CityLoops evaluation framework and Circular City indicator set

Nordland Research Institute

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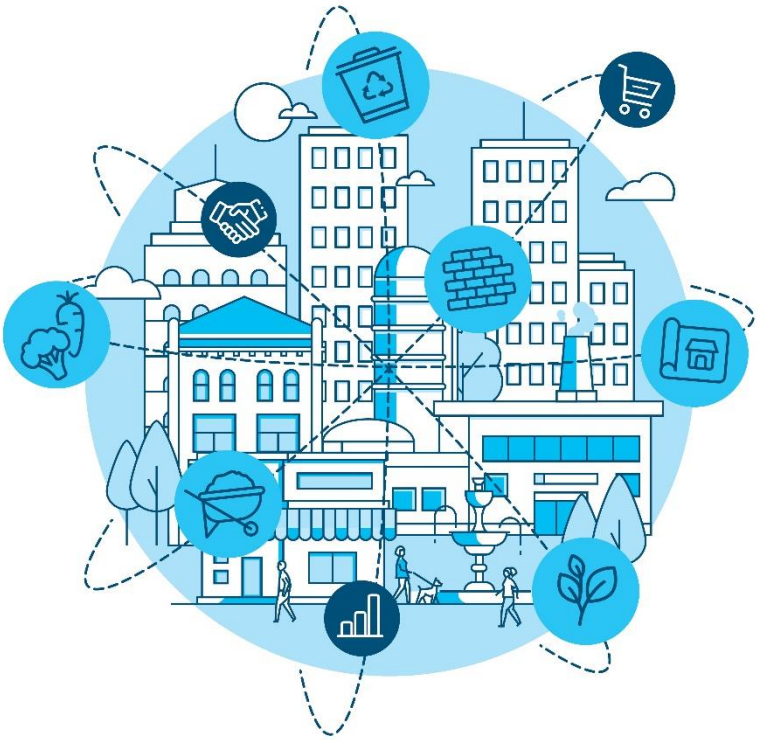


Contents

1. Introduction

This document provides a concise presentation of the framework and indicator set for monitoring progress toward Circular City status developed in the CityLoops project and subsequently applied in the evaluation of the demonstration actions of CityLoops.

Section 2 briefly introduces the key concepts of the framework and explains the purpose and background of the Circular City indicator set. A more detailed and theoretical discussion with references can be found in CityLoops Deliverable 6.1: Circular City Indicator Set.[1]

Section 3 explains how the indicator set was used in practice to evaluate the CityLoops demonstration actions, which focused on enhancing circularity in the management of biowaste and construction and demolition waste in European cities.

Sections 4-6 contain tables presenting the Circular City Strategic Objectives and indicators and showing how these are interlinked. The complete list of indicators can also be found on the website of Metabolism of Cities, where it is presented in an interactive format.[2]

[1] Vangelsten, B.V., Lindeløv, B., Nguyen, N., Hansen, J.Ø., Jensen, A., Jacobi, N., Clement, S., Bellstedt, C., Athanassiadis, A., Kern Kernel, P., Keijsers, E. (2020). Circular City indicator set. Deliverable 6.1 of the EU project CityLoops, 30 October 2020.
[2] https://cityloops.metabolismofcities.org/indicators/

2. Key concepts of the framework

The key concepts of the CityLoops evaluation framework are *Circular City*, *Vision Elements*, *Strategic Objectives*, and *indicators*.

Circular City

The ultimate vision of CityLoops is to make European cities "circular". As defined by CityLoops, a Circular City is one in which:

1. The local government, civil society, businesses, the research community and other local stakeholders collaborate to promote the transition from a linear to a circular economy. This means in practice:
2. fostering business models and economic behavioural patterns that maintain the value and utility of products, components, materials and nutrients for as long as sensible, in order to
3. close material loops and minimize as much as possible harmful resource use and waste generation locally, and thereby
4. improve human well-being, minimize net environmental impacts, protect and enhance biodiversity, and promote social inclusion, both within the city and globally, in line with the sustainable development goals.

Vision Elements

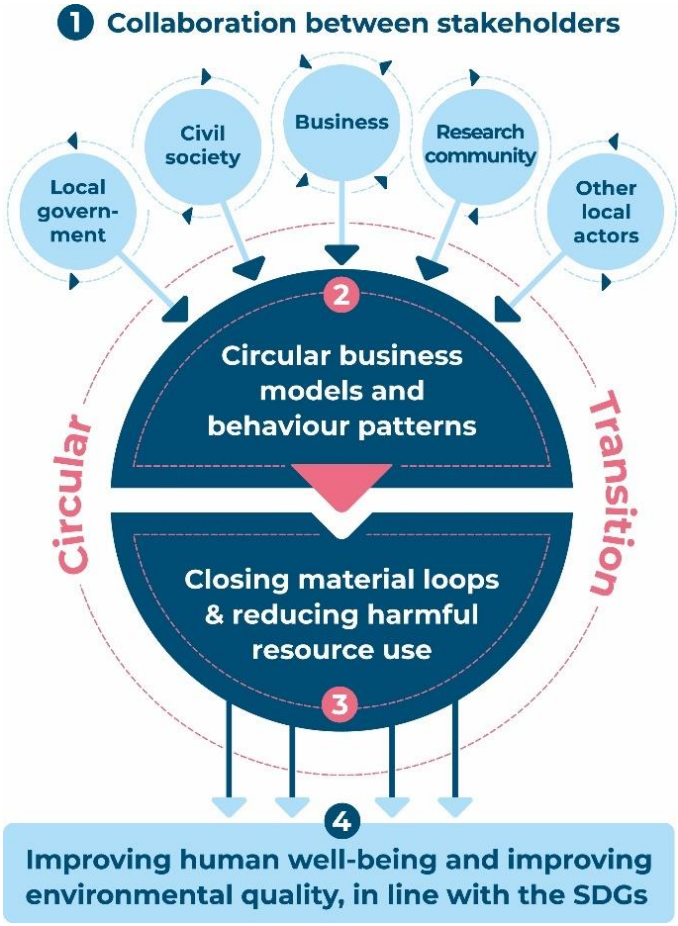
Each of the four characteristics of a Circular City listed above constitutes a *Vision Element*. The list below shows the name CityLoops has assigned to each of the four Vision Elements and provides some more information about each.

1. *Local stakeholder actions*. This Vision Element covers the actions that different local actors can take in order to bring about the circular transition. Actors mentioned are the four categories local government, civil society, business and academia (often referred to as the quadruple helix), but other relevant stakeholders are also included, such as other forms of public and semi-public organisations.
2. *Circular business models and behavioural patterns*. This Vision Element relates to the adjustments in our socio-economic systems which the local stakeholder actions carried out under Vision Element 1 are designed to encourage. This means business models and patterns of human behaviour that foster *cooperative approaches, reuse, adaptation, resource stewardship, stock management, and sharing, which* refocus our socio-economic systems on maintaining the value and utility of products, components, materials and nutrients.
3. *Closing material loops and reducing harmful resource use*. This Vision Element outlines the physical manifestation of the changes we are trying to achieve through the circular transition, in terms of reducing the physical flows, consumption and waste of different materials and resources.
4. *Improving human well-being and reducing environmental impacts*, in line with the SDGs defined by the United Nations. This Vision Element represents our ultimate objectives

of the circular transition – i.e. the impacts which the activities undertaken by local stakeholders under Vision Element 1 aim to achieve.

