formed the main emphasis of these discussions (see Chapter 4). In the next phase, in Winter 2023, we will start to map the co-benefits of the demonstration projects in each of the Re-Value cities. To this purpose, we will organise workshops with the municipality and local partners and stakeholders, to map the co-benefits that have already been taken into account in the demonstrator, and to perform ideation exercises to explore additional co-benefits that might not yet have been taken into account.

[57] COMBI (2015) D2.1 Literature review on Multiple Impact quantification methodologies https://combi-project.eu/wp-content/uploads/2015/09/D2.1_LR-methodologies.pdf
[58] Enefirst (2022) D3.4: Energy Efficiency First and Multiple Impacts: integrating two concepts for decision-making in the EU energy system, https://enefirst.eu/wp-content/uploads/D3.4_MultipleImpactAssessment.pdf
[59] COMBI (2015) D2.1 Literature review on Multiple Impact quantification methodologies https://combi-project.eu/wp-content/uploads/2015/09/D2.1_LR-methodologies.pdf
[60] COMBI tool https://combi-project.eu/tool/

Within the cross-project Impact Model Task Force that was created, one group was tasked to specifically look into co-benefits. Within this Task Force, meetings were held to align work on co-benefits and to investigate how to integrate them into the Impact Model and subsequently presented in an online tool.

Outside of the project, other relevant EU initiatives that work on co-benefits were identified, in order to draw inspiration and align. These include the projects COMBI, MICAT, syn.ikia, and Cultural E. Specifically links were established with the syn.ikia project, which develops a tool that quantifies and monetises multiple benefits for Sustainable Plus Energy Neighbourhoods.

4.4 Summary of results for this report

The results of the literature study are summarised in a spreadsheet, where all identified co-benefits and negative externalities are sorted based on the sector of intervention and the impact category, as defined in the previous section. Figure 3 gives an overview of the coverage of these sectors and impact classes in the examined literature. Grey cells represent combinations where some co-benefits are identified, with the darker grey highlighting the combinations where at least one co-benefit is monetised. This overview makes evident the fact that literature on co-benefits has mostly focused on interventions and policies related to energy efficiency and transport, and that most monetised co-benefits cover impacts in the domains of climate and environmental performance, health, and macro-economic benefits.

Figure 3: Overview of the resulting table of co-benefits (or negative externalities), depicted as a cross-section of impact classes identified in literature (columns) and intervention sectors (rows). Dark grey indicates that some co-benefits in this cell are monetised in the examined literature, while light grey means they are simply mentioned but no quantification or monetisation approach was provided. White means that no mention was found.

It should be noted that the literature study so far has focused on papers, reports and tools that aim to summarise and cover co-benefits in general. Studies that only focus on one specific co-benefit, or did not mention any of the related terminology for co-benefits were not included thus far. It is expected that co-benefits especially in the social and cultural domain may be studied independently and not necessarily referred to as co-benefits (or related terms) in the literature. Additional effort will be thus put into investigating those in the coming months. Furthermore, the intervention sectors in italic font are also believed to be underrepresented in the studied literature and will be further researched.

In the next table (Table 2) we further present the specific co-benefits identified for the most represented sector of energy efficiency in buildings, split based on the level of quantification in the studied literature. While some literature clearly mentions specific changes as either benefits or negative impacts, others maintain a more neutral approach referring to impact indicators. The latter approach is mostly taken in quantification / monetisation tools and methods, which calculate the impact, be it positive or negative.

For the monetized and quantified co-benefits, specific indicators are also identified in the respective literature that mentions them. In some of the cases also a methodology is described to quantify those indicators. However, some methods work based on available assumptions that are specific to certain contexts, such as a specific country, meaning that they are not universally applicable. These findings will be further elaborated in subsequent updates of this deliverable.

Table 2: List of co-benefits or negative externalities for interventions or policies related to energy efficiency in the building sector, split per impact class(bottom layer in Figure 2) and classified based on the level of quantification in the studied literature

Impact class	Monetisation method or indicator expressed in monetary units	Quantification method or quantitative indicator	Only qualitative mention of benefit/impact
Climate change	Energy savings Reduced CO_2/GHG emissions (CO_2, CH_4, N_2O)		Data
Ecosystem	Biodiversity loss Crop damage	Acidification of water bodies Eutrophication of ecosystems	Reduction of waste and pollution
Materials & water	Material Footprint (sum fossil fuels, minerals, biotic, unused) Life-Cycle wide fossil fuel consumption Metal ores	Minerals Biotic raw materials Unused extraction	Water savings
Air pollution	Material damage on buildings	Pollutants reduction (PM_{10}, SO_2, NOx, CO, and non-methane hydrocarbons (NMHCs))	
Health	Reduced or avoided excess cold weather mortality Reduced or avoided excess cold weather morbidity Air pollution-related mortality Air pollution-related morbidity Avoided asthma cases due to the reduced exposure to indoor dampness Reduced healthcare costs, doctors, pharmaceuticals Reduced noise Reduced heat island effect	Pollutants reduction (PM_{10}, SO_2, NOx, CO, and non-methane hydrocarbons (NMHCs))	Reduce allergies from outdoor pollutants Reduced indoor air quality from improved airtightness without ventilation
Comfort		Thermal comfort gains	Ease of use and control by user Aesthetics and architectural integration

Impact class	Monetisation method or indicator expressed in monetary units	Quantification method or quantitative indicator	Only qualitative mention of benefit/impact
			Useful building areas Safety (intrusion and accidents) Reduced exposure to energy price fluctuations Natural lighting and contact with the outside Ease of installation and reduced annoyance Pride, prestige, reputation Reduced outages events (momentary, sustained) Reducing replacement hassles Reduce dust cleaning needs
Social & cultural	Increase user awareness on energy-related issues Enhancement of neighbourhood identity Alleviation of inequality (monetised as income loss/gain)		Community pride and social cohesion
Asset value	Increased property value		
Energy poverty	Buildings life-cycle costs reduction Energy prices decrease (for households in poverty) Improved living conditions (security, comfort, productivity, income-earning opportunities) for people lacking modern energy services Reduced number of households in energy		

Impact class	Monetisation method or indicator expressed in monetary units	Quantification method or quantitative indicator	Only qualitative mention of benefit/impact
	poverty Easier loan conditions Reduced prices in wholesale market Reduced maintenance costs Saving of other fuels consumption		
Employment	Increased employment in energy efficiency jobs Decreased employment in other energy sectors Increased alcoholism, spousal abuse, and increased mental health problems among laid-off employees		
Productivity	Active days (impact through health, asthma, allergy, cardiovascular disease, cold and flu and traffic time saved) Workforce performance	Reduce absenteeism from school/work	Improved learning and earning capability Improved education outcomes
Macro-economy	Impact on GDP, and other macroeconomic indicators (investment, consumption) Fossil fuel price effects ETS price effect	Terms of Trade effect by sector Energy intensity Sectoral shifts	
Energy system	Avoided investment in grid and capacity expansion due to lower energy demand Reduced generation costs Reduced ancillary service cost Reduced congestion cost Fewer reconnection fees	Import dependency Aggregated energy security (supplier diversity) Impact on integration of renewables Energy intensity Derated reserve capacity rate	Avoided other environmental regulations costs Reduced financial risk

Impact class	Monetisation method or indicator expressed in monetary units	Quantification method or quantitative indicator	Only qualitative mention of benefit/impact
	Reduced credit and collection costs Avoided cost of blackout interruption	Avoided line losses Minimising reserve requirements Fewer power shut-off	
Public finance	Increase sales tax revenue of energy efficiency products and services Decrease sales tax revenue from other goods when crowded out by energy efficiency Increase of initial costs of public investment in energy efficiency products and services		Fewer energy subsidies Reduced unemployment subsidy Reduced hospitalisation cost Decrease of public expenditure on public sector energy Decrease of energy excise duty, emission trading and carbon tax revenues Decrease in public investment in energy supply infrastructure (in case of lower demand)
Governance		Innovation in processes and decision making	Institutional relationship and networks created

4.5 Next steps

In the next steps of the project the findings from the literature on co-benefits will be further processed to better align with the structure of the Impact Model. Furthermore, additional research will focus on gathering more information on the less represented domains of governance and social-cultural performance.

Further, the Task Force will work towards developing a graphical user interface to present co-benefits in an interactive way and allow cities to access relevant resources and understand the impacts of different interventions. Figure 5 displays an example of how such a tool could look like. Except for references to related literature and calculation tools, case studies with examples of other cities will be linked.

Figure 4: Example of how the interactive tool for co-benefits could look like. Each cell of the matrix provides a more detailed description of co-benefits as well as links to related literature, case studies and potential calculation tools

5 Conclusions and next steps

This report contains the initial version of Re-Value's NEB Impact Model for value-based urban planning and design, as of November 2023 (M11). After having tested the Impact Model in their demonstration areas and long-term Territorial Transformation Plans, the ultimate aim is for the Re-Value cities eventually to integrate the Impact Model rationale, Key Performance Indicators and co-benefits into their standard day-to-day procedures, adapt them to local context, and regard it as their own.

In this first stage, we organised ideation workshops and city dialogues with the Re-Value cities and their local partners, to extract their ambitions, identify relevant indicators, and map potential co-benefits that can support their implementation.

In the next stage, we will work with the cities, local and cross-cutting partners to identify common and core co-benefits for their demonstration activities in Re-Value, within each city and across the cities in the Community of Practice, and explore how to handle the practical integration of the Impact Model into the cities' demonstrators, long-term Territorial Transformation Plans, and eventually, into their daily procedures across the municipality. This will be achieved through supporting Re-Value cities to develop and implement balanced integrated urban planning and design approaches for urban transformation areas that value quality, inclusion, and other non-monetary benefits, in addition to financial and greenhouse gas emission impacts. In this manner, the Impact Model will become an instrument to support integrated sustainable urban development by providing a whole systems understanding.

Together with the Innovation Cycles on Story-building, Data-driven co-creation and Financial and partnership models (WP1), we will start to map the different methods that can be used to gather data on the indicators and co-benefits - in particular for those impact categories that are difficult to measure - and to identify ways of gathering new types of data where none exist.

Furthermore, we will create concrete guidelines and support tools for municipalities or other urban decision makers to translate the Impact Model into their local context, to facilitate scaling and replication of the Impact Model beyond the Re-Value project.

From 2024 onwards, CrAFt Cities[61], as well as NEB Alliance[62] projects and networks, will be invited to test and update the NEB Impact Model.

