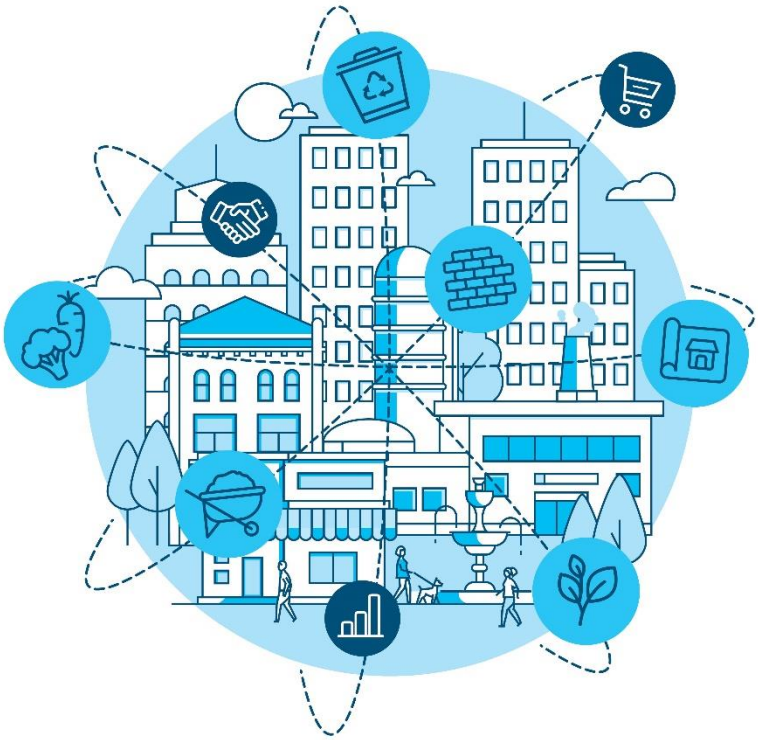
Evaluation Plan: CDW sector, Roskilde

Deliverable 6.2

Roskilde Municipality and Gate 21



Version	2.0
WP	6
Deliverable	6.2 (Evaluation Plan: Construction and Demolition Waste, Roskilde)
Date	18 February 2022
Dissemination level	Public
Deliverable lead	Gate 21
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Abstract	This report details how Roskilde Municipality will evaluate the impact of the CityLoops tools and demonstration activities aimed at improving the circularity of the Construction and Demolition Waste sector.
Keywords	Evaluation, Indicators, Roskilde Municipality, Construction and Demolition Waste
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1. Introduction

The objective of the CityLoops evaluation work is to ensure a comprehensive evaluation framework is established for all demonstration actions to assess their impact on sustainability and to assess the progress towards a more Circular Economy (CE).

This document will guide the practical evaluation work based on the evaluation framework and CE indicators presented in CityLoops Deliverable 6.1 Circular City Indicator Set (Vangelsten et al. 2021). The evaluation aims to cover all the four Vision Elements at the core of the CityLoops circular city definition from Vangelsten et al. (2021). Thus, the evaluation will monitor local level processes and behaviour aimed at improving circularity, impact in terms of more circular material flow and energy use as well as outcomes in terms of improvements on the environment and on human wellbeing. The evaluation will focus mainly on the demonstration actions but impacts at city scale are also included.

This Evaluation Plan presents a list of specific indicators to be monitored over the duration of the Demonstration phase of the CityLoops project (Month 18-44). It further details what data needs to be collected, who is responsible for doing this, how it will be done, and when. The overall responsibility of the development of the Evaluation Plan and its implementation lies with the Evaluation Manager appointed in Roskilde. The implementation of the Evaluation work will be documented in the Interim Evaluation Report to be submitted at Month 36 and the Final Evaluation Report to be submitted at Month 46.

Roskilde Municipality is located in the Greater Copenhagen Area in Denmark. The demonstration area in Roskilde is Musicon, a 200,000 m^2 former concrete factory and gravel pit, which Roskilde Municipality (RK) bought in 2003. The ambition is to create a new neighbourhood like no place else. No grand 'master plan' that locks the development of the area in a specific direction has ever been made. Instead, the different projects are created step-by-step in collaboration between citizens, developers, architects, cultural institutions, local businesses and the municipality, which means that Musicon is a dynamic site in constant movement and change. In Musicon, existing buildings are being refurbished or demolished and structures, construction materials and soil are being used in new constructions.

The Evaluation Plan for Roskilde Municipality will be presented in this report. In the CityLoops project Roskilde Municipality is focusing on the CDW sector. 3 demonstration actions and 6 different tools will be developed and tested during the CityLoops project in Roskilde Municipality. The demonstration actions and tools will focus on soil management and circular building projects.

1.1. Demolition of Hall 11/12 area, preserving the building structure and facilitating reuse of CDW

Short description

Hall 11/12 will be partly demolished and materials from the demolition will be incorporated into other construction projects. The function of hall 12 was and will remain a skate hall. Beams and pillars and the main steel structure of hall 12 will be preserved.
Pre-demolition screening and selective demolition will take place, keeping reusable elements in storage for reuse in new buildings and creating material passports documenting their quality and possible use. Furthermore, a virtual material bank will be created through design for disassembly using Building Information Modelling (BIM).
Circular soil strategies will be implemented in the project by minimising soil movement and facilitating reuse on site.
Tools tested: 1, 2, 8 and 9

Expected outcomes

- Improved mapping of CDW and soil resources in Hall 11/12. The use of tools in the demo project is expected to have a significant impact on recycling and reuse of CDW and soil.
- New working procedures for cooperation between planning, building and environmental departments and authorities in Roskilde Municipality as well as more user involvement leading to more and new potentials for circularity and sustainability.
- New business models for the valorisation of CDW and soil developed and validated. The focus of the business models is on keeping methods, working procedures, and use of materials simple.
- Increased number of CE jobs locally, through migration of costs, including a significant budget going to local craftsmen.
- Materials (structures and soil) retained on demonstration sites. At project's end: 25% of the total mass of building is retained on site. Soil: 5800 tons are retained on site.
- 25% of CDW from demo site is prepared for reuse or high-value recycling.
- Reduced emissions of CO2 related to extraction, processing, and transportation (incl. logistics) of construction (%). At project's end: CDW: 30% CO2 emission reduction. 11 tons of CO2 savings from minimizing excavating and moving soil, by achieving soil balance in the project area instead of normal procedure.