The Vision Elements are based on a wide review of policy and strategy reports and are the outcome of a co-creation process in CityLoops.

The figure below illustrates how the four Vision Elements are related to each other and how different groups of stakeholders must collaborate to bring them about and create a Circular City. Although this is a simplified representation of reality, it may serve as a useful mental model to guide our thinking about the circular transition.



Strategic Objectives

The Vision Elements are quite abstract. To guide action, more specific and practical goals are needed. In CityLoops, the four Vision Elements have been broken down into a set of 44 *Strategic Objectives*. These objectives were formulated based on a review of circular economy strategies from cities across Europe as well as some related reports from international institutions.

The complete list of Strategic Objectives can be found in section 4. To add structure to the list, the 44 Strategic Objectives have been grouped by theme into 14 Strategic Objective groups.

The excerpt below shows the first two Strategic Objectives for Vision Element 1. Note that these two Strategic Objectives belong to the group "Engagement".

SO group	#	Strategic Objective	Definition
Engagement	1	Facilitation of repair and reuse platforms, and the secondary materials market	The local authority's capacity to encourage the establishment and successful operation of repair and reuse platforms and secondary material markets on their territory.
	2	Increased capacity building on CE for public employees and other local stakeholders	The provision of training and other capacity building activities for public sector employees, as well as other stakeholders (such as local businesses) to increase skills relevant to fostering the circular transition.
	…	…	**[Full table in section 4]**

Within the CityLoops evaluation framework, the Strategic Objectives carry two principal functions: (1) to break down the Vision Elements into manageable units that comprehensively cover all possible objectives, and (2) to allow for the allocation of CityLoops demonstration actions and tools. Each CityLoops demonstration action or tool was allocated to one or more Strategic Objectives.

Indicators

To help a city measure its progress toward the Strategic Objectives, CityLoops has compiled a set of 87 *indicators*.[3] The indicators are a tool for tracking progress over time and have been selected for their relevance to one or more of the Strategic Objectives. Many of the indicators in the CityLoops indicator set are quantitative (e.g. "Percentage of new cars that are zero-emission vehicles"). Others are qualitative, meaning that their status at any given time is recorded with a short description or narrative rather than a number.

The complete CityLoops indicator set is in section 5. The excerpt below shows the first two indicators from the list. Note that the first indicator in the excerpt is quantitative whereas the second is qualitative.

#	Indicator name	Indicator definition	Unit
1	New material passports: Impact	Mass of materials given passport per year *(To be selected together with #2)*	Tonnes/ year
2	New material passports: Qualitative description	Description of passport established / updated to facilitate increased circularity. E.g. type of certification/validation, name of the institution issuing the passport, material types/fractions etc *(To be selected together with #1)*	Qualitative data
…	…	**[Full table in section 5]**	…

[3] Initially a raw list of 446 circular economy indicators was compiled; this list can be downloaded from the open-access platform Zenodo: https://doi.org/10.5281/zenodo.8392564. The raw list was reduced to 94 highly relevant indicators to create the CityLoops indicator set as presented in CityLoops Deliverable 6.1. Later the indicator set was modified slightly (as mentioned in Deliverable 6.3) to create the final set of 87 indicators used in subsequent CityLoops deliverables and presented here.

The Vision Elements and Strategic Objectives embody general aspirations to circularity and are not tailored specifically to the context of the CityLoops demonstration cities or actions. The indicators, on the other hand, have been compiled with a view to their relevance for the demonstration actions in CityLoops. This does not mean that the indicator set is useless outside of CityLoops; on the contrary, any initiative seeking to advance circularity at the city level will find some indicators of relevance in the CityLoops indicator set. However, it does mean that some context-dependent modifications may be desirable if the indicator set is to be used outside of CityLoops.

Section 6 contains a set of tables showing which indicators from the indicator set are the most relevant for measuring progress toward each of the Strategic Objectives. An excerpt is reproduced below, showing the first two Strategic Objectives and their associated indicators.

#	Strategic Objective	Indicators supporting this Strategic Objective
1	Facilitation of repair and reuse platforms, and the secondary materials market	1: New material passports: Mass of materials given passport per year 2: New material passports: Description of passport 3: New tools for better mapping of resources and their location: For each tool, qualitative description.
2	Increased capacity building on CE for public employees and other local stakeholders	4: CE-related knowledge building campaigns: For each campaign, specify type of groups reached and type of knowledge building campaign. 5: CE-related knowledge building campaigns: Number of campaigns, and for each campaign, number of people reached
…	…	**[Full table in section 6]**

Summary

The table below sums up how the abstract concept of the Circular City is operationalised in CityLoops. Moving from top to bottom, the Circular City concept is incrementally broken down into elements that become increasingly concrete, specific, and measurable with each step.

	Level
1	Circular City definition
	↓
4	Vision Elements
	↓
14	Strategic Objective groups
	↓
44	Strategic Objectives
	↓
87	Indicators

3. CityLoops evaluation process

The previous section laid out the key concepts of the CityLoops approach to monitoring progress toward Circular City status. This section explains how the CityLoops indicator set was applied in practice to evaluate the demonstration actions of the CityLoops demonstration cities. The evaluation procedure described below can be replicated in other projects aimed at enhancing circularity at the urban level.

The CityLoops project took place over 48 months from 2019 to 2023. Ten cities from across Europe carried out demonstration actions aimed at improving circularity in the management of biowaste and construction and demolition waste. The evaluation task was led by a team from Nordland Research Institute (NRI) who guided the cities through the evaluation process.

Evaluation plan

In the first step of the evaluation process, each of the demonstration cities prepared an *evaluation plan*.[4] This was done early in the project, either before the demonstration actions had started or while they were still in an early phase.

The evaluation plan of each city specified the expected outcomes the city hoped to achieve in each of their demonstration actions and the indicators they intended to use to measure whether the outcome had been achieved. Indicators were chosen from the CityLoops indicator set. In some cases, cities defined additional indicators themselves tailored to their unique context.

Indicator measurement

During the course of the CityLoops project, indicator values were calculated at three points in time for each demonstration action:

1. A baseline value to represent the reference state before the demonstration action.
2. A preliminary value by month 36 of the project to be used for an interim evaluation report.
3. A final value by month 44 of the project to be used for the final evaluation report.

In their evaluation plan, the cities specified how they would calculate a baseline value for each indicator. The purpose of the baseline is to provide a benchmark that the final indicator value can be compared against to measure the progress that has taken place. In general, several different alternatives exist for calculating the baseline:

a) The default scenario is when the demonstration activity is a continuation of ongoing activities, and where the demonstration project improves the circularity of the activities. In these cases, the baseline value is calculated using the same method and data sources as the post demonstration action values.
b) If the demonstration project is the first attempt at recycling a waste fraction, the baseline recycle rate is zero.

[4] The evaluation plans of the CityLoops demonstration cities are collected in a document that can be downloaded from the open-access platform Zenodo: https://doi.org/10.5281/zenodo.8392651.

c) In cases where the demonstration project represents something qualitatively new, a baseline value may not be easy to calculate. Sometimes a relevant baseline value can be estimated based on aggregated values for previous projects of relevance.
d) In cases where a meaningful baseline value cannot be calculated, the final indicator value will be compared against a target value specified by the cities before the start of the project.