[61] The CrAFt CSA project started on 1 May 2022 and it responds to the HEU call on "Collaborative local governance models to accelerate the emblematic transformation of urban environment and contribute to the New European Bauhaus initiative and the objectives of the European Green Deal", https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-miss-2021-cit-01-02

[62] NEB Alliance: https://craft-cities.eu/first-meeting-of-the-new-european-bauhaus-policy-alliance/

Appendices

Appendix 1. Abbreviations and acronyms used in the report

Abbreviation	Terms
BEI	Baseline Emission Inventory
CBA	Cost-benefit analysis
CCD	Circular Cities Declaration
CN	Climate Neutrality
CoP	Community of Practice
CP	Climate Positive
CrAFt	Creating actionable future (project)
EC	European Commission
DDCC	Data-Driven Co-Creation
IC	Innovation Cycle
ICLEI	Local Governments for Sustainability
IM	Impact Model
ITU	International Telecommunication Union
LCA	Life-Cycle Assessment
Framesport	FRAMEwork Initiative Fostering the Sustainable Development of Adriatic Small PORTs
GCA	Green City Accord
GD	Green Deal
KPIs	Key Performance Indicators
LCs	Leading Cities

Abbreviation	Terms
MCA	Multi-criteria analysis
M&E	Monitoring and Evaluation
NEB	New European Bauhaus
NEB-IM	NEB Impact Model
NEB-STAR	New European Bauhaus-Stavanger (project)
NTNU	Norwegian University of Science and Technology
NZC	NetZeroCities
RCs	Replication Cities
RVA	Risk & Vulnerability Assessment
SECAP	Sustainable Energy and Climate Action Plan
SB	Story building
SUMI	Sustainable Urban Mobility Indicators
SPEN	Sustainable Plus Energy Neighbourhoods
TTPs	Territorial Transformation Plans
U4SCC	United for Smart Sustainable Cities
UNECE	United Nations Economic Commission for Europe
UNIBO	University of Bologna
VITO	Vlaamse Instelling voor Technologisch Onderzoek
WBCSD	World Business Council for Sustainable Development
WP	Work package

Appendix 2. Indicators currently reported by Re-Value cities

Table 3: Indicators currently reported by Ålesund

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Circularity (materials)		Household waste and reuse
	Climate neutrality (energy)	Energy efficiency	Energy expenses in municipal property management
			Energy use in municipal property by function and energy type
	Healthy secured water cycles	Drinking water	Drinking water quality
			Percentage of inhabitants served by water supply network
		Wastewater	Percentage of citizens served by sewerage network
			Sewage sludge
			Wastewater treatment
	Sustainable land use	Biodiversity and ecosystem value	Nature management and the outdoors
		Location and space use	Land use and regional planning
			Local administration of agricultural areas
	Sustainable mobility	Active & public transport	Capacity, availability, and travel length (public transport)
			Public charging points
		Modal split	Municipal zero-emission vehicles
			Passengers, route-kms, and passenger-kms by transport mode
			Roads, parking spaces, and road lights
Healthy environment	Outdoor environmental quality	Safety	Fire and accident protection
Social performance	Affordability and inclusivity	Affordability and inclusivity	Accessible areas for recreation and outdoors activities
			Introduction programme to immigrants
			Municipal housing
			Municipal housing charges
			Social assistance and housing benefits
			Temporary residents and night homes
	Cultural sustainability	Arts mobilisation	Cultural and entertainment events
			Cultural expenditure
			Cultural facilities and institutions
		History & heritage	Automatic protection of cultural heritage
			Police reports based on cultural heritage act
			Protected heritage
			Statements on construction and demolition affecting cultural monuments
	Servicing effectiveness	Diversity & accessibility of services	Transport performance
	Sociability	social networks	Church of Norway services and users
			Voluntary clubs and associations

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Economic performance	Legal certainty and future economic value	Future proofness & adaptability	Property management
	Sustainable local embeddedness	Local employment	Local temporary and permanent employment
	Total societal cost of ownership	Total societal cost of ownership	Property tax
Governance	Participation and co-creation	Participation and co-creation	Local referendums
			Persons entitled to vote and voter turnout
	Process quality	Governance setup	County authority accounts
			Management of planning
			Municipal accounts

Table 4: Indicators currently reported by Bruges

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Circularity (materials)	Circularity	Adaptability
			Durability
			Residual waste quantity (kg/inhabitant year)
	Climate neutrality (energy)	CO_2-emissions	CO_2 emissions
		CO_2-emissions	CO_2 emissions for transport
		Energy efficiency	% of Bruges homes with an EPC A or better
			1 cooperative/participatory renewable energy project per 500 inhabitants by 2030 that together provide a total installed capacity of 216 MW from 2021 to 2030 (Bruges: 236 cooperative projects) - or 18kW per 500 inhabitants? = 4.25 MW for Bruges?
			100,000 m2 extra heated via heat pumps in tertiary sector in 2030 (55 GWh)
			15,000 additional heat pumps in residential sector in 2030 (112.5 GWh)
			150,000 m2 extra heat network in tertiary sector (= 15Gwh extra purchase) in 2030
			25 fossil-free renovations within the 50 collectively organised energy-saving renovations per 1000 housing units
			5,000 extra connections for the residential sector heat network (= 50Gwh extra) in 2030
			50 collectively organised energy-saving renovations (at least 10 homes) per 1,000 housing units from 2021 to 2030 (65x50 = 3,250 renovations (of at least 10 homes = 32,500?) (LEKP 1.0)
			50 per 1,000 housing units (Bruges: 65x50=3,250) will be invited to a climate table to discuss a neighbourhood-oriented approach (with a focus on making heat demand more sustainable and the synergy between the four sites) before the end of 2024
			Accelerate the reduction of energy demand by increasing the renovation rate
			achieve an average annual primary energy saving of at least 3% in their own buildings (including technical infrastructure, excluding immovable heritage)
			All public lighting to switch to LED
			Decrease in heat demand for own city buildings by 3.4 GWH in 2030
			Decrease in household heat demand (by 78 Gwh by 2030)
			Draw up local heat and demolition policy plans
			Electricity demand falling among households (not for heating)
			Energy efficiency
			Household natural gas consumption will fall to 0% in 2050 compared to 100% in 2011
			More solar water heaters in tertiary sector (150,000 m2 extra in 2030; 2 GWh)

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
			Natural gas consumption in the tertiary sector will fall to 0% in 2050 compared to 100% in 2011
			Number of building applications for 'thorough energy renovation'
			Number of Fluvius premiums
			Number of heat pumps can also be estimated on the basis of city monitor (survey: triennial, first time surveyed in 2020
			Reduction of tertiary sector heat demand by 48 Gwh by 2030
			Switching to fossil-free heating systems in buildings
			The number of solar water heaters can also be estimated on the basis of the city monitor (survey: triennial, first time surveyed in 2011
		Energy flexibility	Energy flexibility
		Share of renewables	#MWh production of own urban installations (including Pathoekeweg excluding BMCC)
			289 Gwh/y additional wind energy by 2030 (= 430 Gwh)
			Amount of green electricity produced on city property will increase annually to 2,000MWh per year in 2030
			Cooperative wind projects (# windmills)
			Further roll-out of wind energy production capacity
			GW capacity at wind turbine active in Bruges
			GW of solar energy capacity in Bruges
			GWh production from onshore wind turbines
			Increase support for renewable energy in order not to introduce a further levy on renewable energy installations and to phase out existing taxes by 2025 at the latest.
			Increasing the production capacity of photovoltaic solar panels
			Local green electricity production in GWh per year
			More solar water heaters in households (9000 extra by 2030; 14.4 GWh)
			MWh of electricity from local co-op origin for urban consumption (PV installations of Coopstroom and Beauvent)
			Production via PV panels < 10 kWp peak increases by 166 Gwh/y in 2030 (185 Gwh/y)
			Production via PV panels > 10 kWp peak increases by 107 Gwh/y in 2030 (128 Gwh/y)
			Share of renewables
			The ratio of green electricity produced to electricity consumption will be 100% in 2030
	Healthy secured water cycles	Drinking water	Potable water supply
		Rain, surface, groundwater	20 largest paved plots per borough must be completely disconnected from the sewerage system by 2050
			Rainwater well and infiltration
			Road drainage

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
			Surface softening
		Wastewater	Wastewater
	Sustainable land use	Biodiversity and ecosystem value	Ecosystem value including biodiversity
			ha of wet nature restoration by 2027
			Planting of additional trees
		Green-Blue network	Construction of additional green areas
			Green-blue networks including water absorption
			One extra tree per inhabitant by 2030
			Ratio of green area per inhabitant
	Sustainable mobility	Active & public transport	Active and public transportation service levels
			Clean energy buses
			Increase of public transport modal share
			Increasing the share of bicycles, steps and public transport in the mobility mix
			Shared bicycles
			Upgraded cycle path per inhabitant
		Modal split	Access point for a (carbon-free) sharing system
			Balance evolution of passenger transport demand and light freight
			Balance of transport demand for heavy transport
			Charging points
			Freight transport: 4% electrification, 2% hydrogen and addition of 13.8% biofuel in cars with an internal combustion engine
			Low-carbon emission passenger vehicles
			Modal split
			Number of electric shared cars
			Number of premiums for returning licence plates? (own data)
			Number of public charging equivalents
			Number of shared cars
			Parking pressure above ground city monitor
			Reducing private car use
			Use public charging stations kWh
Healthy environment	Indoor environmental quality	Humidity	Humidity
		Temperature	Temperature
	Outdoor environmental quality	Air pollution	NO_2 concentration levels
		CO_2-levels	CO_2 levels
		Noise levels	Noise levels
		Safety	Safety
		Urban heat island	Urban heat island
Social performance	Affordability and inclusivity	Affordability and inclusivity	Diversity of housing offer
			Social impact assessment

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
	Cultural sustainability	History & heritage	Preserving visual landmarks
			Specific heritage regulations
		Spatial, architectural, & artistic quality	Good spatial planning
	Servicing effectiveness	Digitalization	Smart handling of mobility demand
		Diversity & accessibility of services	Mixed living environments (15-min city)
	Sociability	Social innovation	Social innovation
Economic performance	Legal certainty and future economic value	Innovation support	Number of start-ups in Circular Kick Start
	Sustainable local embeddedness	Community business models	Circular HUB established (YES/NO)
			Community supportive business models
			Stimulating, making local food production more sustainable and connecting it
		Local employment	Local temporary and permanent employment
		Local green economy	% of residents buying local products at least weekly
			Local green economy
Governance	Integrity	Reflexive governance	Effective implementation of action plan
			Grade board is available, will be updated and consulted
			Long-term strategy
	Participation and co-creation	Participation and co-creation	Design co-creation actions and projects
			Participation and co-creation processes
	Process quality	Governance setup	Cbs briefing
			Cluster consultation
			Implementation of the Stadsatelier
			Informal network
			Regular communication about climate objectives and achievements via website, social media, print media
		Institutional capital	Connection with external partners for the realisation of the climate plan/goals
			Internal climate team
		Reflexive governance	Monitoring processes in place