1.2. Construction of Parking Houses

Short description

Demo 2a: Construction of Parking House 1 'Indfaldet'. The concrete found in the ground will be kept on site and crushed into a mixed fraction. Design for disassembly.

Demo 2b: Construction of Parking House 2 'Pulsen'. The house will be built as a steel structure. Design for disassembly. Roskilde will create a physical construction material bank on the ground floor of P-house 2.
Tools tested: 1 and 9

Expected outcomes

- Improved mapping of soil resources in the construction of parking garages. The use of tools in the demo project is expected to have a significant impact on recycling and reuse of soil and to minimise the CO2 impact of the construction projects.
- New working procedures for cooperation between planning, building and environmental departments and authorities leading to more circularity. More user involvement leading to new potentials for circularity and sustainability through increased knowledge and social sustainability.
- Changed tendering procedures, shifting emphasis from lowest cost to a fixed cost and quality in the award criteria.
- New business models for reuse and valorisation of soil developed and validated with focus on soil balance for whole areas instead of individual plots.
- Soil retained on demonstration sites. Pulsen: 1,500 m3 of soil is expected to be kept on site.
- Reduced virgin gravel from multi-storey car park, Pulsen. The reduction is expected to amount to 1500 m3 of virgin gravel in comparison to normal procedure.
- Soil is reused and large uniform fractions of CDW are reused/recycled, e.g. concrete and roof tiles.
- Reduced emissions of CO2 related to extraction, processing, and transportation (incl. logistics) of construction (%). Indfaldet: CO2 savings from keeping soil on site in multi-storey car park Indfaldet is expected to be 6.7 tons of CO2e. Future CO2 saving potential is 326 tons for building the parking garage as design for disassembly. Pulsen: Target CO2 savings from keeping soil on site is 5-10 tons of CO2e.

1.3. Circular soil management (part of the other demo sites)

Short description

Tools which in the demonstration project shows operational and which give a positive impact on the soil balance inside the demonstration area will be part of a future Circular soil management at city level in order to keep excavation of soil to a minimum and use excess soil locally, instead of driving it further away. A template for soil strategy including the relevant tools is developed, for instance a tool predicting barriers against soil balance and an instrument for predicting how much soil will be excavated in the city.
Tools tested: 1, 2, 4, 5

Expected outcomes

- Strategic approach to circular soil management in the municipality. It is expected that the tools will be scaled and integrated in normal procedure in Roskilde and that the project managers using the tools have the adequate competence level to use to tools.
- Raised awareness of circular practices across our administration and amongst local citizens and businesses. Internal sustainability group will focus on increased communication, both internally and externally.

1.4. CityLoops Tools

Tools 1, 2, 4, 5, 8 and 9 tested in the demonstration actions:

CityLoops Tools	Description
1. LCA	LCA tool for building materials and soil. Estimates the potential CO2-savings of keeping soil or reuse/recycle building materials.
2. Screening procedure and selective demolition	Resource mapping with detailed screening for selective demolition. Guidelines for pre-demolition audit and selective demolition. Identifies materials with potential for reuse.
4. Instrument for predicting future excavated soil production	Predict annual volumes of future excavated soil within a period of 12 years (2020-2031). It will be evaluated by comparing predicted soil volumes with annual soil volumes reported for a period of 12 years.

5. Assessing soil reuse potential	Geotechnical drilling tests will show what kinds of soil are present on site, to identify the types of soil and the reuse potential for different purposes.
8. Databank and digital marketplace for recovered materials	The circular procurement strategy includes use of the virtual material bank to source and supply secondary construction materials. The data is extracted from BIM models and kept in a database.
9. Construction material passport and CDW materials databank	When designing for disassembly material passport and materials databank can be useful. Categorisation of materials from demolished buildings for reuse or recycling. For materials going out (from selective demolition) and in (in new projects)

2. Indicators to be monitored

16 indicators have been chosen to evaluate the three demonstration actions and the seven tools. The indicators represent both the different aspects of circular economy in the CityLoops project, and the different elements for a sustainable development where the environmentally, socially, and economically aspects also have to be considered. Furthermore, the indicators are chosen to represent the expected impacts from the project plan. The key impacts from the project plan includes scientific impacts, innovation/economic impacts, societal impacts, and environmental impacts. The indicators chosen in the evaluation plan can support a standardised documentation of the conductive elements with circular economy. The documentation can support replication of other CDW projects.