Data collection

During and after the demonstration actions, the cities collected and recorded baseline, interim, and final data for their chosen indicators in accordance with their evaluation plan. All cities recorded their data in a spreadsheet format, using the same online file so that each city had access to the indicator information recorded by other cities. This facilitated cross-city learning as many cities had chosen similar indicators. NRI provided feedback to the cities on their data collection and requested elaborations and clarifications when necessary.

Evaluation

The final step in the evaluation process in CityLoops was the actual evaluation and preparation of evaluation reports – an interim and a final report. This work was carried out by NRI in collaboration with the cities. For each expected outcome of the demonstration actions, NRI assessed the extent to which the outcome had been achieved based on the indicator measurements and other information provided by the cities, and summarised the assessment in the report.[5]

[5] Hansen, J.Ø., Lindeløv, B., Vangelsten, B.V., Palmer-Abbs, M., … Nguyen, N. (2023). CityLoops Evaluation Report. Deliverable 6.4 of the EU project CityLoops, 30 September 2023.

4. List of Strategic Objectives

Strategic Objectives and key UN SDGs addressed for Circular City Vision Element 1 "Local stakeholder actions"

SO group	#	Strategic Objective	Definition	SDG ref.
Engagement	1	Facilitation of repair and reuse platforms, and the secondary materials market	The local authority's capacity to encourage the establishment and successful operation of repair and reuse platforms and secondary material markets on their territory.	12
	2	Increased capacity building on CE for public employees and other local stakeholders	The provision of training and other capacity building activities for public sector employees, as well as other stakeholders (such as local businesses) to increase skills relevant to fostering the circular transition.	17
	3	Increased collaboration with local and regional stakeholders in CE planning and implementation, and the promotion of regional upscaling	Increased involvement of, and collaboration with, relevant stakeholders (including civil society, businesses, the research community, and other public sector actors) at the local and regional level at all different stages of CE planning, implementation, monitoring, reviewing, as a fundamental prerequisite to systemic transformation. This objective thus refers to the degree and quality of interaction and collaboration. This includes actions aimed at developing or upscaling activities to the regional level where appropriate.	17
	4	Increased engagement with national and international policy makers and researchers on the CE	Given that the circular transition will require the adjustment of policy and regulatory frameworks at all levels of government, multi-level governance collaboration will be crucial. Local governments must be proactive in sharing experiences, knowledge, and good practices within the national and European arena.	17
	5	Increased provision of information on CE to local stakeholders	The provision of quality information to relevant stakeholders (including the general public) about CE in general, the actions being taken by the local authorities, and the opportunities for contributing or getting involved, to increase their awareness and foster active participation. Awareness is a key enabler for the circular economy transition.	17
Regulation and incentives	6	Improved regulatory framework to support circularity	Recognising the limits to setting regulations locally, these objectives denote the aim to improve, where possible, the existing local regulatory levers, in order to promote circular principles. Such measures may e.g. include banning certain products or adapting local waste, construction, or mobility regulations.	16
	7	Increased use of economic incentives and fiscal measures to promote circularity as well as removal of subsidies hindering circularity	The objective refers to local authorities applying economic incentives and fiscal measures to promote circularity in their territory. Such measures may e.g. incentivising reuse and repair practices over new purchases by increasing the cost of discard or to apply local taxes and fees that promote the use of secondary materials and products.	8

SO group	#	Strategic Objective	Definition	SDG ref.
	8	Integration of circularity principles into public procurement and financing processes	This objective refers to the integration of circularity principles into the ways local authorities procure works, services, and goods as well as into financing processes. Such principles could have manifold aims but can sensibly be determined as those that increase the use of secondary materials, extend product/stock lifetimes, or intensify their use. Integrating these principles into public procurement means in practice to specify the intended effect of the services or goods purchased on these principles. Outputs could be tender specifications (integration of circularity as criteria), financial procedural agreements and guidelines, etc. Generally every time the local authority spends money, circularity principles should be applied. This, again, constitutes one of the biggest levers local authorities have in contributing to a more circular economy.	11,16
Vision and urban management	9	Existence of city-wide strategy on CE with measurable objectives translated into targeted actions	The existence of a city-wide strategy on the development of a local circular economy and/or local contribution to a more circular economy in general, including specific objectives and measures, as a key enabler, based on scientific/evidence-based (metabolic) analysis.	11,16
	10	Integration of circularity principles into asset management, including publicly owned land, buildings, and infrastructure	This objective refers to the aim to include circularity principles into public asset management, including for instance publicly owned land, buildings, and infrastructure. Such principles could have manifold aims but can sensibly be determined as those that increase the use of secondary materials, extend product/stock lifetimes, or intensify their use. Including such principles in urban asset management means in practice to give those principles a certain importance, if not prioritise them among other existing principles. Examples of relevant outputs are e.g. asset management procedures and guidelines, procurement, maintenance, assessment schemes etc.	9,11
	11	Integration of circularity principles into urban planning decisions such as zoning and planning decisions, construction and demolition permits, and mobility planning	The inclusion of CE principles in urban planning decisions, such as zoning and planning decisions, construction and demolition permits, and mobility planning. Such principles could have manifold aims but can sensibly be determined as those that increase the use of secondary materials, extend product/stock lifetimes, or intensify their use. Systematically incorporating such principles in urban planning decisions is one of the most important levers for local authorities in promoting the transition to a CE on their territory.	9,11

Strategic Objectives and key UN SDGs addressed for Circular City Vision Element 2 "Circular business models and behaviour patterns"

SO group	#	Strategic Objective	Definition	SDG ref.
Circular design and business models	12	Increased asset lifetimes, including through flexible design and use	Increasing the lifetime of assets (equipment, machinery, buildings, infrastructure, and consumer goods) in order to reduce waste generation and resource use. This can occur through different kinds of interventions, induced by different urban actors, including e.g. permit extensions, eco-design, modular design & design for repair, maintenance, etc.	9,12
	13	Increased provision of local, sustainable, and healthy food	Recognising that local food production and distribution entails clear health and climate benefits, this objective refers to increasing the share of locally produced and consumed food.	3,12
	14	Increased rate of exploitation of assets (including equipment, machinery, buildings, infrastructure	Increasing the exploitation rate of assets (e.g. equipment, machinery, buildings, infrastructure, and consumer goods), intensifying their use and increasing their utility. One of the main mechanisms, through which this can occur, is through sharing activities (e.g. car sharing, sharing office- or production space). An increased rate of exploitation of assets is a key circularity objective as it increases the utility of existing assets for society and counteracts the use of virgin materials.	9,12
	15	Increased sustainable urban mobility options	Increasing sustainable mobility options such as e.g. public transport, e-mobility, sharing models, cycling and walking as a significant enabler for circularity with strong co-benefits for climate, health and well-being.	9,11
Circular value chains and infrastructure	16	Enhanced waste collection, treatment and processing systems, including increased on-site reuse and treatment of waste	An enhanced local waste collection (e.g. improved waste quality and separate collection, limiting informal dumping), as well as treatment that reduces incineration and landfill and favours material and energy recovery, including also increased on-site reuse and waste treatment.	6,11,12
	17	Increased cooperation among sectors	Increasing industrial sector cooperation and information sharing in order to understand cross-sectoral supply chains, raw material inputs and outputs, wastes etc., which allows for exploitation of synergies, building industrial symbiosis and is thus a key enabler for the circular economy.	17
	18	Increased use of repair and reuse platforms, and the secondary materials market	Increasing the utilisation of reuse platforms and secondary material markets by commercial suppliers and buyers, as well as private households, and public sector organisations. The notion is that increased use of such platforms will increase the reuse and use of secondary materials and products, which constitutes one of the primary mechanisms for building a more circular economy.	8,12
	19	Localisation of supply chains	Localising supply chains brings about a number of benefits for circularity as well as other co-benefits. Localising supply chains may decrease dependency and hence increase economic resilience, add value and bring jobs to the region, allow for more sustainability oversight and transparency and reduce transport costs and emissions, and is thus a key objective for making the local economy more circular.	12
Private investments, jobs and gross	20	Increased gross value added of circular economy activities (repair, reuse, sharing, recycling)	Increasing the value generated by local economic activities that increase repair, reuse, sharing and recycling of materials and products including recovery and exploitation of waste. The continued, gradual increase of value added from those activities, is a potential indication for reduced resource use, and highlights the growing economic significance of the sector.	8