Table 5: Indicators currently reported by Burgas, with proposed indicators in italic

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Circularity (materials)	Circularity	Level of recycling per type of waste
			Solid waste treatment
			Use of recycled materials in the pilot zone
			Use of recycled pavement
	Climate neutrality (energy)	CO_2-emissions	GHG emissions CO_2 emissions for transport
		Energy efficiency	Energy demand and consumption
		Energy efficiency	
		Energy efficiency	Energy efficient street lighting
		Energy efficiency	Rate of retrofit of administrative and residential buildings and generated primary energy savings
		Share of renewables	Introduction and use of RES
		Share of renewables	Solar potential of the city and opportunities for photovoltaic installations on the roofs of administrative and residential buildings
	Healthy secured water cycles	Drinking water	Biological qualities/characterization
		Rain, surface, groundwater	Flood risk management monitoring system
		Rain, surface, groundwater	Precipitation rate
		Rain, surface, groundwater	Water levels of rivers, sea, reservoirs
		Rain, surface, groundwater	Water temperature
	Sustainable land use	Biodiversity and ecosystem value	Implemented nature-based solutions
			Sites of the Natura 2000 network
		Green-Blue network	Urban forestry, blue & green corridor and infrastructure connectivity
		Location and space use	Landslide management
	Sustainable mobility	Active & public transport	Extension of sustainable mobility walking infrastructure accessibility and pedestrian tracks

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
			Shared bicycles and ecomobility options
		Modal split	Modal share of private vehicles
			Modal split
			Uptake of low-carbon vehicles for private, freight, and public transport
			Use of parking spaces
Healthy environment	Outdoor environmental quality	Air pollution	Air quality
		noise levels	Noise levels
		Safety	Risk of natural and climate disaster or hazards
			Road safety
		Urban heat island	Urban heat island
Social performance	Affordability and inclusivity	Affordability and inclusivity	Access to skill development opportunities
			Affordable space for recreation
			Equal access to employment
			Equal access to improved services for all inhabitants and tourists
	Cultural sustainability	Cultural value & diversity	Cultural value and diversity, cultural events
		History & heritage	History and heritage
			Intangible heritage
			Preserving visual landmarks
		Identity & belonging	Identity and belonging
		Spatial, architectural, & artistic quality	Aesthetic
			Livability and attractiveness
	Servicing effectiveness	Digitalization	Use of digital twin
		Diversity & accessibility of services	Recreation and sport conditions
			Mixed living environments (15-min city)
	Sociability	*Social capital*	Enhanced physical and mental wellbeing
Economic performance	Legal certainty and future economic value	*Futureproofedness & adaptability*	attractiveness and future economic value

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
	Sustainable local embeddedness	*Human capital*	Behavioural change related to climate adaptation and mitigation
			Innovation capacity building
		Local employment	Local temporary and permanent employment
		Local green economy	Local economic activity
			Local entrepreneurship and local businesses/ventures
			Local traditional economic activities (salt, mud, cosmetics)
	Total societal cost of ownership	Total societal cost of ownership	Economic returns of natural capital
Governance	Integrity	Reflexive governance	Effective implementation of action plan
			Ethics
	Participation and co-creation	Participation and co-creation	Citizens' participation in public consultation
			Design co-creation actions, workshops and public events
	Process quality	Institutional capital	Local administration capacity allocated

Table 6: Indicators currently monitored by Rimini

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Circularity (materials)		% of waste collected separately and actually sent for recycling
			Municipal waste generated per capita (tons)
			Municipal waste landfilled (%)
			Recycling rate of municipal waste (%)
			Solid waste treatment
	Climate neutrality (energy)	CO_2-emissions	Emission standard of motorcycles
			Emissions of pollutants by Local Public Transport
			Energy efficiency of Local Public Transport
			Greenhouse gas emissions indicator
			Total carbon emissions (tCO_2eq)
			Total carbon emissions (tCO_2eq) per inhabitant
			Total of absolut C02eq in tons emissions (2019)
			Total of absolut C02eq in tons emissions for inhabitants Anno 2019
			Total yearly energy consumption per inhabitant
		Energy efficiency	Classification of emissivity
			Energy building classification
		Share of renewables	% establishments and public establishments (waterfront and beach) served by renewable energy sources
			Annual energy consumption in the municipality per inhabitant, expressed as final energy (kwh/inhabitant)
	Healthy secured water cycles	Drinking water	Consumption of water for civil use (domestic and non-domestic)
			Consumption of water for other use
			Consumption of water for productive use
			Household water consumption (litres/capita/day)
			Length of water supply network
			Percentage of citizens served by water supply network
			Seasonal consumption of bathing establishments (mc water fountains and showers)
			Water supply network losses / ILI
		Rain, surface, groundwater	Reduction of the waterproof surface compared to the current (%)
			sqm of areas for sustainable urban drainage
			Total waterproof area (sqm)
		Wastewater	Percentage of citizens served by sewerage network
			Percentage of urban wastewater meeting the requirements of the UWWTD (regarding collection and secondary treatment)
	Sustainable land use	Biodiversity and ecosystem value	Change in number of species of birds in urban area/built-up areas in the city
			Sites of the Natura 2000 network
		Green-Blue network	Areas of historical greenery and of villas, gardens and parks that have artistic, historical, landscape interest and/or that stand out for their uncommon beauty

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
			Classification based on "type" vegetation
			Green recreational areas
			Municipal school gardens
			Nr. of plants currently present on the action area
			Nr. of plants present after the implementation of the sea park (LI)
			N. of privately planted trees and shrubs
			Nr. of plants on the beach and seaside
			Percentage of protected natural areas, restored and naturalised areas on public land in municipality
			Percentage of tree canopy cover within the city
			Planting additional trees
			Trend of vegetation cover in urban green infrastructure
			Urban forest
			Urban forestry, plantation & green corridor connectivity
			Urban gardens
			Urban parks
		Location and space use	Land use for transport and parkings
			Potentially transformable areas according to urban planning tools
			Urban Sprawl
	Sustainable mobility	Active & public transport	Actual/new Cycle path in metres
			Bus lane operation
			Bus stop connectivity with other public transport services
			Bus stop coverage
			Continuity of the cycle-pedestrian network
			Crossings to meet pedestrian desire lines
			Ease of crossing side roads for people walking
			Effective width for cycling
			Factors influencing bus passenger journey time
			Impact of kerbside activity on bus operations
			Impact of kerbside activity on cycling
			Cycle-pedestrianism index
			Pedestrianism index
			Nr. of electric bikes charging points
			N. of existing bike stands
			Nr. of users which arrive at the seaside by walking or cycling
			Nr. of walking people/cyclist that transit
			Increase in existing bicycle stalls(LI)
			Population served by public transport
			Presence of zones reserved to pedestrians
			Presence of Limited Traffic Zones
			Provision of cycle parking

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
			Quality of footway surface
			Shared bicycles
			Support for interchange between cycling and underground/rail
			Trips with scooters / e-bikes
			Type and suitability of pedestrian crossings away from junctions
			Width of clear, continuous walking space
		Modal split	Additional features to support people using controlled crossings
			Car sharing
			Congestion and delays of Local Public Transport
			Electric charging points
			Intermodality of transports
			Mobility space usage indicator
			Sharing of scooters
			Multimodal integration indicator
			Opportunity for active mobility indicator
			Presence of private parking spaces
			Presence of public areas for meeting places, events, etc
			Presence of public car parking
			Reducing private car use
			Sharing of footway with people cycling
			Sharing parking slots coverage
Healthy environment	Outdoor environmental quality	Air pollution	Air pollutant emissions indicator
			Air quality
			NO_2 concentration levels
			O_3 concentration levels
			PM_{10} daily concentration levels
			$PM_{2.5}$ concentration levels
		Noise levels	2022 Noise Map, five-year update
			Noise hindrance indicator
			Noise indicator of the Local Public Transport
			Noise surveys in the pre and post-work action area using dedicated sensors
			Percentage of (adult) population with High Sleep Disturbance
			Percentage of population (adult) highly annoyed
			Percentage of the population exposed to average day-evening-night noise levels (Lden) ≥ 55 dB
			Percentage of the population exposed to night-time noise (Lnight) ≥ 50 dB
			Protection from noise
		Safety	Accident Index for Local Public Transport
			Index to evaluate road safety based on the number of accidents occurred in the last 10 years.
			Interaction between large vehicles and people cycling

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
			Qualitative index obtained through a questionnaire on the safety perceived by users of infrastructure.
			Step-free access from the street to the station entrance
			Security indicator
			Traffic fatalities
			Traffic safety active mode index
		Urban heat island	Study of the local microclimate after the work
			Study of the local microclimate before the works
Social performance	Affordability and inclusivity	Affordability and inclusivity	Accessibility for mobility impaired groups
	Cultural sustainability	Arts mobilisation	Cultural and entertainment events
			Cultural facilities and institutions
		Cultural value & diversity	Nr. sporting/recreational events involving sea park and beach months November/March
			Nr. of participants in cultural and awareness raising events
		History & heritage	Key historical and landscape elements
		Spatial, architectural, & artistic quality	Incidence of public outdoor spaces used as squares or places of aggregation
		Sustainable tourism	Hotel and extra-hotel capacity
			Nr. fruit-producing trees at the Parco del Mare in months November/February
			Nr. out of season hotels
			Nr. public establishments open in November/February
	Servicing effectiveness	Diversity & accessibility of services	% of accessible beaches
			% of new accessible beaches
			Access to mobility services indicator
			Accessibility educational services
			Coverage of sharing point service
			Degree of discontinuity of infrastructure
			Identification of the green and sports areas present per inhabitant
			Incidence of the covered area and its arrangement with respect to the total area.
			Mixed living environments (15-min city)
			Satisfaction with public transport indicator
			Urban functional diversity indicator
	Sociability	Social networks	Places of cult/religion
Economic performance	Legal certainty and future economic value	Futureproofedness & adaptability	State of preservation built
			Type of building
			Year of construction built
	Sustainable local embeddedness	Human capital	Nr. of educational and training institutions, universities, research organisations involved