This chapter presents an overview of the indicators that will be monitored during the CityLoops Implementation Phase (see table below). The indicator selection has been made based on several criteria:

- Relevance to the city's circularity strategies and the Demonstration Actions and Tools: Each selected indicator will monitor and evaluate specific processes and impacts related to the Demonstration Action activities and/or the use of the Tools. Indicators may be monitored either at Demonstration Action scale or at City scale, or in some cases at both. For each evaluation scale, the indicator is paired with the expected outcome or target value listed in the table below. This will allow evaluation of the progress towards improved circularity and the effectiveness of the CityLoops Tools and Activities.
- Data availability and quality: Through dialogue with local stakeholders internally and externally to the CityLoops consortium, data availability, accessibility and quality has been mapped to ensure that the evaluation process for the selected indicators can be carried out in a practical and timely manner.
- Cross-City comparison and adherence to the Circular City definition: As part of the process of developing the Evaluation Plans continuous dialogue between the cities and the CityLoops partner coordinating the evaluation work has been carried out to ensure some overlap and consistency in the selection of indicator between cities to allow comparison where practical. This dialogue has also ensured that indicators are selected to monitor progress towards circularity in a broad sense covering as much as possible all four Vision Elements of the Circular City definition as described in Vangelsten et al. (2021).

Tables 1 to 4 list the selected indicators for each of the four Vision Elements in the CityLoops circular city definition (Vangelsten et al., 2021). The tables describe at which level the indicators will be applied (Demonstration Action or City level) and which Demonstration Actions they will evaluate.

Table 1: List of indicators related to Vision Element 1 "Local Stakeholder Actions"

Indicator #	Indicator name	Scope (Demo/City)	Demo action 1	Demo action 2	Demo action 3
3/20	New tools for better mapping of resources and their location: Qualitative description and Impact	D	X	X	X
9	New formal CE-based collaboration platforms/networks	C			
10	Stakeholder contribution to improved circularity	D	X	X	
12/15	Circularity requirements in procurement beyond existing levels: Qualitative and Impact	D		X	
19	Progress towards circular city strategy objectives	C			

Table 2: List of indicators related to Vision Element 2 "Circular business models and behaviour patterns".

Indicator #	Indicator name	Scope (Demo/City)	Demo action 1	Demo action 2	Demo action 3
23	Eco-innovation: Qualitative description[1]	D	X	X	
30/31	New digital material databank/market place: Qualitative description and impact	C			

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

33	CE-based employment	D	X		

Table 3: List of indicators related to Vision Element 3 "Closing material loops and reducing harmful resource use"

Indicator #	Indicator name	Scope (Demo/City)	Demo action 1	Demo action 2	Demo action 3
27	Increased share of materials retained and reused on demonstration sites	D	X	X	
34	Reduced use of virgin materials	D		X	
49/52	Quantity of material subjected to reuse or recycling	D	X	X	

Table 4: List of indicators related to Vision Element 4 "Improving human wellbeing and reducing environmental impacts"

Indicator #	Indicator name	Scope (Demo/City)	Demo action 1	Demo action 2	Demo action 3
85	GHG emissions per year	D	X	X	

Links between the selected indicators and the expected outcomes for the specific Demonstration Actions (and if relevant, application of tools outside the scope of the demonstration actions) are shown in the tables below.

Table 5: Linking expected outcomes to the selected indicators for Demonstration Action 1.

Vision Element	Expected outcome	Indicator
1 Local Stakeholder Actions	Improved mapping of CDW and soil resources in Hall 11/12. The use of tools in the demo project is expected to have a significant impact on recycling and reuse of CDW and soil.	3/20. New tools for better mapping of resources and their location: Qualitative description and impact
	New working procedures for cooperation between planning, building and environmental	10. Stakeholder contribution to improved circularity

Vision Element	Expected outcome	Indicator
	departments and authorities in Roskilde Municipality as well as more user involvement leading to more and new potentials for circularity and sustainability.	
2 Circular business models and behaviour patterns	New business models for the valorisation of CDW and soil developed and validated. The focus of the business models is on keeping methods, working procedures, and use of materials simple.	23. Eco-innovation: Qualitative description[2]
	Increased number of CE jobs locally, through migration of costs, including a significant budget going to local craftsmen.	33. CE-based employment
3 Closing material loops and reducing harmful resource use	Materials (structures and soil) retained on demonstration sites. At project's end: 25% of the total mass of building is retained on site Soil: 5800 tons are retained on site	27. Increased share of materials retained and reused on demonstration sites
	25% of CDW from demo site is prepared for reuse or high-value recycling	49/52. Quantity of material subjected to reuse or recycling
4 Improving human wellbeing and reducing environmental impacts	Reduced emissions of CO2 related to extraction, processing, and transportation (incl. logistics) of construction (%). At project's end: CDW: 30% CO2 emission reduction 11 tons of CO2 savings from minimizing excavating and moving soil, by achieving soil balance in the project area instead of normal procedure	85. GHG emissions per year

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

Table 6: Linking expected outcomes to the selected indicators for Demonstration Action 2.

Vision Element	Expected outcome	Indicator
1 Local Stakeholder Actions	Improved mapping of soil resources in the construction of parking garages. The use of tools in the demo project is expected to have a significant impact on recycling and reuse of soil and to minimise the CO2 impact of the construction projects.	3/20. New tools for better mapping of resources and their location: Qualitative description and impact
	New working procedures for cooperation between planning, building and environmental departments and authorities leading to more circularity. More user involvement leading to new potentials for circularity and sustainability through increased knowledge and social sustainability.	10. Stakeholder contribution to improved circularity
	Changed tendering procedures, shifting emphasis from lowest cost to a fixed cost and quality in the award criteria.	12/15. Circularity requirements in procurement beyond existing levels:
2 Circular business models and behaviour patterns	New business models for reuse and valorisation of soil developed and validated with focus on soil balance for whole areas instead of individual plots.	23. Eco-innovation: Qualitative description[3]
3 Closing material loops and reducing harmful resource use	Soil retained on demonstration sites. Pulsen: 1500 m3 of soil is expected to be kept on site.	27. Increased share of materials retained and reused on demonstration sites
	Reduced virgin gravel from multi-storey car park, Pulsen. The reduction is expected to	34. Reduced use of virgin materials