SO group	#	Strategic Objective	Definition	SDG ref.
value added	21	Increased number of jobs in the local circular economy (repair, reuse, sharing, recycling, eco-design)	Increasing the number of jobs in the local circular economy and the share of employment in the latter but also the rate of employment in general, providing an indication for both the value and size of the circular economy but also for a just transition from the linear model.	8

Strategic Objectives and key UN SDGs addressed for Circular City Vision Element 3 "Closing material loops and reducing harmful resource use"

SO group	#	Strategic Objective	Definition	SDG ref.
Material / energy flow	22	Reduced (harmful) raw material consumption	A state in the local material economy of reduced material consumption (i.e. grouped into non-metallic minerals, metals, fossil energy carriers and biomass) by refusing product or material use (abandoning its function, making it redundant or deploying a radically different solution) through reducing overall consumption, consumption of raw materials, and consumption of overexploited or hazardous materials.	12
	23	Reduced overall energy demand and increased share of renewable energy	A state in the local material economy, in which the consumption of (local) renewable energy is increased and consumption of fossil fuels is reduced in absolute terms.	7,13
Re-use and recycling	24	Increased share of renewable and secondary raw materials in overall material demand	A state in the local material economy of an increased share of secondary materials in overall raw materials demand and an increased share of renewable raw materials in overall materials demand.	12
	25	Increased self-sufficiency / self-reliance	Self-sufficiency will be increased by decreasing the imports of virgin raw materials, using locally available materials, such as reusing secondary raw materials that were locally produced and decreasing the export of waste materials, instead treating it locally. This will also bring about a state in the local material economy where retention of nutrients (e.g. phosphorus in wastewater) is captured and retained, bringing about an economic benefit, counteracting resource scarcity.	12
	26	Increased quantity of materials available for the next cycle	The increase of material amounts for the next cycle of use by following the 2018 EU waste hierarchy with the preference starting from the top, namely through *preserving* materials and products (extending lifetimes), *reusing* products or materials (i.e. use of the same product and function by another user), *repairing* products (as to maintain its original function), *repurposing* products (using products or their components in a new product with different function), through *refurbishing* or *remanufacturing*, and *recycling* of products or materials (obtaining higher or lower grade recycled materials for the same function or for inferior products (backfilling)).	12
Waste generation / management	27	Reduced waste generation	Reduced waste generation, assessed according to different waste fractions, including biodegradable material (e.g. zero avoidable food waste).	12
	28	Reduced incineration and landfilling activities and amounts subjected	Reduced amounts of (waste) materials, assessed according to different waste fractions, including biodegradable materials, subjected to final destinations such as incineration and landfilling.	12

Strategic Objectives and key UN SDGs addressed for Circular City Vision Element 4 "Improving human wellbeing and reducing environmental impacts"

SO group	#	Strategic Objective	Definition	SDG ref.
Well-being	29	Improved education	The educational sector represents a key local mandate and part of municipal services of general interest. Having to access to high quality education is an essential part of well-being and acts as enabler for a number of other elements of the well-being concept as well. This objective aims at measuring the impact of a transformed economy on the local education system.	4
	30	Improved public health	Good health is a core part of the well-being concept. Hence, this objective refers to a good state of public health, especially targeting those aspects that are connected to GHG emissions, air quality and quality of food, etc.	3
	31	Improved recreational services	Improving recreational ecosystem services is a key component of human well-being. This objective refers to the impacts of integrated urban planning measures on the quantity and quality of green spaces in the city.	11, 15
	32	Improved access to basic services	This objective refers to the impact the circular economic model has on people's access to basic services such as sanitation, drinking water, shelter etc.	6,7,9,11
	33	Reduced unemployment	Employment is core component of human well-being and also an enabler for other components such as participation, livelihood, health and shelter. This objective hence refers to the impact circular business models have on unemployment.	8
	34	Reduced poverty and inequality	Reducing poverty and inequality is a of course a crucial part of well-being as well as advancing the SDGs. Transitioning from a linear to a circular economic model also bears the chance of increasing jobs and value added as well as to tackle asymmetric distribution of wealth to reduce inequality. This objective refers to reducing poverty and inequality through an inclusive and all-encompassing circularity transition.	1,10
	35	Human-centred land-use and urban planning	Access, proximity, and the derived mobility needs in urban centres is both a part of well-being and also a key objective of urban planning. This objective refers thus to human centred urban planning practices that unlock co-benefits for humans and the environment while reducing GHG-emissions and air pollution – induced by circular principles.	11
Environment impacts (local)	36	Reduced biodiversity loss and deforestation	Biodiversity (local or global) is a key metric for the functioning and health of the earth's regenerative capacity and ecosystem services for humans. This objective refers to maintaining or increasing biodiversity and reducing deforestation locally, alongside the circularity transition.	14,15
	37	Improved water quality	Water quality is a core component of environmental quality, strongly impacting on ecosystems and their services but also directly on human health. This objective hence refers to improving water quality locally	6,14

SO group	#	Strategic Objective	Definition	SDG ref.
			by reducing harmful releases and improving water treatment.	
	38	Improved air quality	Air quality is a core component of environmental state, strongly impacting on ecosystems and their services but also directly on human health. This objective hence refers to improving air quality locally by reducing releases of pollutants and improving technical solution on the output side.	3,11,12
	39	Reduced soil degradation	The quality of soil is a key enabler for provisional ecosystem services, used e.g. in agriculture, but also in the construction sector. Its good quality is a core metric for the state of the environment and human health and well-being. This objective thus refers to improving soil quality through circularity interventions that aim at recuing soil use, as well as reducing contamination of soils, locally.	2,3,12
Environment impacts (global)	40	Mitigate climate change	Reducing emissions locally through shifting from a linear to a more circular production and consumption model, realizes its impact globally through reduced global warming potential. This objective thus aims at achieving a reduction of GHG-emissions through CE interventions, in line with local agendas and EU targets.	7,13
	41	Reduce global adverse environmental impact of local consumption	Aggregate objective on global environmental impacts and indicators.	12
Economic impacts	42	Transformed, sustainable local economy	This objective refers to achieving a profound change of the economic system (locally or regionally), including e.g. elements of justice, equality, environmental soundness and prosperity, through the deployment of a circular economy with all its implications.	8,12
	43	Increased resilience of local economy	This objective aims at making the local economy more resilient against shocks (e.g. natural disasters, health crisis or financial) by e.g. diversification, localization or other measures that can be induced by transitioning to a more circular economy.	9,11
Impacts on urban resilience	44	Reduced risk of urban infrastructure against natural disasters	This objective refers to increasing urban resilience against natural disasters through circular interventions at the city level as well as in its effort to adapt to climate change.	11,13

5. List of Circular City indicators

List of proposed indicators for **Vision Element 1 "Local Stakeholder Actions"**. The left-most column specifies which Strategic Objective group each indicator is most relevant for.