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
			Nr. of educational projects and awareness raising workshops organised
			Nr. of students involved in educational projects
		Local green economy	Business activities
			Productive activities connected to the port channel
Governance	Participation and co-creation	Participation and co-creation	Design co-creation actions and projects
			Nr. of awareness raising events organised
	Process quality	Institutional capital	Nr. of meetings of the multidisciplinary team within the city administration
			Nr. of municipality's departments involved
			Nr. of stakeholders involved

Table 7: Indicators currently monitored by Cascais

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Climate neutrality (energy)	Energy efficiency	Energy efficiency
			Energy expenses in municipal property management
	Sustainable mobility	Active & public transport	Shared bicycles
	Sustainable mobility		Use of public bus
Healthy environment	Indoor environmental quality	Temperature	Temperature
	Outdoor environmental quality	CO_2-levels	CO_2 levels
	Outdoor environmental quality	Noise levels	Noise levels
	Outdoor environmental quality	Temperature	Meteorological data
	Outdoor environmental quality	Urban heat island	Urban heat island
Social performance	Servicing effectiveness	Digitalization	*FixCascais*
	Sociability	Social networks	*Number of residents' associations*
		Social networks	*Number of youth associations*
Economic performance	Sustainable local embeddedness	Local employment	Local temporary and permanent employment
Governance	Integrity	Reflexive governance	Resilience: - % of adaptation actions implemented regarding our action plan
	Participation and co-creation	Participation and co-creation	*Neighbourhood tutors program*
			Number of participants on townhall actions
			Number of projects on participatory budgeting

Table 8: Indicators currently collected by Constanța

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Climate neutrality (energy)	CO_2-emissions	Total energy produced with clean sources
		Energy efficiency	Housing buildings with increased energy performance
			Public buildings with increased energy performance
		Energy flexibility	Yearly primary energy consumption
	Healthy secured water cycles	Drinking water	Drinking water quality
	Sustainable land use	Green-Blue network	Built/optimised green infrastructure for adapting to climate change
	Sustainable mobility	Active & public transport	Clean energy buses
			Cycle facilities
			Extension of bicycle network
			Increase of public transport modal share
			Infrastructure for prioritising clean public transport
			Length of dedicated bus lanes
			No of PT stations
			No. of tickets sold
			Public charging points
			Use of public bus
		Modal split	Calls of sea-going vessels by type of ship
			Cargo types
			Traffic figures / type of ship
Healthy environment	Outdoor environmental quality	Air pollution	Air quality
			NO_2 concentration levels
			O_3 concentration levels
			PM_{10} daily concentration levels
			$PM_{2.5}$ concentration levels
		Noise levels	Noise levels
		Safety	Black spots in traffic
			Car accidents
			Damaged cars from car accidents
			People injured from car accidents
			Public safety
			Rehabilitated pedestrian areas to improve accessibility and safety
			Traffic fatalities
Social performance	Affordability and inclusivity	Affordability and inclusivity	People benefiting from the public buildings benefiting from consolidation works
			People living in poverty
			People that have access to new/rehabilitated/modernised public spaces in urban areas
			Users benefiting from the Built/optimised green infrastructure for adapting to climate change

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
	Cultural sustainability	Arts mobilisation	People participating in public events
		Sustainable tourism	Hotel and extra-hotel capacity
			Number of nights spent in the tourism unit
			Public events for tourists
			Tourism attraction facilities
			Tourist arrivals
Economic performance	Sustainable local embeddedness	Community business models	Number of new start-ups established
		Local employment	Local temporary and permanent employment
			Unemployment rate
	Total societal cost of ownership	Total societal cost of ownership	Public buildings benefiting from consolidation works

Table 9: Indicators currently monitored by İzmir

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Climate neutrality (energy)	CO_2-emissions	CO_2 emissions
		Energy efficiency	Energy efficiency
	Healthy secured water cycles		Healthy and secured water cycles
Healthy environment	Indoor environmental quality	Humidity	Humidity
		Temperature	Temperature
	Outdoor environmental quality	CO_2-levels	CO_2 levels
		Noise levels	Noise levels
		Safety	Safety
		Urban heat island	Urban heat island
Social performance	Cultural sustainability	Cultural value & diversity	Cultural value and diversity
		History & heritage	History and heritage
	Sociability	Resilience	Resilience
			Sociability
Economic performance	Sustainable local embeddedness	Community business models	Community supportive business models
		Local employment	Local temporary and permanent employment
Governance	Participation and co-creation	Participation and co-creation	Participation and co-creation processes
	Process quality	Governance setup	Process quality

Table 10: Indicators currently monitored by Písek

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Climate neutrality (energy)	CO_2-emissions	CO_2 emissions
		Energy flexibility	Biogas cogeneration unit
			Hydroelectric power plants
		Share of renewables	Photovoltaic development
			Share of renewables
	Healthy secured water cycles	Rain, surface, groundwater	Flood risk management
			Rainwater management
			Water reservoirs, pipelines, and local sources
			Water retention in the landscape
		Wastewater	Sludge disposal and incineration plant
			Wastewater
			Wastewater treatment plant
			Water treatment
	Sustainable land use	Biodiversity and ecosystem value	Amphibian protection measures
			Passport for mowing frequency
		Green-Blue network	Green-blue networks including water absorption
Healthy environment	Indoor environmental quality	Humidity	Humidity
		Temperature	Temperature
	Outdoor environmental quality	Air pollution	NO_2 concentration levels
		CO_2-levels	CO_2 levels
		Noise levels	Noise levels
		Safety	Safety
		Urban heat island	Urban heat island
Social performance	Cultural sustainability	Arts mobilisation	Cultural and entertainment events
	Servicing effectiveness	Digitalization	E-services
	Sociability	Social networks	Community events
Economic performance	Sustainable local embeddedness	Community business models	Entrepreneurship support (Podnikni to!)
		Human capital	Job fair and events by the chamber of commerce
Governance	Participation and co-creation	Participation and co-creation	Citizens' participation in public consultation
		Participation and co-creation	Number of projects on participatory budgeting
		Participation and co-creation	Public hearings

Table 11: Indicators currently monitored by Rijeka

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Climate neutrality (energy)	CO_2-emissions	CO_2 emissions
		Energy efficiency	Public building energy consumption
		Share of renewables	Share of renewables
	Healthy secured water cycles	Drinking water	Drinking water quality
	Sustainable land use	Location and space use	Spatial plans
	Sustainable mobility	Active & public transport	Pedestrian infrastructure
		Active & public transport	Public transport network
		Active & public transport	Shared bicycles
Healthy environment	Outdoor environmental quality	CO_2-levels	CO_2 levels
		Temperature	Meteorological data
Social performance	Cultural sustainability	Arts mobilisation	Cultural and entertainment events
			Performance of cultural industry
		History & heritage	Mapping heritage values
Economic performance	Sustainable local embeddedness	Human capital	Human capital
		Local employment	Local temporary and permanent employment
	Total societal cost of ownership	Total societal cost of ownership	Municipal taxes and fees
Governance	Participation and co-creation	Participation and co-creation	Number of projects on participatory budgeting
			Public hearings
	Process quality	Institutional capital	Number of employees

Appendix 3. Underlying indicator models

Table 12: Indicators recommended in Sustainable Energy and Climate Action Plans[63]

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Circularity (materials)		Biological treatment of solid waste
			Incineration and open burning of waste
			solid waste disposal
	Climate neutrality (energy)	CO_2-emissions	Energy consumption by municipal fleet
			Energy consumption by private and commercial transport
			Energy consumption by public transport
			GHG reduction targets
		Energy efficiency	Average energy demand of social housing buildings / sq.m.
			Energy consumption (electricity + heating) per capita / national energy consumption (electricity + heating) per capita
			EPC bands of dwelling higher than B
			F+G+H band (EPC) dwelling/total number of dwelling
			Final energy consumption by sector and type
			Households or persons connected to the electricity grid / total households or persons
			Households or persons connected to the gas grid / total households or persons
			Low absolute energy expenditure (M/2)
			Number of households with only oil boilers, wood calefactions, conventional gas boilers
			Ownership of heating and cooling systems
			Share of buildings renovated per year
		Energy flexibility	Certified green electricity supply
			Local heat/cold production plants
			Local/distributed electricity production
		Share of renewables	Local/distributed renewable energy production
	Healthy secured water cycles	Drinking water	Number of water quality warnings issued
		Rain, surface, groundwater	% change in water absorption
	Sustainable land use	Biodiversity and ecosystem value	% change in crop yield / evolution of the annual grassland productivity
			% change in Forest composition
			% change in number of native species
			% of agriculture losses from extreme weather conditions/events (e.g. drought/water scarcity, soil erosion)
			% of areas affected by soil erosion / soil quality degradation

[63] Covenant of Mayors for Climate & Energy Europe. (2020). Covenant of Mayors EU: Reporting Guidelines

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
			% of grey/blue/green areas affected by extreme weather conditions/events (e.g. Heat Island Effect, Flood, Rockfalls and/or Landslides, Forest/Land Fire)
			% of habitat losses from extreme weather event(s)
			% of livestock losses from extreme weather conditions
			% of livestock losses from pests/pathogens
			% of native (animal/plant) species affected by diseases related to extreme weather conditions/events
			% of timber losses from pests/pathogens
		Green-Blue network	% change in green & blue infrastructure/areas (e.g. through new urban planning regulation/policy)
		Location and space use	Population density (compared to national/regional average in year X in country/region X)
	Sustainable mobility	Active & public transport	Length of transport network (e.g. road/rail) located in areas at risk (e.g. flood/drought/heat wave/ forest or land fire)
Healthy environment	Indoor environmental quality	Temperature	Households with centralised cooling system / total households
			Households with centralised cooling system older than 10 y / total households with cooling system
			Households with centralised heating system / total households
			Number of cooling degree days per year
			Number of heating degree days per year
	Outdoor environmental quality	Air pollution	Number of air quality warnings issued
		Safety	Average response time (in min.) for police/fire-fighters/emergency services in case of extreme weather events
			Hours needed to inform population of a risk via an early warning system
			Number of people injured/evacuated/relocated due to extreme weather event(s) (e.g. heat or cold waves)
		Temperature	Frequency of cold waves
			Frequency of heat waves
Social Performance	Affordability and inclusivity	Affordability and inclusivity	% share of vulnerable population groups (e.g. elderly (65+)/young (25-) people, lonely pensioner households, low-income/unemployed households, migrants and displaced people) - compared to national average in year X in country X
			Arrears on utility bills / total population or households
			At-risk-of-poverty rate
			Average age of the buildings
			Average price of electricity
			Average price of gas
			Citizens / households under poverty threshold / number of citizens / households