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

Vision Element	Expected outcome	Indicator
	amount to 1500 m3 of virgin gravel in comparison to normal procedure.	
	Soil is reused and large uniform fractions of CDW are reused/recycled, e.g. concrete and roof tiles.	49/52. Quantity of material subjected to reuse/recycling
4 Improving human wellbeing and reducing environmental impacts	Reduced emissions of CO2 related to extraction, processing, and transportation (incl. logistics) of construction (%). Indfaldet: CO2 savings from keeping soil on site in multi-storey car park Indfaldet is expected to be 6.7 tons of CO2e. Future CO2 saving potential is 326 tons for building the parking garage as design for disassembly. Pulsen: Target CO2 savings from keeping soil on site is 5-10 tons of CO2e.	85. GHG emissions per year

Table 7: Linking expected outcomes to the selected indicators for Demonstration Action 3.

Vision Element	Expected outcome	Indicator
1 Local Stakeholder Actions	Strategic approach to circular soil management in the municipality. It is expected that the tools will be scaled and integrated in normal procedure in Roskilde and that the project managers using the tools have the adequate competence level to use to tools.	3. New tools for better mapping of resources and their location: Qualitative description
	Raised awareness of circular practices across	19. Progress towards circular city strategy objectives

Vision Element	Expected outcome	Indicator
	our administration and amongst local citizens and businesses. Internal sustainability group will focus on increased communication, both internally and externally.	

Table 8: Linking expected outcomes to the selected indicators for City level.

Vision Element	Expected outcome	Indicator
1 Local Stakeholder Actions	Internal and external CE-based collaboration platforms/networks established: - Internal: A new environmental group is formed in the municipality focusing on implementing CE in the strategy of the city. The expected outcome from this group/network is to strengthen stakeholder engagement and create a better dialogue between the different departments in the municipality. - External: Scaling the results from the demo projects to other municipalities.	9. New formal CE-based collaboration platforms/networks
2 Circular business models and behaviour patterns	BIM Model will function as a digital material bank for new construction. In renovation projects, screenings will be used to map materials, and materials from the physical material bank will be a part of the digital databank.	30/31. New digital material databank/marketplace: Qualitative description and Impact

3. Plan for monitoring

The tables below detail the monitoring plan for each of the selected indicators. This will guide the CityLoops Evaluation work to be carried out and documented in the Interim Evaluation Report in Month 36 and the Final Evaluation Report in Month 46 of the project. The 16 metadata categories described for each of the selected indicators is based on the Circular City Indicator Set (Vangelsten et al. 2021). Metadata categories 1-5 and 7-8 are standard for all cities/waste streams whereas the others (6 and 9-16) vary from case to case and are therefore customized by each city to fit the scope and focus of their demonstration activities and the tools that they will test.

3.1. New tools for better mapping of resources and their location: Qualitative description

Metadata group	#	Metadata category	Fill in data for indicator		
Identi-fier	1	Indicator number	3		
	2	Indicator name	New tools for better mapping of resources and their location: Qualitative description		
Link to Circular City Definition	3	Vision Element	x	1. Local stakeholder actions	
				2. Circular business models and behavioural patterns	
				3. Closing material loops and reducing harmful resource use	
				4. Improving human well-being and reducing environmental impacts	
	4	Category	1	x	Engagement and capacity building
				x	Regulation and incentives
				x	Vision and urban management
			2		Circular design and business models
					Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3		Material/energy flow
					Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)
					Environment impacts (local)

			☐ Economic impacts ☐ Impacts on urban resilience
Indicator definition and description	5	Definition / Description of indicator	Qualitative description of individual tools, including scope and scale (e.g. demonstration vs city level), target users.
	6	Rationale	The tools that are being used/tested in the demonstration actions will help make the demo projects more circular. The mapping of resources and their location can help the municipality with planning, reuse/recycling and get an overview of the resources in the area. On demonstration level, the tools will be described in detail. On city level, the tools will be described in a more general manner. Indicator 3 is selected together with indicator 20. The expected outcome is that the six tools listed above will be used to improve mapping of CDW and soil resources in Roskilde municipality. It is expected that the tools will be scaled and integrated in normal procedure in Roskilde and that the project managers using the tools have the adequate competence level to use to tools. The use of tools in the demo projects is expected to have a significant impact on recycle and reuse of CDW and soil and minimise the CO2 impact of the construction projects.
	7	Methodology	Qualitative description + quantitative description (number of tools used)
	8	Unit	Qualitative data
Data	9	Baseline data / definition	Short qualitative and quantitative description of tools available before the CityLoops tools were developed.
	10	Data Sources / Relevant Databases	Roskilde Municipality will provide the qualitative and quantitative description needed for the tools. The qualitative description will focus on: 1. How the tools are integrated in normal procedure in Roskilde Municipality (procedure description). 2. How the tools are used by the project managers and assessment of capacity and knowledge to use the tools (interview). The quantitative description will focus on 1. How many of the tools are used (number)
	11	Overall accuracy	Reasonably accurate local level qualitative insights.
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City: Roskilde Municipality Demonstration actions: D1, D2 and D3
	14	Reference period	1.10.2019 – 30.9.2023, three times of monitoring (baseline, interim - M36/Sept22, final - M44/May23)
	15	SDG Reference	12