SO group	#	Indicator name	Indicator definition	Unit
Engagement and capacity building + Regulation and incentives + Vision and urban management	1	New material passports: Impact	Mass of materials given passport per year *(To be selected together with #2)*	Tonnes/ year
	2	New material passports: Qualitative description	Description of passport established / updated to facilitate increased circularity. E.g. type of certification/validation, name of the institution issuing the passport, material types/fractions etc *(To be selected together with #1)*	Qualitative data
	3	New tools for better mapping of resources and their location: Qualitative description	Qualitative description of individual tools, including scope and scale (e.g. demonstration vs city level), target users. *(To be selected together with #20)*	Qualitative data
Engagement and capacity building	4	CE-related knowledge building campaigns: Qualitative description	Description of knowledge building campaigns. The campaigns would normally be in the form of formalized education events, e.g. classes, courses, education workshops. Describe: Type of groups reached and type of knowledge building campaign. *(To be selected together with #5)*	Qualitative data
	5	CE-related knowledge building campaigns: Impact	Number of campaigns Number of people reached for each campaign *(To be selected together with #4)*	No. of campaigns No. of people
	6	Circularity-related stakeholder activities	Description of activity type and dialogue methods, which stakeholder groups and when in the process Number of people involved	Qualitative data No. of people
	7	New methods and technologies for stakeholder involvement: Qualitative description	Number of methods, and for each a qualitative description of the method *(To be selected together with #8)*	No. of methods Qualitative data
	8	New methods and technologies for stakeholder involvement: Impact	Description of stakeholder groups involved Number of people impacted *(To be selected together with #7)*	Qualitative data No. of people
	9	New formal CE-based collaboration platforms/networks	Number of CE-based collaboration platforms/networks Number of members in CE-based collaboration platforms/networks	No. of networks No. of people
	10	Stakeholder contribution to improved circularity	Qualitative description of input from stakeholder activities and how it has contributed to improved circularity	Qualitative data + potential quantitative impact data

SO group	#	Indicator name	Indicator definition	Unit
	11	Communication measures on circular transformations and waste prevention	Describe type of communication measures, e.g. campaigns, provision of information, events for the public/companies.	No. of communication measures No. of people
Regulation and incentives	12	Circularity requirements in procurement beyond existing levels	Description of requirements in procurements going beyond what is current standard practice. *(To be selected together with #15)*	Qualitative data + potential quantitative impact data
	13	Circular procurement ambition set out in strategy / policy documents.	List and describe ambition and to which degree the ambitions are being fulfilled	Score on categorical scale (1-5)
	14	Investments in circular economy programmes	The share of investments made by selected public and private financial institutions in programmes / projects that explicitly focus on promoting CE.	%
	15	Procurement with circularity requirements[6] beyond existing levels: Impact	Number of procurements with circularity requirements Value of procurement with circularity requirements *(To be selected together with #12)*	No. of actions Monetary value of procurements
	16	Procurements making use of stakeholder dialogue to strengthen circularity: Qualitative description	Description of stakeholder dialogue in procurement processes focusing on circularity (e.g. demonstration action related or at city level) *(To be selected together with #17)*	Qualitative data
	17	Procurements making use of stakeholder dialogue to strengthen circularity: Impact	For each procurement action value of procurement described in indicator #16. Mass of materials impacted. *(To be selected together with #16)*	Monetary value Tonnes / year
	18	CityLoops indicators used in procurement tenders and contracts	For each procurement action, describe to which degree CityLoops indicators have been used as part of circularity requirements in procurements.[7]	No. of indicators
Vision and urban management	19	Progress towards circular city strategy objectives	Describe to which degree the city is making progress towards its circularity objectives. Identify categories of relevant strategy documents, select documents and relevant selected CE targets.	Score on categorical scale (1-5)
	20	New tools for better mapping of resources and their location: Impact	Describe impact of CityLoops tools described in indicator #3 on material flows and other relevant parameters. *(To be selected together with #3)*	Tonnes / year Other relevant quantitative units (Monetary, jobs etc)
	21	New planning instruments/tools for improved circularity: Qualitative description (see also #22)	Define and select planning instruments/ tools relevant to improve circularity. *(To be selected together with #22)*	Qualitative data

[6] With reference to definition of Circular City as given in CityLoops D6.1 (Vision Elements and Strategic Objectives).
[7] See Table on "Circularity requirements beyond standard/existing levels" in D6.1 data collection template for Circular Procurements (Appendix C).

SO group	#	Indicator name	Indicator definition	Unit
	22	New planning instruments/tools for improved circularity: Impact (see also #21)	Quantify impact of all planning instruments/tools described in indicator #21. *(To be selected together with #21)*	No. of tools Tonnes / year

List of indicators for **Vision Element 2 "Circular business models and behaviour patterns"**. The left-most column specifies which Strategic Objective group each indicator is most relevant for.

SO group	#	Indicator name	Indicator definition	Unit
Private investments, jobs and gross value added + Circular design and business models	23	Eco-innovation: Qualitative description[8]	Describe the business model, including how it contributes to moving up the waste hierarchy. *(To be selected together with #24)*	Qualitative data
	24	Eco-innovation: Impact	For each case of implementation of CE business models in indicator #23, describe impact in terms of value creation and material flow. *(To be selected together with #23)*	Monetary value Tonnes / year
Circular design and business models	25	Percentage of new cars that are zero-emission vehicles	The share of new passenger cars or light commercial vehicles with zero tailpipe GHG emissions, e.g. battery electric or hydrogen cars	%
	26	Transport modal share in commuting (cars, motorcycles, taxi, bus, metro, tram, bicycle, pedestrian)	Share of different transport modes used for work commuting during	%
Circular value chains and infrastructure + Reuse and recycling	27	Increased share of materials retained and reused on demonstration sites	The relative share of materials retained and reused on demonstration sites, measured for selected/key on-site waste material fractions and the total mass of waste materials.	Mass %
	28	Volume onsite sorting (Improved source separation)	The relative share of waste materials produced and sorted on demonstration sites	Mass %
Circular value chains and infrastructure	29	New material hotels: Mass of material stored in hotel	The indicator assesses the impact and significance of the material hotel by logging the flow and stock of materials in the hotel.	Tonnes / year Tonnes
	30	New digital material databank/marketplace: Qualitative description	Description of the digital material databank/marketplace in term of objective, type, scope, stage of development, target/user groups and other aspects deemed relevant. *(To be selected together with #31)*	Qualitative data
	31	New digital material databank/marketplace: Impact	The impact of the digital marketplace is assessed by estimating the mass and value of material registered and traded per time period. *(To be selected together with #30)*	Tonnes / year Monetary value/time

[8] CE business model refers for example to moving up the waste ladder/hierarchy described in D6.1 Figure 10 (p. 40).

SO group	#	Indicator name	Indicator definition	Unit
Private investments, jobs and gross value added	32	Reduced costs due to improved circularity	For selected cost type(s) (e.g. transport, virgin material costs, waste treatment costs), direct impacts on costs should be estimated.	Monetary value
Private investments, jobs and gross value added + Well-being	33	CE-based employment	Assess the impact of demonstration actions or at sector/city level by estimating the increase in CE related jobs	Jobs

List of indicators for **Vision Element 3 "Closing material loops and reducing harmful resource use"**. The left-most column specifies which Strategic Objective group each indicator is most relevant for.