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
			Citizens / households with social support
			Dwelling ownership
			Energy poor households / persons supported / total energy poor households asking for support
			Energy poor households / persons supported / total energy poor households detected
			Existence of energy poverty strategy / specific measures related energy poverty
			Existing rent regulation
			High share of energy expenditure in income (2M)
			Inability to keep home adequately cool
			Inability to keep home adequately warm
			Inhabitants / households receiving support to pay public transport services/public transport users
			Number of social housing apartments/total number of apartments
			Over and under occupation of dwellings
			Percentage of households / persons within the municipality with access to clean cooking fuels and technologies
			Percentage of households or persons within the municipality experiencing heating discomfort / total households or population
			Percentage of population or households spending up to XX % of their income on energy services
			Share of households or persons with presence of leak, damp, rot in their dwelling / total households or persons
			Social housing apartments not having easy access to public transport (*)/ all social housing apartments
			Specific measures related energy poverty
			Vulnerable households or persons / total households or persons
	Cultural sustainability	Sustainable tourism	% change in tourist flows / tourism activities due to climate vulnerability
	Servicing effectiveness	Diversity & accessibility of services	% of areas non-accessible for emergency responses (e.g. firefighting services)
			Average length (in hours) of the public service interruptions (e.g. energy/water supply, public transport traffic, health/civil protection/emergency services)
			Average time needed to reach a health facility
			Number of days with public service interruptions (e.g. energy/water supply, health/civil protection/emergency services, waste)
			Persons or households living more than one km from nearest public transport station / number of persons or households
			Population or households not having access to essential services within 1 hour by walking, cycling or public transport / total population or households

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
			Travel time index
Economic performance	Legal certainty and future economic value	Futureproofedness & adaptability	% of (e.g. residential/commercial/agricultural/industrial/touristic) areas at risk (e.g. flood/drought/heat wave/ forest or land fire)
			% of population living in areas at risk (e.g. flood/drought/heat wave/ forest or land fire)
		Regulatory stability & foreseeability	Existing incentives of landlord's programs
	Sustainable local embeddedness	Human capital	Awareness-raising campaigns targeting vulnerable households
			Number of households educated in house energy/water/waste management
			Percentage of households or persons within the municipality experiencing cooling discomfort / total households or population
		Local employment	Unemployment rate
	Total societal cost of ownership	Total societal cost of ownership	% of public funds available to address a climate hazard and its impacts (e.g. fire, flood, heatwave, etc)
			€ annual amount of compensation received (e.g. insurance)
			€ annual direct economic losses (e.g. in commercial/agricultural/industrial/touristic sectors) due to extreme weather event(s)
			Energy related expenditure / local GDP
			Money spent to support energy poor households or persons / in relation to local GDP
			Number or % of (public/residential/tertiary) buildings damaged by extreme weather conditions/events
			Number or % of transport/energy/water/waste/ICT infrastructure damaged by extreme weather conditions/events
Governance	Integrity	Reflexive governance	Budget foreseen and spent
			Effective implementation of action plan
			Long-term strategy
			Monitoring processes in place
	Process quality	Governance setup	Financing sources
			Type of administrative structure
		Institutional capital	Connection with external partners for the realisation of the climate plan/goals
			Local administration capacity allocated

Table 13: Indicators in the U4SCC framework, with mandatory indicators highlighted in bold[64]

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Circularity (materials)		**Solid waste collection**
			Solid waste treatment
	Climate neutrality (energy)	CO2-emissions	GHG emissions
		Energy efficiency	Clean and efficient energy sources
			Public building energy consumption
			Public building sustainability
			Reduction of demand and energy savings in The building stock
			Residential Thermal Energy consumption
		Energy flexibility	Demand Response Penetration
			Electricity consumption
			Electricity system outage frequency
			Electricity system outage time
		Share of renewables	Maximum use of renewable sources
			Renewable Energy consumption
	Healthy secured water cycles	Drinking water	**Drinking water quality**
			Freshwater consumption
			Household water consumption (litres/capita/day)
			Potable water supply
			Water supply network losses
		Wastewater	**Household sanitation**
			Wastewater collection
			Wastewater treatment
	Sustainable land use	Green-Blue network	**Green areas**
			Protected natural areas
		Location and space use	Urban development and spatial planning
	Sustainable mobility	Active & public transport	**Extension of bicycle network**
			Pedestrian infrastructure
			Public transport network
			Shared bicycles
			Shared vehicles
		Modal split	Low-carbon emission passenger vehicles
			Transportation mode share
Healthy environment Healthy environment	Outdoor environmental quality	Air pollution	**Air quality**
			EMF exposure
		Noise levels	Noise levels
		Safety	Emergency service response time
			Fire and accident protection
			Intersection control
			Natural disaster related deaths

[64] U4SSC. (2017). Collection Methodology for Key Performance Indicators for Smart Sustainable Cities

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
			Police service
			Population living in disaster prone areas
			Traffic fatalities
			Violent crime rate
Social performance	Affordability and inclusivity	Affordability and inclusivity	**Access to electricity**
			Gender income equity
			Gini coefficient
			Green Area Accessibility
			Housing expenditure
			Informal settlements
			People living in poverty
			Childcare availability
	Cultural sustainability	Arts mobilisation	**Cultural expenditure**
			Cultural facilities and institutions
	Servicing effectiveness	Digitalization	Availability of WiFi in public areas
			Drainage/stormwater ICT monitoring
			Dynamic public transport information
			Electricity supply ICT monitoring
			Electronic health records
			Fixed broadband subscriptions
			Household internet access
			Integrated building management systems
			Smart electricity meters
			Smart water meters
			Student ICT access
			Traffic ict monitoring
			Water supply ict monitoring
			Wireless broadband coverage
			Wireless broadband subscriptions
		Diversity & accessibility of services	Public transport network convenience
			Recreation and sport conditions
			Travel time index
Economic performance	Legal certainty and future economic value	Futureproofedness & adaptability	Resilience plans
		Innovation support	**Patents**
			R&D expenditure
	Sustainable local embeddedness	Community business models	Small and medium-size enterprises
	Sustainable local embeddedness	Human capital	Adult literacy
	Sustainable local embeddedness	Local employment	ICT sector employment
	Sustainable local embeddedness		Tourism Sector employment
	Sustainable local embeddedness		**Unemployment rate**

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
	Sustainable local embeddedness		**Youth unemployment rate**
	Sustainable local embeddedness	Local green economy	Local food production
	Total societal cost of ownership	Total societal cost of ownership	**Disaster related economic losses**
	Total societal cost of ownership		Health insurance/public health coverage
Governance	Participation and co-creation	Participation and co-creation	**Persons entitled to vote and voter turnout**
	Process quality	Governance setup	Open data
	Process quality		Public sector e-government and e-procurement

Table 14: Indicators required by the Green City Accord monitoring framework[65]

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Circularity (materials)		Municipal waste generated per capita (tons)
			Municipal waste landfilled (%)
			Recycling rate of municipal waste (%)
	Healthy secured water cycles	Drinking water	Household water consumption (litres/capita/day)
			Water supply network losses / ILI
		Wastewater	Percentage of urban wastewater meeting the requirements of the UWWTD (regarding collection and secondary treatment)
	Sustainable land use	Biodiversity and ecosystem value	Change in number of species of birds in urban area/built-up areas in the city
		Green-Blue network	Percentage of protected natural areas, restored and naturalised areas on public land in municipality
			Percentage of tree canopy cover within the city
Healthy environment	Outdoor environmental quality	Air pollution	NO_2 concentration levels
			PM_{10} daily concentration levels
			$PM_{2.5}$ concentration levels
		Noise levels	Percentage of (adult) population with High Sleep Disturbance
			Percentage of the population exposed to average day-evening-night noise levels (Lden) ≥ 55 dB
			Percentage of the population exposed to night-time noise (Lnight) ≥ 50 dB

[65] European Commission. (2022b). Green City Accord Indicators Guidebook. https://environment.ec.europa.eu/publications/green-city-accord-indicators-guidebook_en

Table 15: Indicators or core qualities identified in the 10 Kernkwaliteiten framework[66]

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Healthy secured water cycles	Rain, surface, groundwater	Climate drought
			Flood risk management
			Precipitation rate
			Retention-storage-delayed discharged
	Sustainable land use	Biodiversity and ecosystem value	Ecosystem services
			Soil quality
		Green-Blue network	Green-blue networks including water absorption
	Sustainable mobility		Sustainable mobility infrastructure
Healthy environment	Indoor environmental quality		Indoor air quality
	Outdoor environmental quality	Air pollution	Air quality
		Noise levels	Noise levels
		Urban heat island	Heat stress
			Urban heat island
			Light nuisance
			Odour nuisance
			Sensory tranquillity
Social performance	Cultural sustainability	History & heritage	Mapping heritage values
			Non-protected heritage
			Preserving visual landmarks
			Protected heritage
		Spatial, architectural, & artistic quality	Architectural cohesion
			Readability and recognizability
			Urban unity
			Visual attractiveness
	Servicing effectiveness	Diversity & accessibility of services	Intensified use of infrastructure
			Mixed living environments (15-min city)
Economic performance	Legal certainty and future economic value	Innovation support	Innovative and resilient economy
	Sustainable local embeddedness	Community business models	Diversity of local activities
Governance	Participation and co-creation	Participation and co-creation	Participation and co-creation processes

[66] Flemish government. (n.d.). Get started with the 10 core qualities of the environment. Retrieved 15 March 2023, from: https://omgeving.vlaanderen.be/nl/aan-de-slag-met-de-10-kernkwaliteiten-van-de-omgeving

Table 16: Framesport indicator set[67]

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Climate neutrality (energy)	CO_2-emissions	Emission standard of motorcycles
			Energy efficiency of the TPL
		Energy efficiency	Classification of emissivity
			Energy building classification
	Healthy secured water cycles	Drinking water	Water quality
		Rain, surface, groundwater	Determination of the soil permeability classes
			Level of exposure to flood risk
	Sustainable land use	Green-Blue network	Classification based on "type" vegetation
		Location and space use	Land use for transport and parkings
			Potentially transformable areas according to urban planning tools
			Urban Sprawl
	Sustainable mobility	Modal split	Presence of private parking spaces
			Presence of public areas for meeting places, events, etc
			Street classification
Healthy Environment	Outdoor environmental quality	Noise levels	Noise indicator of the TPL
			Protection from noise
Social performance	Cultural sustainability	Arts mobilisation	Cultural and entertainment events
		History & heritage	Key historical and landscape elements
		Spatial, architectural, & artistic quality	Incidence of public outdoor spaces used as squares or places of aggregation
		Sustainable tourism	Hotel and extra-hotel capacity
	Servicing effectiveness	Diversity & accessibility of services	% of accessible beaches
			% of new accessible beaches
			Degree of discontinuity of infrastructure
			Identification of the green and sports areas present per inhabitant
			Incidence of the covered area and its arrangement with respect to the total area.
	Sociability	Social networks	Places of cult/religion
Economic performance	Legal certainty and future economic value	Futureproofedness & adaptability	State of preservation built
			Type of building
			Year of construction built
	Sustainable local embeddedness	Local green economy	Business activities
			Productive activities connected to the port channel