Other	16	Comments	Corresponds to the project plan: Impact 1, Indicator 1a. *Reduced consumption of virgin construction and organic materials.*

3.2. New formal CE-based collaboration platforms/networks

Metadata group	#	Metadata category	Fill in data for indicator		
Identi-fier	1	Indicator number	9		
	2	Indicator name	New formal CE-based collaboration platforms/networks		
Link to Circular City Definition	3	Vision Element	x	1. Local stakeholder actions	
				2. Circular business models and behavioural patterns	
				3. Closing material loops and reducing harmful resource use	
				4. Improving human well-being and reducing environmental impacts	
	4	Category	1	x	Engagement and capacity building
					Regulation and incentives
					Vision and urban management
			2		Circular design and business models
					Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3		Material/energy flow
					Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)
					Environment impacts (local)
					Economic impacts
					Impacts on urban resilience
Indicator definition and description	5	Definition / Description of indicator	# of CE-based collaboration platforms/networks # of members in CE-based collaboration platforms/networks		
	6	Rationale	It is important to know how the demo projects influence relevant stakeholders. Therefore, the indicator will be divided into internal and external CE-based collaboration platforms/networks. Internal: A new environmental group is formed in the municipality focusing on implementing CE in the strategy of the city. The expected outcome from this group/network is to strengthen stakeholder engagement and create a better dialogue between the		

			different departments in the municipality. External: Learning network with other municipalities in Denmark. The expected outcome of the network is to share know-how and experience by working with CE in the construction sector in municipalities with the objective of scaling the results from the demo actions.
	7	Methodology	a) Number of formalised CE-based collaboration platforms/networks b) Number of people in formalised CE-based collaboration platforms/networks and their position/department in the municipality
	8	Unit	Number of networks Number of people (position/department)
Data	9	Baseline data / definition	Baseline is 0 (only activities during the project are measured)
	10	Data Sources / Relevant Databases	The data needed for the internal CE-based collaboration platforms/network will be provided by Roskilde Municipality. The data needed for the external CE-based collaboration platforms/network will be provided by Gate 21. Participants lists, interviews with stakeholders, and lists of networking meetings will be used. Gate 21 provides a template for both.
	11	Overall accuracy	Reliable data
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	The reference area for the internal network is: City: Roskilde Municipality taking point of departure in city level The reference area for the external network is: Greater Copenhagen.
	14	Reference period	1.1.2021 – 30.9.2023, Data collected continuously (data will be filled in in the template after each meeting)
	15	SDG Reference	15
Other	16	Comments	Corresponds to the project plan: Impact 4, Indicator 4b. *Improved stakeholder collaboration in relation to CDW and soil reuse and recycling*

3.3. Stakeholder contribution to improved circularity

Metadata group	#	Metadata category	Fill in data for indicator		
Identi-fier	1	Indicator number	10		
	2	Indicator name	Stakeholder contribution to improved circularity		
Link to Circular City Definition	3	Vision Element	x		1. Local stakeholder actions
					2. Circular business models and behavioural patterns
					3. Closing material loops and reducing harmful resource use
					4. Improving human well-being and reducing environmental impacts
	4	Category	1	x	Engagement and capacity building
					Regulation and incentives
					Vision and urban management
			2		Circular design and business models
					Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3		Material/energy flow
					Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)
					Environment impacts (local)
					Economic impacts
					Impacts on urban resilience
Indicator definition and description	5	Definition / Description of indicator	Qualitative description of input from stakeholder activities and how it has contributed to improved circularity		
	6	Rationale	The dialogue and collaboration between the municipality and the stakeholders are strategically important for the city. Both the internal and external CE-related stakeholder activities contribute to know-how, knowledge sharing and an increased awareness of CE. Expected outcome: New local stakeholder partnerships and procedures. Improved stakeholder collaboration in relation to CDW and soil reuse and recycling. The indicator will be used in the same way with all the demonstration actions.		
	7	Methodology	a) List inputs from stakeholders		

			b) Describe how it has been used by those that invited the stakeholder activity c) Describe how it has contributed to improved circularity Both the internal and external stakeholder activities will incorporate interviews from the participants in the network. The focus will be on barriers and solutions. The information can be used as inspiration for other CE building projects.
	8	Unit	Qualitative data + potential quantitative impact data
Data	9	Baseline data / definition	Baseline is 0 (only activities during the project are measured)
	10	Data Sources / Relevant Databases	The data needed for the internal stakeholder contribution to improved circularity will be provided by Roskilde Municipality and RUC. The data needed for the external stakeholder contribution to improved circularity will be provided by Gate 21. The data will be based on interviews with stakeholders.
	11	Overall accuracy	Reasonably accurate local level qualitative insights
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	The reference areas for the internal network are: City: Roskilde Municipality taking point of departure in the demonstration actions: D1 and D2 The reference area for the external network is: Greater Copenhagen.
	14	Reference period	1.1.2021 – 30.9.2023, Data collected continuously
	15	SDG Reference	15
Other	16	Comments	Corresponds to the project plan: Impact 4, Indicator 4b. *Improved stakeholder collaboration in relation to CDW and soil reuse and recycling*

3.4. Circularity requirements in procurement beyond existing levels

Metadata group	#	Metadata category	Fill in data for indicator	
Identi-fier	1	Indicator number	12	
	2	Indicator name	Circularity requirements in procurement beyond existing levels	
Link to	3	Vision Element	x	1. Local stakeholder actions