SO group	#	Indicator name	Indicator definition	Unit
Material / energy flow	34	Domestic material consumption (DMC)	The total amount of materials directly used by an economy and is defined as the annual quantity of raw materials extracted from the domestic territory, plus all physical imports minus all physical exports.[9]	Tonnes/year
	35	Domestic material consumption (DMC) of virgin materials	The total amount of virgin materials directly used.	Tonnes/year
	36	Total energy demand	Total energy demand for all sectors in the city.	MWh/year
	37	Share of renewable energy in total energy demand	Renewable energy usage in the city as a share of total energy demand	%
	38	Local biomass for energy generation.	Give an overview of local biomass used for energy production (e.g. incineration, biogas).	Tonnes/year
Re-use and recycling	39	Circular Material Use Rate	The circular material use rate (CMU), also called Circularity rate measures, in percentage, the share of material recovered and fed back into the economy - thus saving extraction of primary raw materials - in overall material use. A higher Circularity rate value indicates more secondary materials substituting for primary raw materials i.e. avoiding the environmental impacts of extracting primary material.	%
	40	Share of renewable raw materials in domestic material consumption	This indicator assesses the significance of renewable materials in the economy, i.e. resources that have a natural rate of availability and yield a continual flow of services which may be consumed in any time period without endangering future consumption possibilities as long as current use does not exceed net renewal during the period under consideration.	%
	41	Share of secondary materials in domestic material consumption	This indicator assesses the significance of secondary materials in the economy	%

[9] Eurostat: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Domestic_material_consumption_(DMC). Retrieved 7 August 2023.

SO group	#	Indicator name	Indicator definition	Unit
	42	Share of local secondary materials in domestic material consumption	This indicator assesses the significance of locally sourced secondary materials in the economy	%
	43	Import of materials	Identify mass of materials imported at city and sector level	Tonnes/year
	44	Export of waste materials	Identify collected waste at city and sector lever being exported out of the city.	Tonnes/year
	45	Export of waste materials to incineration	Assess the share of the waste exported out of the city that goes to incineration	Tonnes/year
	46	Export of waste materials to landfill	Assess the share of the waste exported out of the city that goes to landfill	Tonnes/year
	47	Export of waste materials to composting	Assess the share of the waste exported out of the city that goes to composting	Tonnes/year
	48	EU self-sufficiency for raw materials[10]	The indicator measures how much the city is independent from the rest of the world for several raw materials.	%
	49	Quantity of material subjected to reuse	Estimate mass of materials being reused at city/sector level. “Reuse” means reuse of discarded yet still usable product, for the same purpose, by a different user.[11]	Tonnes/year
	50	Quantity of material subjected to repair	Estimate mass of materials being repaired at city/sector level. “Repair” means repair or maintenance of broken or malfunctioning product, to enable continuation of its original function.[6]	Tonnes/year
	51	Quantity of material subjected to remanufacturing	Estimate mass of materials being remanufactured at city/sector level. ‘Remanufacture’ means using parts of a discarded product in a new product of the same function.[6]	Tonnes/year
	52	Quantity of material subjected to recycling	Estimate material subjected to recycling at demo, sector, and city level. “Recycling” means processing of materials to achieve the original high-quality or reduce to low quality.[6]	Tonnes/year
	53	Quantity of material for anaerobic digestion	Estimate mass of materials going to anaerobic digestion.	Tonnes/year
	54	End of Life Collection Rate	The End-of-Life Collection Rate (EoL CR) measures the efficiency with which end-of-life material fraction is collected.	%
	55	EOL-RR (End of Life Recycling Rate).	The End-of-Life Recycling Rate (EoL RR) measures the efficiency with which the mass contained in End-of-Life products is collected, pre-treated, and finally recycled.	%
	56	Quantity of material for composting	Estimate mass of materials going to composting at demo, sector, and city scale.	Tonnes/year

[10] See metadata in Eurostat indicator “EU self-sufficiency for raw materials (cei_pc010)”.

[11] Definition from Potting; José and Aldert Hanemaaijer (eds.) (PBL), Roel Delahaye and Rutger Hoekstra (CBS), Jurgen Ganzevles and Johannes Lijzen (RIVM) (2018). Circular economy: what we want to know and can measure. Framework and baseline assessment for monitoring the progress of the circular economy in the Netherlands. PBL Netherlands Environmental Assessment Agency publication number 3217. The Hague, 2018.

SO group	#	Indicator name	Indicator definition	Unit
Waste generation / management	57	Amount of sector specific waste that is produced	Total mass of waste for sector.	Tonnes/year
	58	End of Life Processing Rate	The End-of-Life Processing Rate (EoL PR) measures the efficiency of the end-of-life processing process.	%
	59	Incineration rate	Mass percentage of waste which incinerated.	%
	60	Incineration rates per material fractions	Mass percentage of waste which incinerated for each material fraction as defined by local waste management companies.	%
	61	Landfilling rate	Mass percentage of waste which landfilled.	%
	62	Landfilling rates per material fractions	Mass percentage of waste which landfilled for each material fraction as defined by local waste management companies.	%

List of indicators for **Vision Element 4 "Improving human wellbeing and reducing environmental impacts"**. The left-most column specifies which Strategic Objective group each indicator is most relevant for.

SO group	#	Indicator name	Indicator definition	Unit
Well-being	63	Percentage of school-aged population enrolled in school	Percentage of school-aged population enrolled in school	%
	64	Percentage of students completing secondary education	Percentage of students completing secondary education	%
	65	Average life expectancy	Average life expectancy	Years
	66	Number of in-patient hospital beds per 100 000 population	Number of in-patient hospital beds per 100,000 population	Beds / 100,000 inhabitants
	67	Open green space area ratio per 100,000 inhabitants	Open green space area ratio per 100,000 inhabitants	Hectare / 100,000 people
	68	Share of green space areas within urban limits	Share of green space areas within urban limits	%
	69	Percentage of city population with potable water supply service	Total houses connected to potable water supply service. Total inhabitants living in these houses.	%
	70	Percentage of city population with authorized electrical service	Total houses connected to electrical service/ infrastructure. Total inhabitants living in these houses.	%
	71	Percentage of city population with regular solid waste collection (residential)	Total houses getting regular waste management service. Total inhabitants living in these houses.	%