[67] FRAMESPORT. (2022). New opportunities for the Small Ports of the Adriatic Sea. Framesport. https://framesport.eu/

Table 17: Healthy Streets indicators[68]

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Sustainable land use	Green-Blue network	Planting at footway level (excluding trees)
			Street trees
			Street trees in area
Healthy Environment	Outdoor environmental quality	Noise levels	Noise from large vehicles
			Traffic noise based on peak hour motorised traffic volumes
		Safety	Collision risk between people cycling and turing motor vehicles
			Surveillance of public spaces
Social performance	Servicing effectiveness	Diversity & accessibility of services	Walking distance between resting points (benches and other informal seating
			Walking distance between resting points (benches and other informal seating)
			Walking distance between sheltered areas protect from the rain including fixed awning or other shelter provided by buildings /infrastructure
			Walking distance between sheltered areas protect from the rain including fixed awning or other shelter provided by buildings /infrastructure

Table 18: Sustainable Urban Mobility Indicators with core indicators highlighted in bold [69]

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
Technical-environmental performance	Climate neutrality (energy)	CO2-emissions	**Greenhouse gas emissions by urban transport**
		Energy efficiency	**Energy efficiency by urban transport**
	Sustainable land use	Location and space use	Mobility space usage
	Sustainable mobility	Active & public transport	**Opportunity for active mobility**
		Modal split	**Modal split**
			Multimodal integration
Healthy environment	Outdoor environmental quality	noise levels	**Noise hindrance**
		Safety	**Road deaths**
			Security in relation to crime
			Traffic safety active modes
Social performance	Affordability and inclusivity	Affordability and inclusivity	**Accessibility of public transport for mobility-impaired groups**
			Affordability of public transport for the poorest group
	Cultural sustainability	spatial, architectural, & artistic quality	Quality of public spaces

[68] Healthy Streets Indicators. Healthy Streets. Retrieved 21 June 2023, from https://www.healthystreets.com/what-is-healthy-streets

[69] Ruprecht Consult. (2020). Technical support related to sustainable urban mobility indicators (SUMI). https://transport.ec.europa.eu/system/files/2020-09/sumi_wp1_harmonisation_guidelines.pdf

Pillar	Impact Category	Indicator	Sub-indicator or units-measurement method
	Servicing effectiveness	Diversity & accessibility of services	**Access to mobility services**
			Commuting travel time
			Urban functional diversity
			Congestions and delays
			Satisfaction with public transport

Appendix 3. List of aggregated indicator frameworks with which one or more Re-Value cities currently work

The list in this Appendix shows all indicators with which one or more Re-Value cities currently work. Items in the list may be target values set by a city. In this case, the corresponding indicator is the unity to be reached according to the target value. This is a working list, showing redundancy. Hereby similar indicators can potentially be merged into one single indicator. There is however a trade-off to be made, because changing the corresponding metrics may burden cities with unnecessary additional workload. One indicator can have different measurement methods in different cities. The intention is to let the cities as much as possible with their current metrics. Next iterations will clarify how these opposing requirements can best be dealt with.

In the next step, we will use the list to identify potential complementary indicators together with each city, and, where possible, identify common indicators for all Re-Value cities to work with, in particular areas such as social and cultural innovation that are currently not frequently used.

- **Environmental performance**
  - **Circularity - materials**
    - Circularity
      - Adaptability
      - Durability
      - Level of recycling per type of waste
      - Material flow analysis
    - Life cycle analysis
      - Life Cycle Assessment
    - (*blank* / waste)
      - % of waste collected separately and actually sent for recycling
      - Biological treatment of solid waste
      - Household waste and reuse
      - Incineration and open burning of waste
      - Municipal waste generated per capita (tons)
      - Municipal waste landfilled (%)
      - Recycling rate of municipal waste (%)
      - Residual waste quantity (kg/inhabitant year)
      - Solid waste collection
      - Solid waste disposal
      - Solid waste treatment
      - Use of recycled materials in the pilot zone
      - Use of recycled pavement
  - **Climate neutrality - energy**
    - CO_2-emissions
      - CO_2-emissions
      - CO_2-emissions for transport
      - Emission standard of motorcycles
      - Pollutant emissions from local public transport (Trasporto Pubblico Locale)
      - Energy consumption by municipal fleet
      - Energy consumption by private and commercial transport
      - Energy consumption by public transport

Energy efficiency of the local public transport (Trasporto Pubblico Locale)
GHG emissions
GHG reduction targets
Greenhouse gas emissions indicator
Total carbon emissions (tCO_2eq)
Total carbon emissions (tCO_2eq) per inhabitant
Total energy produced with clean sources
Total of absolute C02eq in tons emissions (2019)
Total of absolute C02eq in tons emissions per inhabitant (2019)
Total yearly energy consumption per inhabitant

Energy efficiency

% of Bruges homes with an EPC A or better
1 cooperative/participatory renewable energy project per 500 inhabitants by 2030 that together provide a total installed capacity of 216 MW from 2021 to 2030
100,000 m2 extra heated via heat pumps in the tertiary sector in 2030 (55 GWh)
15,000 additional heat pumps in the residential sector in 2030 (112.5 GWh)
150,000 m2 extra heat network in the tertiary sector (15 GWh extra purchase) in 2030
25 fossil-free renovations within the 50 collectively organised energy-saving renovations per 1000 housing units
5,000 extra connections for the residential sector heat network (50 GWh extra) in 2030
50 collectively organised energy-saving renovations (at least 10 homes) per 1,000 housing units from 2021 to 2030
50 per 1,000 housing units will be invited to a climate table to discuss a neighbourhood-oriented approach (with a focus on making heat demand more sustainable and the synergy between the four sites) before the end of 2024
Accelerate the reduction of energy demand by increasing the renovation rate
Achieve an average annual primary energy saving of at least 3% in own buildings (including technical infrastructure, excluding immovable heritage)
All public lighting to switch to LED
Average energy demand of social housing buildings / sq.m.
Classification of emissivity
Clean and efficient energy sources
Decrease in heat demand for own city buildings (3.4 GWh by 2030)
Decrease in household heat demand (78 GWh by 2030)
Draw up local heat and demolition policy plans
Electricity demand falling among households (not for heating)
Energy building classification
Energy consumption (electricity + heating) per capita / national energy consumption (electricity + heating) per capita
Energy demand and consumption
Energy district solutions
Energy efficiency
Energy efficient park lighting
Energy expenses in municipal property management
Energy use in municipal property by function and energy type
EPC bands of dwellings higher than B
F+G+H band (EPC) dwellings/total number of dwellings
Final energy consumption by sector and type
Household natural gas consumption to 0% in 2050 compared to 100% in 2011

- Households or persons connected to the electricity grid / total households or persons
- Households or persons connected to the gas grid / total households or persons
- Housing with increased energy performance
- Low absolute energy expenditure (M/2)
- More solar water heaters in tertiary sector (150,000 m2 extra in 2030; 2 GWh)
- Natural gas consumption in the tertiary sector to 0% in 2050 compared to 100% in 2011
- Number of building applications for 'thorough energy renovation'
- Number of Fluvius premiums
- Number of heat pumps (can be estimated on the basis of the city monitor)
- Number of households with only oil boilers, wood calefaction, conventional gas boilers
- Ownership of heating and cooling systems
- Public building energy consumption
- Public building sustainability
- Public buildings with increased energy performance
- Rate of retrofit
- Reduction of demand and energy savings in the building stock
- Reduction of tertiary sector heat demand (48 GWh by 2030)
- Residential Thermal Energy consumption
- Share of buildings renovated per year
- Switching to fossil-free heating systems in buildings
- Number of solar water heaters (can be estimated on the basis of the city monitor)

Energy flexibility

- Biogas cogeneration unit
- Certified green electricity supply
- Demand response penetration
- Electricity consumption
- Electricity system outage frequency
- Electricity system outage time
- Energy cascade use
- Energy flexibility
- Energy storage
- Hydroelectric power plants
- Local heat/cold production plants
- Local/distributed electricity production
- Yearly primary energy consumption

Share of renewables

- #MWh production of own urban installations
- % establishments and public establishments (waterfront and beach) served by renewable energy sources
- 289 GWh/y additional wind energy by 2030 (= 430 GWh)
- Amount of green electricity produced on city property to increase annually to 2,000 MWh per year in 2030
- Annual energy consumption in the municipality per inhabitant, expressed as final energy (kWh/inhabitant)
- Cooperative wind projects (# windmills)
- Further roll-out of wind energy production capacity
- GW capacity of wind turbines in Bruges
- GW capacity of solar energy in Bruges

- GWh production from onshore wind turbines
- Increased support for renewable energy in order not to introduce a further levy on renewable energy installations and to phase out existing taxes by 2025 at the latest.
- Increasing the production capacity of photovoltaic solar panels
- Introduction and use of RES
- Local green electricity production in GWh per year
- Local/distributed renewable energy production
- Maximum use of renewable sources
- More solar water heaters in households (9000 extra by 2030; 14.4 GWh)
- MWh of electricity from local co-op origin for urban consumption (PV installations of Coopstroom and Beauvent)
- Photovoltaic development
- Production via PV panels < 10 kWp peak to increase by 166 GWh/y in 2030 (185 GWh/y)
- Production via PV panels > 10 kWp peak to increase by 107 GWh/y in 2030 (128 GWh/y)
- Renewable Energy consumption
- Share of renewables
- Solar energy potential
- The ratio of green electricity produced to electricity consumption 100% in 2030

Healthy secured water cycles

Drinking water

- Biological qualities/characterization
- Consumption of water for civil use (domestic and non-domestic)
- Consumption of water for other uses
- Consumption of water for productive use
- Drinking water quality
- Freshwater consumption
- Household water consumption (litres/capita/day)
- Length of water supply network
- Number of water quality warnings issued
- Percentage of citizens served by water supply network
- Potable water supply
- Seasonal consumption of bathing establishments (mc water fountains and showers)
- Water quality
- Water supply network losses