					2. Circular business models and behavioural patterns
					3. Closing material loops and reducing harmful resource use
					4. Improving human well-being and reducing environmental impacts
	4	Category	1		Engagement and capacity building
				x	Regulation and incentives
					Vision and urban management
			2		Circular design and business models
					Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3		Material/energy flow
					Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)
					Environment impacts (local)
					Economic impacts
					Impacts on urban resilience
Indicator definition and description	5	Definition / Description of indicator	Description of requirements in procurements going beyond what is current standard practice		
	6	Rationale	Procurement requirements are important to increase circularity in public CDW projects. The requirements will be tested in the demonstration actions in Roskilde Municipality. The indicator will be used in the same way with all the demonstration actions. Indicator 12 is selected together with indicator 15.		
	7	Methodology	The methodology is a four-step approach: 1. Decide which procurements are relevant for analysis (e.g. demo action focused procurements only or a wider range of procurements). 2. Describe current standard practice in terms of CE requirements. 3. For each procurement case, describe additional requirements beyond standard practice. 4. In case of several relevant procurements, summarize relevant progress beyond existing levels.		
	8	Unit	Qualitative data + potential quantitative impact data		
Data	9	Baseline data / definition	The baseline data will be a description of the current circularity requirements. The data will be described with the same methodology as used in this indicator.		
	10	Data Sources / Relevant Databases	The data needed will be provided by Roskilde Municipality. Construction and demolition tenders and contracts will be used. Qualitative description from project manager (interview) supported by specific criteria tenders.		

	11	Overall accuracy	Reasonably accurate local level qualitative insights but not scalable data.
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	Demonstration actions: D2
	14	Reference period	1.1.2021 – 30.9.2023, three times of monitoring (baseline, interim - M36/Sept22, final - M44/May23)
	15	SDG Reference	12
Other	16	Comments	Corresponds to the project plan: Impact 4, Indicator 4a. *New Decision making guidelines and Circular procurement methods and guidelines*

3.5. Procurement with circularity requirements beyond existing levels: Impact

Metadata group	#	Metadata category	Fill in data for indicator		
Identi-fier	1	Indicator number	15		
	2	Indicator name	Procurement with circularity requirements beyond existing levels: Impact		
Link to Circular City Definition	3	Vision Element	x		1. Local stakeholder actions
					2. Circular business models and behavioural patterns
					3. Closing material loops and reducing harmful resource use
					4. Improving human well-being and reducing environmental impacts
	4	Category	1		Engagement and capacity building
				x	Regulation and incentives
					Vision and urban management
			2		Circular design and business models
					Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3		Material/energy flow
					Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)
					Environment impacts (local)

			☐ Economic impacts ☐ Impacts on urban resilience
Indicator definition and description	5	Definition / Description of indicator	# of procurements with circularity requirements Value of procurement with circularity requirements
	6	Rationale	Procurement requirements are important to increase circularity in public CDW projects. The requirements will be tested in the demonstration actions in Roskilde Municipality. The outcome of the increased CE in procurement requirements are listed above under demo actions. The indicator will be used in the same way with all the demonstration actions. Indicator 15 is selected together with indicator 12.
	7	Methodology	For each action: ● Type of procurement action ● Value of procurement For the whole period considered: ● Time period ● Number of procurement contracts ● Sum up the total value of these contracts
	8	Unit	Number of actions Monetary value of procurements
Data	9	Baseline data / definition	The baseline will be 0
	10	Data Sources / Relevant Databases	The data needed will be provided by Roskilde Municipality. Construction and demolition contracts and data from authorities will be used.
	11	Overall accuracy	Reliable data
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	Demonstration actions: D2
	14	Reference period	1.1.2021 – 30.9.2023, three times of monitoring (baseline, interim - M36/Sept22, final - M44/May23)
	15	SDG Reference	12
Other	16	Comments	Corresponds to the project plan: Impact 4, Indicator 4a. *New Decision making guidelines and Circular procurement methods and guidelines* Impact 3. *Value creation, Cost effectiveness and Cost savings*

3.6. Progress towards circular city strategy objectives

Metadata group	#	Metadata category	Fill in data for indicator		
Identi-fier	1	Indicator number	19		
	2	Indicator name	Progress towards circular city strategy objectives		
Link to Circular City Definition	3	Vision Element	x	1. Local stakeholder actions	
				2. Circular business models and behavioural patterns	
				3. Closing material loops and reducing harmful resource use	
				4. Improving human well-being and reducing environmental impacts	
	4	Category	1		Engagement and capacity building
					Regulation and incentives
				x	Vision and urban management
			2		Circular design and business models
					Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3		Material/energy flow
					Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)
					Environment impacts (local)
					Economic impacts
					Impacts on urban resilience
Indicator definition and description	5	Definition / Description of indicator	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.		
	6	Rationale	Roskilde Municipality will significantly contribute to the awareness of reuse and recycling. In 5 years, the circular procurement will be a standard in all projects and demand for reuse and recycling will be a central focus point. The municipality will be able to calculate the environmental effect of different CDW actions with the CityLoops tools. In 25 years, the effect of public circular procurement will have spread to all levels of the construction practice in the municipality and general construction practice will have changed.		
	7	Methodology	For each of the identified targets: Describe ambition and judge on scale 1. no progress, 2. little progress, 3. some progress, 4. ambition nearly reached, 5. ambition reached or beyond		
	8	Unit	Score on categorical scale (1-5)		

Data	9	Baseline data / definition	The baseline (2019) will be defined on the categorical scale used in this indicator.
	10	Data Sources / Relevant Databases	The data needed will be provided by Roskilde Municipality. The city's strategy documents, decisions and commitments on the promotion of CE will be used.
	11	Overall accuracy	Reasonably accurate local level qualitative insights.
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City: Roskilde Municipality
	14	Reference period	1.1.2021 – 30.9.2023, three times of monitoring (baseline, interim - M36/Sept22, final - M44/May23)
	15	SDG Reference	12
Other	16	Comments	The circular city strategy objectives from the project plan can be found in 'Key impacts of CityLoops aimed for in the years following the conclusion of the project'