SO group	#	Indicator name	Indicator definition	Unit
	72	Percentage of city population served by wastewater collection	Total amount of houses connected to wastewater sewage works. Total inhabitants living in these houses.	%
	73	Unemployment rate	Eurostat: Unemployed persons are all persons 15 to 74 years of age (16 to 74 years in ES, IT and the UK) who were not employed during the reference week, had actively sought work during the past four weeks and were ready to begin working immediately or within two weeks.	%
	74	AROP – at-risk-of-poverty rate for the total population	Eurostat definition: At risk-of-poverty are persons with an equivalised disposable income below the risk-of-poverty threshold, which is set at 60 % of the national median equivalised disposable income (after social transfers).	%
	75	QSR – income quintile share ratio.	Eurostat: The income quintile share ratio or the S80/S20 ratio is a measure of the inequality of income distribution.	Income ratio
	76	Average commuting distance/time	Average duration of commute (and/or commuting distance) to and from work or an educational establishment, using any types of transport modes.	Time Distance
	77	Share of population having access to public transport within 15 minutes by foot	Population residing <500 metres from a public transport stop (%).[12]	%
	78	Percentage of urban development that occurs on existing urban land rather than on greenfield land	Greenfield land can be understood as undeveloped land in a city or rural area either used for agriculture or landscape design or left to evolve naturally. Using the CORINE Land Cover (CLC) nomenclature,[13] "existing urban land" would be all areas in the Area class "Artificial surfaces" except Area class "141 Green urban areas".	%
Environmental impacts (local)	79	Percentage of city area protected as natural sites	A protected area is a defined geographical space, recognised, dedicated, and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated eco-system services and cultural values. (IUCN Definition 2008)	%
	80	Percentage of residential and commercial wastewater that is treated according to applicable national standards	Wastewater treatment is the process of removing suspended and dissolved physical, chemical, and biological contaminants to produce (a) water that is safe to be discharged to the environment or suitable for reuse and (b) a solid sludge suitable for disposal or reuse.	%
	81	Percentage of water samples in a year that comply with national	Number of water samples with in national potable water quality standards.	%

[12] Urban Agenda for the EU (2019). Urban mobility indicators for walking and public transport. Indicator C1. https://ec.europa.eu/futurium/en/system/files/ged/convenient-access-to-public-transport.pdf. Retrieved 7 August 2023.
[13] CORINE Land Cover (CLC) nomenclature: https://land.copernicus.eu/eagle/files/eagle-related-projects/pt_clc-conversion-to-fao-lccs3_dec2010. Retrieved 7 August 2023.

SO group	#	Indicator name	Indicator definition	Unit
		potable water quality standards		
	82	Urban population exposure to air pollution by particulate matter	The indicator shows the population-weighted concentration of PM10 and PM2.5 to which the urban population is potentially exposed.	Micrograms per cubic metre
	83	Levels of Particulate Matter (PM10 – mg/m3)	Particulate matter (PM10) comprises solid and liquid particles of less than 10 micrometres suspended in air.	µg/m3
	84	Levels of Particulate Matter (PM2.5 – mg/m3)	Particulate matter (PM2.5) comprises solid and liquid particles of less than 10 micrometres suspended in air.	µg/m3
Environmental impacts (global)	85	GHG emissions per year	The indicator measures annual emissions of the so-called “Kyoto basket” of greenhouse gases. The indicator should be calculated at city level and when relevant, for demonstration actions. Focus is on direct emissions.	Tonnes CO2-equivalents / year
	86	Annual CO_2 equivalent emissions per capita	The indicator measures annual emissions of the so called “Kyoto basket” of greenhouse gases per capita at city level.	Tonnes CO2-equivalents / capita / year
	87	Annual CO_2 emissions per unit of GDP	The indicator measures annual direct emissions of CO2 at city level per GDP at city level.	Tonnes CO2 / Monetary unit

6. Strategic Objectives vs. indicators

List of indicators evaluating progress towards the Strategic Objectives of Vision Element 1 (Local stakeholder actions)

SO group	SO #	Strategic Objective	Indicators supporting this Strategic Objective
Engagement and capacity building	1	Facilitation of repair and reuse platforms, and the secondary materials market	1: New material passports: Mass of materials given passport per year 2: New material passports: Description of passport 3: New tools for better mapping of resources and their location: For each tool, qualitative description.
	2	Increased capacity building on CE for public employees and other local stakeholders	4: CE-related knowledge building campaigns: For each campaign, specify type of groups reached and type of knowledge building campaign. 5: CE-related knowledge building campaigns: Number of campaigns, and for each campaign, number of people reached
	3	Increased collaboration with local and regional stakeholders in CE planning and implementation, and the promotion of regional upscaling	6: Circularity related stakeholder activities: Number of people involved, qualitative description of activity type and dialogue methods, which stakeholder groups and when in the process 7: New methods and technologies for stakeholder involvement: Number of methods, and for each a qualitative description of the method 8: New methods and technologies for stakeholder involvement: For each, a description of stakeholder groups involved, number of people impacted 9: Number of (and number of members in) new formal CE-based collaboration platforms/networks 10: How was input from stakeholders used to improve circularity (qualitative description)?
	4	Increased engagement with national and international policy makers and researchers on the CE	10: How was input from stakeholders used to improve circularity (qualitative description)?
	5	Increased provision of information on CE to local stakeholders	11: Number of (and number of people reached by) communication measures (campaign, provision of information, events for the public/companies) on circular transformations and waste prevention
Regulation and incentives	6	Improved regulatory framework to support circularity	2: New material passports: Description of passport 12: Number of circularity requirements in procurement beyond existing levels (tender or contract) including description of requirement 13: Progress towards circular procurement ambition set out in strategy / policy documents. Describe ambition and judge on scale: 1. no progress, 2. little progress, 3. some progress, 4. ambition nearly reached, 5. ambition reached or beyond.
	7	Increased use of economic incentives and fiscal measures to promote circularity as well as removal of subsidies hindering circularity	14: Financial institutions: percentage of investments under circular economy programmes

	8	Integration of circularity principles into public procurement and financing processes	12: Number of circularity requirements in procurement beyond existing levels (tender or contract) including description of requirement 13: Progress towards circular procurement ambition set out in strategy / policy documents. Describe ambition and judge on scale: 1. no progress, 2. little progress, 3. some progress, 4. ambition nearly reached, 5. ambition reached or beyond. 14: Financial institutions: percentage of investments under circular economy programmes 15: Value and number of procurements with circularity requirements beyond existing levels 16: Procurements making use of stakeholder dialogue to strengthen circularity: no. of procurement actions, and for each procurement action, qualitative description of dialogue (type, dialogue partners, when in the process) 17: Procurements making use of stakeholder dialogue to strengthen circularity: For each procurement action, value of procurement and mass of materials impacted 18: Number (and for each procurement action, a list) of CityLoops indicators that are used in procurement tenders and contracts.
Vision and urban management	9	Existence of city-wide strategy on CE with measurable objectives translated into targeted actions	19: Progress towards circular city strategy objectives. Describe ambition and judge on scale: 1. no progress, 2. little progress, 3. some progress, 4. ambition nearly reached, 5. ambition reached or beyond.
	10	Integration of circularity principles into asset management, including publicly owned land, buildings and infrastructure	3: New tools for better mapping of resources and their location: For each tool, qualitative description. 20: New tools for better mapping of resources and their location: For each tool, estimate impact in terms of amount of materials impacted or other relevant parameter per year 21: New planning instruments/tools for improved circularity: Qualitative description of each instrument/tool 22: New planning instruments/tools for improved circularity: For each instrument/tool: number of projects where tool was used / Total mass of materials that the tool has impacted on per year/ Recirculated mass of materials that the tool has impacted on per year
	11	Integration of circularity principles into urban planning decisions such as zoning and planning decisions, construction and demolition permits, and mobility planning	3: New tools for better mapping of resources and their location: For each tool, qualitative description. 20: New tools for better mapping of resources and their location: For each tool, estimate impact in terms of amount of materials impacted or other relevant parameter per year 21: New planning instruments/tools for improved circularity: Qualitative description of each instrument/tool 22: New planning instruments/tools for improved circularity: For each instrument/tool: number of projects where tool was used / Total mass of materials that the tool has impacted on per year/ Recirculated mass of materials that the tool has impacted on per year

List of indicators evaluating progress towards the Strategic Objectives of Vision Element 2 (Circular business models and behaviour patterns)