Rain-, surface-, groundwater

- % change in water absorption
- 20 largest paved plots per borough must be completely disconnected from the sewerage system by 2050
- Climate drought
- Determination of the soil permeability classes
- Flood risk management
- Level of exposure to flood risk
- Meteoric water in sewers (cube metres)
- Metres of coast exposed to risk of flooding
- Precipitation rate
- Rainwater and greywater management
- Rainwater management
- Rainwater well and infiltration

- Reduction of the waterproof surface compared to the current (%)
- Retention-storage-delayed discharged
- Road drainage
- Sqm of areas for sustainable urban drainage
- Surface softening
- Surface water quality
- Total waterproof area (sqm)
- Water levels of rivers, sea, reservoirs
- Water reservoirs, pipelines, and local sources
- Water retention in the landscape
- Water temperature

Wastewater

- Household sanitation
- Percentage of citizens served by sewerage network
- Percentage of urban wastewater meeting the requirements of the Urban Waste Water Treatment Directive (UWWTD, regarding collection and secondary treatment)
- Sewage sludge
- Sludge disposal and incineration plant
- Wastewater
- Wastewater collection
- Wastewater treatment
- Wastewater treatment plant
- Water treatment

Sustainable land use

Biodiversity and ecosystem value

- % change in crop yield / evolution of the annual grassland productivity
- % change in forest composition
- % change in number of native species
- % of agriculture losses from extreme weather conditions/events (e.g. drought/water scarcity, soil erosion)
- % of areas affected by soil erosion / soil quality degradation
- % of grey/blue/green areas affected by extreme weather conditions/events (e.g. heat island effect, flood, rockfalls and/or landslides, forest/land fire)
- % of habitat losses from extreme weather event(s)
- % of livestock losses from extreme weather conditions
- % of livestock losses from pests/pathogens
- % of native (animal/plant) species affected by diseases related to extreme weather conditions/events
- % of timber losses from pests/pathogens
- Amphibian protection measures
- Change in number of species of birds in urban area/built-up areas in the city
- Ecosystem services
- Ecosystem value including biodiversity
- Hectares of wet nature restoration by 2027
- Implemented nature-based solutions
- Nature management and the outdoors
- Passport for mowing frequency
- Planting of additional trees
- Quality of local ecosystem

- Sites of the Natura 2000 network
- Soil quality

Green-Blue network functions

- % change in green & blue infrastructure/areas (e.g. through new urban planning regulation/policy)
- Areas of historical greenery and of villas, gardens and parks that have artistic, historical, landscape interest and/or that stand out for their uncommon beauty
- Built/optimized green infrastructure for adapting to climate change
- Classification based on "type" vegetation
- Construction of additional green areas
- Green areas
- Green recreational areas
- Green-blue networks including water absorption
- Municipal school gardens
- No. of plants currently present on the action area
- No. of plants present after the implementation of the sea park
- No. of privately planted trees and shrubs
- No. of plants on the beach and seaside
- One extra tree per inhabitant by 2030
- Percentage of protected natural areas, restored and naturalised areas on public land in municipality
- Percentage of tree canopy cover within the city
- Planting additional trees
- Planting at footway level (excluding trees)
- Protected natural areas
- Ratio of green area per inhabitant
- Street trees
- Street trees in area
- Trend of vegetation cover in urban green infrastructure
- Urban forest
- Urban forestry, plantation & green corridor connectivity
- Urban gardens
- Urban parks

Location and space use

- Land use and regional planning
- Land use for transport and parkings
- Landslide management
- Local administration of agricultural areas
- Population density (compared to national/regional average in year X in country/region X)
- Potentially transformable areas according to urban planning tools
- Redevelopment rate
- Spatial plans
- Urban density
- Urban development and spatial planning
- Urban Sprawl

Sustainable mobility

Active & public transport

- Active and public transportation service levels

Actual/new cycle paths in metres
Bus lane operation
Bus stop connectivity with other public transport services
Bus stop coverage
Capacity, availability, and travel length (public transport)
Clean energy buses
Continuity of the bicycle and pedestrian network
Crossings to meet pedestrian desire lines
Cycle facilities
Ease of crossing side roads for people walking
Effective width for cycling
Extension of bicycle network
Factors influencing bus passenger journey time
Impact of kerbside activity on bus operations
Impact of kerbside activity on cycling
Increase of public transport modal share
Increasing the share of bicycles, steps and public transport in the mobility mix
Index of cycle-pedestrian characteristics
Index of pedestrian characteristics
Infrastructure for prioritising clean public transport
Length of dedicated bus lanes
Length of transport network (e.g. road/rail) located in areas at risk (e.g. flood/drought/heat wave/ forest or land fire)
No. of electric bike charging points
No. of existing bike stands
No. of users which arrive at the seaside by walking or cycling
No. of walking people/cyclist that transit
No. of existing bicycle stalls in increase
No. of public transport stations
No. of tickets sold
Pedestrian infrastructure
Population served by public transport
Presence of zones reserved to pedestrians
Presence of zones with limited traffic
Provision of cycle parking
Public charging points
Public transport network
Quality of footway surface
Shared bicycles
Shared vehicles
Support for interchange between cycling and underground/rail
Trips with scooters / e-bikes
Type and suitability of pedestrian crossings away from junctions
Upgraded cycle paths per inhabitant
Use of public bus
Width of clear, continuous walking space

Modal split

Access point for a (carbon-free) sharing system

Additional features to support people using controlled crossings
Balance evolution of passenger transport demand and light freight
Balance of transport demand for heavy transport
Calls of sea-going vessels by type of ship
Car sharing
Cargo types
Charging points
Congestion and delays of local public transport
Electric charging points
Freight transport: 4% electrification, 2% hydrogen and addition of 13.8% biofuel in cars with an internal combustion engine
Intermodality of transports
Low-carbon emission passenger vehicles
Mobility space usage indicator
Modal share of private vehicles
Modal split
Multimodal integration indicator
Municipal zero-emission vehicles
Number of electric shared cars
Number of premiums for returning licence plates
Number of public charging equivalents
Number of shared cars
Opportunity for active mobility indicator
Parking pressure above ground city monitor
Passengers, route-kms, and passenger-kms by transport mode
Presence of private parking spaces
Presence of public areas for meeting places, events, etc
Presence of public car parking
Reducing private car use
Scooter sharing
Sharing of footway with people cycling
Sharing parking slots coverage
Traffic figures / type of ship
Transportation mode share
Uptake of low-carbon vehicles for private, freight, and public transport
Use of parking spaces
Use of public charging stations kWh

Safety

Step-free access from the street to the station entrance

(*blank*)

Mobility as a service
Roads, parking spaces, and road lights
Street classification
Sustainable mobility infrastructure

Healthy living

Indoor environmental quality

Humidity

Humidity

- Temperature
  - Households with centralised cooling system / total households
  - Households with centralised cooling system older than 10 y / total households with cooling system
  - Households with centralised heating system / total households
  - Number of cooling degree days per year
  - Number of heating degree days per year
  - Temperature
- CO_2-levels
  - Indoor air quality
  - CO_2-levels

Outdoor environmental quality

- Air pollution
  - Air pollutant emissions indicator
  - Air quality
  - EMF exposure
  - NO_2 concentration levels
  - Number of air quality warnings issued
  - O_3 concentration levels
  - PM_{10} daily concentration levels
  - $PM_{2.5}$ concentration levels
- Noise levels
  - 2022 Noise map, five-year update
  - Noise from large vehicles
  - Noise hindrance indicator
  - Noise indicator of the local public transport
  - Noise levels
  - Noise surveys in the pre and post-work action area using dedicated sensors
  - Percentage of (adult) population with high sleep disturbance
  - Percentage of population (adult) highly annoyed
  - Percentage of the population exposed to average day-evening-night noise levels (Lden) ≥ 55 dB
  - Percentage of the population exposed to night-time noise (Lnight) ≥ 50 dB
  - Protection from noise
  - Traffic noise based on peak hour motorised traffic volumes
- Safety
  - Accident Index for local public transport
  - Average response time (in min.) for police/fire-fighters/emergency services in case of extreme weather events
  - Black spots in traffic
  - Car accidents
  - Collision risk between people cycling and touring motor vehicles
  - Damaged cars from car accidents
  - Emergency service response time
  - Fire and accident protection
  - Hours needed to inform population of a risk via an early warning system
  - Index to evaluate road safety based on the number of accidents occurred in the last 10 years.
  - Interaction between large vehicles and people cycling
  - Intersection control

- Natural disaster related deaths
- Number of people injured/evacuated/relocated due to extreme weather event(s) (e.g. heat or cold waves)
- People injured from car accidents
- Police service
- Population living in disaster prone areas
- Public safety
- Qualitative index obtained through a questionnaire on the safety perceived by users of infrastructure.
- Rehabilitated pedestrian areas to improve accessibility and safety
- Risk of natural and climate disaster or hazards
- Road safety
- Safety
- Security indicator
- Surveillance of public spaces
- Traffic fatalities
- Traffic safety active mode index
- Violent crime rate

Temperature

- Frequency of cold waves
- Frequency of heat waves
- Meteorological data

Urban heat island

- Heat stress
- Study of the local microclimate after the works
- Study of the local microclimate before the works
- Urban heat island

(*blank*)

- Light nuisance
- Odour nuisance
- Sensory tranquillity
- Visual pollution

Social Performance

Affordability and inclusivity

Affordability and inclusivity

- % share of vulnerable population groups (e.g. elderly (65+)/young (25-) people, lonely pensioner households, low-income/unemployed households, migrants and displaced people) - compared to national average in year X in country X
- Access to electricity
- Access to skill development opportunities
- Accessibility for mobility impaired groups
- Arrears on utility bills / total population or households
- At-risk-of-poverty rate
- Average age of the buildings
- Average price of electricity
- Average price of gas
- Citizens / households under poverty threshold / number of citizens / households
- Citizens / households with social support