3.7. New tools for better mapping of resources and their location: Impact

Metadata group	#	Metadata category	Fill in data for indicator		
Identi-fier	1	Indicator number	20		
	2	Indicator name	New tools for better mapping of resources and their location: Impact		
Link to Circular City Definition	3	Vision Element	x		1. Local stakeholder actions
					2. Circular business models and behavioural patterns
					3. Closing material loops and reducing harmful resource use
					4. Improving human well-being and reducing environmental impacts
	4	Category	1		Engagement and capacity building
					Regulation and incentives
				x	Vision and urban management
			2		Circular design and business models
					Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3		Material/energy flow
					Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)

				Environment impacts (local) Economic impacts Impacts on urban resilience
Indicator definition and description	5	Definition / Description of indicator	Describe impact of CityLoops tools described in indicator # 3 on material flows.	
	6	Rationale	The tools that are being used/tested in the demonstration actions will help make the projects more circular. The mapping of resources and their location can help the municipalities with planning, reuse/recycling and get an overview of the resources in the area. The expected outcome of the use of tools is listed above under demo actions. The indicator will be used in the same way with all the demonstration actions. Indicator 20 is selected together with indicator 3.	
	7	Methodology	For each tool (estimate) Volume of materials impacted per year	
	8	Unit	Tonnes / year	
Data	9	Baseline data / definition	The baseline will be 0 (no data and little experience)	
	10	Data Sources / Relevant Databases	The data needed will be provided by Roskilde Municipality. Reports from e.g. Golders and COWI will be used.	
	11	Overall accuracy	Reliable data	
Context	12	Sector coverage	CDW	
	13	Reference area / Spatial implementation scale	Demonstration actions: D1 and D2	
	14	Reference period	1.1.2021 – 30.9.2023, three times of monitoring (baseline, interim - M36/Sept22, final - M44/May23)	
	15	SDG Reference	12	
Other	16	Comments	Corresponds to the project plan: Impact 1, Indicator 1a. *Reduced consumption of virgin construction and organic materials.*	

3.8. Eco-innovation: Qualitative description

Metadata group	#	Metadata category	Fill in data for indicator

Identi-fier	1	Indicator number	23		
	2	Indicator name	Eco-innovation: Qualitative description		
Link to Circular City Definition	3	Vision Element			1. Local stakeholder actions
			x		2. Circular business models and behavioural patterns
					3. Closing material loops and reducing harmful resource use
					4. Improving human well-being and reducing environmental impacts
	4	Category	1		Engagement and capacity building
					Regulation and incentives
					Vision and urban management
			2	x	Circular design and business models
					Circular value chains and infrastructure
				x	Private investments, jobs and gross value added
			3		Material/energy flow
					Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)
					Environment impacts (local)
					Economic impacts
					Impacts on urban resilience
Indicator definition and description	5	Definition / Description of indicator	Describe the business model, including how it contributes to moving up the waste hierarchy		
	6	Rationale	Business cases for reuse, recycling, and valorisation of CDW are developed during the CityLoops project in Roskilde Municipality. Business models for building materials and soil will be developed and validated. The expected outcome is a business case on the demo actions. The indicator will be used in the same way with all the demonstration actions.		
	7	Methodology	For each model, a qualitative description of model, its circular strategy		
	8	Unit	Qualitative data		
Data	9	Baseline data / definition	Baseline is 0		
	10	Data Sources / Relevant Databases	The data needed will be provided by Roskilde Municipality and the Danish Association of Construction Clients. Interviews with stakeholders will be used.		
	11	Overall accuracy	Reasonably accurate local level qualitative insights		
Conte xt	12	Sector coverage	CDW		
	13	Reference area / Spatial	Demonstrations actions: D1 and D2		

		implementation scale	
	14	Reference period	Project period 1.1.2021 – 30.9.2023, baseline data (2019) and in the end of the project (2023).
	15	SDG Reference	
Other	16	Comments	Corresponds to the project plan: Impact 4, Indicator 4c. *New products, service concepts and business models relating to the reuse/recycling of the specific material flows addressed, leading to new business opportunities and job creatio*

3.9. Increased share of materials retained and reused on demonstration sites

Metadata group	#	Metadata category	Fill in data for indicator		
Identi-fier	1	Indicator number	27		
	2	Indicator name	Increased share of materials retained and reused on demonstration sites		
Link to Circular City Definition	3	Vision Element			1. Local stakeholder actions
			x		2. Circular business models and behavioural patterns
					3. Closing material loops and reducing harmful resource use
					4. Improving human well-being and reducing environmental impacts
	4	Category	1		Engagement and capacity building
					Regulation and incentives
					Vision and urban management
			2		Circular design and business models
				x	Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3		Material/energy flow
				x	Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)
					Environment impacts (local)
					Economic impacts
					Impacts on urban resilience
Indicator definition and	5	Definition / Description of indicator	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.		