SO group	SO #	Strategic Objective	Indicators supporting this Strategic Objective
Circular design and business models	12	Increased asset lifetimes, including through flexible design and use	23: Eco-innovation: Number of new CE business models/cases. This includes a qualitative description of model, its circular strategy (material, component, product, function) 24: Eco-innovation: For each new CE business models/cases: its impact in terms of turnover and amount of material (potentially) impacted.
	13	Increased provision of local, sustainable, and healthy food	
	14	Increased rate of exploitation of assets (including equipment, machinery, buildings, infrastructure)	23: Eco-innovation: Number of new CE business models/cases. This includes a qualitative description of model, its circular strategy (material, component, product, function) 24: Eco-innovation: For each new CE business models/cases: its impact in terms of turnover and amount of material (potentially) impacted.
	15	Increased sustainable urban mobility options	25: Percentage of new cars that are zero-emission vehicles 26: Transport modal share in commuting (cars, motorcycles, taxi, bus, metro, tram, bicycle, pedestrian)
Circular value chains and infrastructure	16	Enhanced waste collection, treatment and processing systems, including increased on-site reuse and treatment of waste	27: Increased share of materials retained and reused on demonstration sites 28: Volume onsite sorting (Improved source separation)
	17	Increased cooperation among sectors	
	18	Increased use of repair and reuse platforms, and the secondary materials market	29: New material hotels: Mass of material stored in hotel 30: New digital material databank/marketplace: Description of tool, mass of material registered, mass and value of materials traded 31: New digital material databank/marketplace: Mass of material registered, mass and value of materials traded per year
	19	Localisation of supply chains	27: Increased share of materials retained and reused on demonstration sites 28: Volume onsite sorting (Improved source separation)
Private investments, jobs and	20	Increased gross value added of circular economy activities (repair, reuse, sharing, recycling)	23: Eco-innovation: Number of new CE business models/cases. This includes a qualitative description of model, its circular strategy (material, component, product, function) 24: Eco-innovation: For each new CE business models/cases: its impact in terms of turnover and amount of material (potentially) impacted. 32: Reduced costs due to improved circularity (e.g. transport, virgin material, waste treatment): Description of cost type and quantify saving

	21	Increased number of jobs in the local circular economy (repair, reuse, sharing, recycling, eco-design)	23: Eco-innovation: Number of new CE business models/cases. This includes a qualitative description of model, its circular strategy (material, component, product, function) 24: Eco-innovation: For each new CE business models/cases: its impact in terms of turnover and amount of material (potentially) impacted. 33: CE-based employment: Number of new CE related jobs and number of existing jobs becoming circular

List of indicators evaluating progress towards the Strategic Objectives of Vision Element 3 (Closing material loops and reducing harmful resource use).

SO group	SO #	Strategic Objective	Indicators supporting this Strategic Objective
Material/energy flow	22	Reduced (harmful) raw material consumption	34: Domestic material consumption (DMC)
	23	Reduced overall energy demand and increased share of renewable energy	36: Total energy demand 37: Share of renewable energy in total energy demand 38: Local biomass for energy generation
Re-use and recycling	24	Increased share of renewable and secondary raw materials in overall material demand	27: Increased share of materials retained and reused on demonstration sites 28: Volume onsite sorting (Improved source separation) 40: Share of renewable raw materials in domestic material consumption 41: Share of secondary materials in domestic material consumption
	25	Increased self-sufficiency / self-reliance	42: Share of local secondary materials in domestic material consumption 43: Import of materials 45: Export of waste materials to incineration 48: EU self-sufficiency for raw materials
	26	Increased quantity of materials available for the next cycle	27: Increased share of materials retained and reused on demonstration sites 28: Volume onsite sorting (Improved source separation) 49: Quantity of material subjected to reuse 50: Quantity of material subjected to repair 51: Quantity of material subjected to remanufacturing 52: Quantity of material subjected to recycling 53: Quantity of material for anaerobic digestion 55: EOL-RR (End of Life Recycling Rate). Specify the share of mass going to landfill, energy recovery, recycling, re-use 56: Quantity of material for composting
Waste generation/management	27	Reduced waste generation	55: EOL-RR (End of Life Recycling Rate). Specify the share of mass going to landfill, energy recovery, recycling, re-use 60: Incineration rates per material fractions 62: Landfilling rates per material fractions
	28	Reduced incineration and landfilling activities and amounts subjected	60: Incineration rates per material fractions 62: Landfilling rates per material fractions

List of indicators evaluating progress towards the Strategic Objectives of Vision Element 4 (Improving human well-being and reducing environmental impacts)

SO group	SO #	Strategic Objective	Indicators supporting this Strategic Objective
Well-being	29	Improved education	63: Percentage of school-aged population enrolled in school 64: Percentage of students completing secondary education
	30	Improved public health	65: Average life expectancy 66: Number of in-patient hospital beds per 100,000 population
	31	Improved recreational services	67: Open green space area ratio per 100,000 inhabitants 68: Share of green space areas within urban limits
	32	Improved access to basic services	69: Percentage of city population with potable water supply service 70: Percentage of city population with authorized electrical service 71: Percentage of city population with regular solid waste collection (residential) 72: Percentage of city population served by wastewater collection
	33	Reduced unemployment	33: CE-based employment: Number of new CE related jobs and number of existing jobs becoming circular 73: Unemployment rate
	34	Reduced poverty and inequality	74: AROP – at-risk-of-poverty rate for the total population 75: QSR – income quintile share ratio.
	35	Human-centred land-use and urban planning	76: Average commuting distance/time 77: Share of population having access to public transport within 15 minutes by foot 78: Percentage of urban development that occurs on existing urban land rather than on greenfield land
Environment impacts (local)	36	Biodiversity loss and deforestation	79: Percentage of city area protected as natural sites
	37	Improved water quality	80: Percentage of residential and commercial wastewater that is treated according to applicable national standards 81: Percentage of water samples in a year that comply with national potable water quality standards
	38	Improved air quality	82: Urban population exposure to air pollution by particulate matter 83: Levels of Particulate Matter (PM10 – mg/m3) 84: Levels of Particulate Matter (PM2.5 – mg/m3)
	39	Reduced soil degradation	56: Quantity of material for composting
Environment impacts (global)	40	Mitigate climate change	85: GHG emissions per year 86: Annual CO2 equivalent emissions per capita 87: Annual CO2 emissions per unit of GDP
	41	Reduce global adverse environmental impact of local consumption	
Economic	42	Transformed, sustainable local economy	
	43	Increased resilience of local economy	

Im-pact	44	Reduced risk of urban infrastructure against natural disasters	

CITYLOOPS

CityLoops is an EU-funded project focusing on construction and demolition waste (CDW), including soil, and organic waste (OW), where seven European cities are piloting solutions to be more circular.

Høje-Taastrup and Roskilde (Denmark), Mikkeli (Finland), Apeldoorn (the Netherlands), Bodø (Norway), Porto (Portugal) and Seville (Spain) are the seven cities implementing a series of demonstration actions on CDW and OW, and developing and testing over 30 new tools and processes.

Alongside these, a sector-wide circularity assessment and an urban circularity assessment are to be carried out in each of the cities. The former, to optimise the demonstration activities, whereas the latter to enable cities to effectively integrate circularity into planning and decision making. Another two key aspect of CityLoops are stakeholder engagement and circular procurement.

CityLoops runs from October 2019 until September 2023.

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