- Diversity of housing offer
- Dwelling ownership
- Energy poor households / persons supported / total energy poor households asking for support
- Energy poor households / persons supported / total energy poor households detected
- Equal access to employment
- Equal access to improved services for all citizens and tourists
- Existence of energy poverty strategy / specific measures related energy poverty
- Existing rent regulation
- Gender income equity
- Gini coefficient
- Green Area Accessibility
- High share of energy expenditure in income (2M)
- Housing expenditure
- Inability to keep home adequately cool
- Inability to keep home adequately warm
- Informal settlements
- Inhabitants / households receiving support to pay public transport services/public transport users
- Introduction programme to immigrants
- Municipal housing
- Municipal housing charges
- Number of social housing apartments/total number of apartments
- Over- and under-occupation of dwellings
- People benefiting from the public buildings / benefiting from consolidation works
- People living in poverty
- People that have access to new/rehabilitated/modernized public spaces in urban areas
- Percentage of households / persons within the municipality with access to clean cooking fuels and technologies
- Percentage of households or persons within the municipality experiencing heating discomfort / total households or population
- Percentage of population or households spending up to XX % of their income on energy services
- Share of households or persons with presence of leak, damp, rot in their dwelling / total households or persons
- Social assistance and housing benefits
- Social fairness and inclusion
- Social housing apartments not having easy access to public transport / all social housing apartments
- Social impact assessment
- Specific measures related energy poverty
- Temporary residents and night homes
- Users benefiting from the built/optimized green infrastructure for adapting to climate change
- Vulnerable households or persons / total households or persons

Cultural sustainability

- Arts mobilisation
  - Cultural and entertainment events
  - Cultural expenditure
  - Cultural facilities and institutions
  - People participating in public events
  - Performance of cultural industry
- Cultural value & diversity

- Cultural value and diversity
- No. of sporting/recreational events involving sea park and beach months November/March
- No. of participants in cultural and awareness raising events

History & heritage
- Automatic protection of cultural heritage
- History and heritage
- Intangible heritage
- Key historical and landscape elements
- Mapping heritage values
- Non-protected heritage
- Police reports based on cultural heritage act
- Preserving visual landmarks
- Protected heritage
- Specific heritage regulations
- Statements on construction and demolition affecting cultural monuments

Identity & belonging
- Identity and belonging

Spatial, architectural, & artistic quality
- Aesthetics
- Architectural cohesion
- Good spatial planning
- Incidence of public outdoor spaces used as squares or places of aggregation
- Livability and attractiveness
- Readability and recognizability
- Urban unity
- Visual attractiveness

Sustainable tourism
- % change in tourist flows / tourism activities due to climate vulnerability
- Hotel and extra-hotel capacity
- No. users park of the sea months November/February
- No. out of season hotel presences
- No. public establishments open in November/February
- Number of nights spent in the tourism unit
- Public events for tourists
- Tourism attraction facilities
- Tourist arrivals

Servicing effectiveness

Digitalization
- Availability of WiFi in public areas
- Drainage/stormwater ICT monitoring
- Dynamic public transport information
- Electricity supply ICT monitoring
- Electronic health records
- E-services
- FixCascais
- Fixed broadband subscriptions
- Household internet access
- Integrated building management systems

- Smart electricity meters
- Smart handling of mobility demand
- Smart water meters
- Student ICT access
- Traffic ICT monitoring
- Use of digital twins
- Water supply ICT monitoring
- Wireless broadband coverage
- Wireless broadband subscriptions

Diversity & accessibility of services

- % of accessible beaches
- % of areas non-accessible for emergency responses (e.g. firefighting services)
- % of new accessible beaches
- Access to mobility services indicator
- Accessible areas for recreation and outdoor activities
- Accessibility educational services
- Affordable space for recreation
- Average length (in hours) of the public service interruptions (e.g. energy/water supply, public transport traffic, health/civil protection/emergency services)
- Average time needed to reach a health facility
- Childcare availability
- Coverage of sharing point service
- Degree of discontinuity of infrastructure
- Identification of the green and sports areas present per inhabitant
- Incidence of the covered area and its arrangement with respect to the total area.
- Intensified use of infrastructure
- Mixed living environments (15-min city)
- Number of days with public service interruptions (e.g. energy/water supply, health/civil protection/emergency services, waste)
- Persons or households living more than one km from nearest public transport station / number of persons or households
- Population or households not having access to essential services within 1 hour by walking, cycling or public transport / total population or households
- Public transport network convenience
- Recreation and sport conditions
- Satisfaction with public transport indicator
- Transport performance
- Travel time index
- Urban functional diversity indicator
- Walking distance between resting points (benches and other informal seating)
- Walking distance between sheltered areas protected from the rain including fixed awning or other shelter provided by buildings /infrastructure

Sociability

Resilience

- Resilience

Social capital

- Enhanced physical and mental wellbeing
- Social LCA

Social innovation

- Social innovation
- Social networks
  - Church of Norway services and users
  - Community events
  - Number of residents' associations
  - Number of youth associations
  - Places of cult/religion
  - Social networks
  - Voluntary clubs and associations

Economic performance

Legal certainty and future economic value

- Futureproofedness & adaptability
  - % of (e.g. residential/commercial/agricultural/industrial/touristic) areas at risk (e.g. flood/drought/heat wave/forest or land fire)
  - % of population living in areas at risk (e.g. flood/drought/heat wave/forest or land fire)
  - Attractiveness and future economic value
  - Property management
  - Resilience plans
  - Risk profiling
  - State of preservation building stock
  - Type of building
  - Year of construction building stock
- Innovation support
  - Innovative and resilient economy
  - Number of start-ups in Circular Kick Start
  - Patents
  - R&D expenditure
- Regulatory stability & foreseeability
  - Existing incentives of landlord's programs

Sustainable local embeddedness

- Community business models
  - Circular HUB established
  - Community supportive business models
  - Diversity of local activities
  - Entrepreneurship support (Podnikni to!)
  - Number of new start-ups established
  - Small and medium-size enterprises
  - Stimulating, making local food production more sustainable and connecting it
- Human capital
  - Adult literacy
  - Awareness-raising campaigns targeting vulnerable households
  - Behavioural change related to climate adaptation and mitigation
  - Human capital
  - Innovation capacity building
  - Job fairs and events by the chamber of commerce
  - No. of educational and training institutions, universities, research organisations involved
  - No. of educational projects and awareness raising workshops organised
  - No. of students involved in educational projects

- No. of households educated in house energy/water/waste management
- Local employment
  - ICT sector employment
  - Local temporary and permanent employment
  - Tourism sector employment
  - Unemployment rate
  - Youth unemployment rate
- Local green economy
  - % of residents buying local products at least weekly
  - Business activities
  - Local economic activity
  - Local entrepreneurship and local businesses/ventures
  - Local food production
  - Local green economy
  - Local traditional economic activities (salt, mud, cosmetics)
  - Productive activities connected to the port channel

Total societal cost of ownership

- Total societal cost of ownership
  - % of public funds available to address a climate hazard and its impacts (e.g. fire, flood, heatwave, etc.)
  - € annual amount of compensation received (e.g. insurance)
  - € annual direct economic losses (e.g. in commercial/agricultural/industrial/touristic sectors) due to extreme weather event(s)
  - Disaster related economic losses
  - Economic returns of natural capital
  - Energy related expenditure / local GDP
  - Health insurance/public health coverage
  - Life Cycle Costing
  - Money spent to support energy poor households or persons / in relation to local GDP
  - Municipal taxes and fees
  - Number or % of (public/residential/tertiary) buildings damaged by extreme weather conditions/events
  - Number or % of transport/energy/water/waste/ICT infrastructure damaged by extreme weather conditions/events
  - Property tax
  - Public buildings benefiting from consolidation works

Governance

Integrity

- reflexive governance
  - Budget foreseen and spent
  - Effective implementation of action plan
  - Ethics
  - Grade board functioning
  - Long-term strategy
  - Monitoring processes in place
  - Resilience: % of adaptation actions implemented regarding the corresponding action plan

Participation and co-creation

- Participation and co-creation
  - Citizens' participation in public consultation

- Design co-creation actions and projects
- Local referendums
- Neighbourhood tutors program
- Number of awareness raising events organised
- Number of participants on townhall actions
- Number of projects on participatory budgeting
- Participation and co-creation processes
- Persons entitled to vote and voter turnout
- Public hearings

Process quality

Governance setup

- College of mayor and aldermen’s briefing
- Cluster consultation
- County authority accounts
- Exploitation
- Financing sources
- Implementation of the Stadsatelier (city workshop)
- Informal network
- Management of planning
- Municipal accounts
- Open data
- Process quality
- Public sector e-government and e-procurement
- Regular communication about climate objectives and achievements via website, social media, print media
- Type of administrative structure

Institutional capital

- Connection with external partners for the realization of the climate plan/goals
- Internal climate team
- Local administration capacity allocated
- No. of meetings of the multidisciplinary team within the city administration
- No. of municipality's departments involved
- No. of stakeholders involved
- No. of employees

Out of Scope*

Out of Scope

Out of scope

- % of families eating vegetarian at least 1 time per week
- Children in kindergarten from linguistic and cultural minorities
- Children welfare and assistance
- Dental healthcare
- Education
- Expenditure and kindergartens
- Health care services
- Higher education degrees
- In-patient hospital beds

- Life expectancy

Maternal mortality rate
Mental health and drug treatment
Number of deaths related to extreme weather event(s) (e.g. heat or cold waves)
Number of tonnes of food per year rescued from supermarket via distribution platform (Food plough)
Nursing and care services
Persons with an education level under lower secondary school
Persons with respiratory and circulatory problems
Physicians
Pupils in primary and lower secondary school
School enrollment
Turning food loss and surplus into profit
Upper secondary education

*note: education and health care have been intentionally left out of the IM's illustrative indicator set in order to limit its scope to the strictly necessary. Education and health care could, for example, be regarded as contributing to human capital (in the broadest sense of the word).
Furthermore, a substantial number of indicators could be assigned to different impact categories, including some of the current 'out of scope' indicators.

About Re-Value – Re-Valuing Urban Quality & Climate Neutrality in European Waterfront Cities

The Re-Value partnership consists of nine European waterfront cities and selected European organisations that work to make the urban transition irresistible for everyone. This is done by demonstrating how climate neutrality and urban quality can be aligned, by re-valuing the cities' connection to their waterfronts, strengthening co-benefits and mitigating potential adverse impacts.

Ålesund (Norway), Bruges (Belgium), Burgas (Bulgaria), and Rimini (Italy) demonstrate how integrated urban planning and design can be optimally deployed to achieve climate neutrality and significantly reduce GHG emissions by 2030. In addition, Cascais (Portugal), Constanța (Romania), İzmir (Türkiye), Písek (Czechia), and Rijeka (Croatia) learn, replicate and develop their own participatory story-building, data-driven scenarios, and financial and partnership models on integrated urban planning and design to accelerate their journeys to climate neutrality.

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Learn more about the partnership and the outcomes on re-value-cities.eu.

Partners

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