	6	Rationale	Roskilde Municipality strives to increase reused/recycled materials in building projects. It is relevant to keep the materials and the soil on site, to reduce the CO2 emissions from both transportation and from consumption of virgin resources. The expected outcome is listed above under demo actions. The indicator will be used in the same way with all the demonstration actions.
	7	Methodology	For selected waste fractions and total mass of waste materials: Retained and reused mass of materials / total mass of (waste) materials at demonstration site
	8	Unit	Mass %
Data	9	Baseline data / definition	The mass % of retained and reused materials from similar projects previously done by Roskilde Municipality
	10	Data Sources / Relevant Databases	The data needed will be provided by Roskilde Municipality and other relevant organizations involved in the project. Data from BIM models will be used.
	11	Overall accuracy	Reliable data
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	Demonstration actions: D1 and D2
	14	Reference period	Evaluation period 1.10.2019 – 30.9.2023, three times of monitoring (baseline, interim - M36/Sept22, final - M44/May23)
	15	SDG Reference	
Other	16	Comments	Corresponds to the project plan: Impact 1, indicator 1e. *Materials retained on demonstration sites.*

3.10. New digital material databank / marketplace: Qualitative description

Metadata group	#	Metadata category	Fill in data for indicator	
Identi-fier	1	Indicator number	30	
	2	Indicator name	New digital material databank/marketplace: Qualitative description	
Link to Circular City Definition	3	Vision Element		1. Local stakeholder actions
			x	2. Circular business models and behavioural patterns
				3. Closing material loops and reducing harmful resource use
				4. Improving human well-being and reducing environmental impacts
	4	Category	1	Engagement and capacity building

					Regulation and incentives
					Vision and urban management
			2		Circular design and business models
				x	Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3		Material/energy flow
				x	Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)
					Environment impacts (local)
					Economic impacts
					Impacts on urban resilience
Indicator definition and description	5	Definition / Description of indicator	Description of the digital material databank/marketplace in term of objective, type, scope, stage of development, target/user groups and other aspects deemed relevant		
	6	Rationale	The digital material databank/marketplace is an important element in reusing and recycling more components from demolished buildings. The databank can support the circular procurement strategy in the municipalities. The expected outcome is a digital material databank in Roskilde. Indicator 30 is selected together with indicator 31		
	7	Methodology	Qualitative description		
	8	Unit	Qualitative data		
Data	9	Baseline data / definition	Qualitative description of how materials from demolished buildings were handled in term of objective, type, scope, target/user groups and other aspects deemed relevant in 2019 (same procedure as the definition describes)		
	10	Data Sources / Relevant Databases	The data needed will be provided by Roskilde Municipality. Project reports and previous strategies from the municipality will be used.		
	11	Overall accuracy	Accurate		
Context	12	Sector coverage	CDW		
	13	Reference area / Spatial implementation scale	City: Roskilde Municipality		
	14	Reference period	Evaluation period 1.11.2021 – 30.9.2023, in the end of the project		
	15	SDG Reference	12		
Other	16	Comments	Correspondence to the project plan: Indicator 4c. *Development of business cases and establishment of a materials Databank and market place to allow an effective assessment of the CE opportunities where waste is generated, facilitate traceability, and enable a trading system.*		

3.11. New digital material databank/marketplace: Impact

Metadata group	#	Metadata category	Fill in data for indicator		
Identi-fier	1	Indicator number	31		
	2	Indicator name	New digital material databank/marketplace: Impact		
Link to Circular City Definition	3	Vision Element			1. Local stakeholder actions
			x		2. Circular business models and behavioural patterns
					3. Closing material loops and reducing harmful resource use
					4. Improving human well-being and reducing environmental impacts
	4	Category	1		Engagement and capacity building
					Regulation and incentives
					Vision and urban management
			2		Circular design and business models
				x	Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3		Material/energy flow
				x	Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)
					Environment impacts (local)
					Economic impacts
					Impacts on urban resilience
Indicator definition and description	5	Definition / Description of indicator	The impact of the digital marketplace is assessed by estimating the mass and value of material registered and traded per time period.		
	6	Rationale	The digital material databank/marketplace is an important element in reusing and recycling more components from demolished buildings. The databank can support the circular procurement strategy in the municipalities. Indicator 31 is selected together with indicator 30		
	7	Methodology	Mass of materials registered per time period Mass of materials traded per time period Value of materials traded per time period Time period can be month or year		

			Total mass should be registered, and optionally key material fractions
	8	Unit	Tonnes / year Monetary value/time
Data	9	Baseline data / definition	Qualitative description of how materials from demolished buildings were handled in term of objective, type, scope, target/user groups and other aspects deemed relevant in 2019 (same procedure as described in the definition) No quantitative data available. Baseline will be 0.
	10	Data Sources / Relevant Databases	The data needed will be provided by Roskilde Municipality Data from the material databank/marketplace
	11	Overall accuracy	Reliable data
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City: Roskilde Municipality
	14	Reference period	Evaluation period 1.1.2021 – 30.9.2023, yearly
	15	SDG Reference	12
Other	16	Comments	Correspondence to the project plan: Indicator 4c. *Development of business cases and establishment of a materials Databank and market place to allow an effective assessment of the CE opportunities where waste is generated, facilitate traceability, and enable a trading system.*

3.12. CE-based employment

Metadata group	#	Metadata category	Fill in data for indicator		
Identi-fier	1	Indicator number	33		
	2	Indicator name	CE-based employment		
Link to Definition Circular City	3	Vision Element			1. Local stakeholder actions
			x		2. Circular business models and behavioural patterns
					3. Closing material loops and reducing harmful resource use
					4. Improving human well-being and reducing environmental impacts
	4	Category	1		Engagement and capacity building
					Regulation and incentives
					Vision and urban management
			2		Circular design and business models
					Circular value chains and infrastructure

				x	Private investments, jobs and gross value added
			3		Material/energy flow
					Re-use and recycling
					Waste generation/management
			4	x	Well-being
					Environment impacts (global)
					Environment impacts (local)
					Economic impacts
					Impacts on urban resilience
Indicator definition and description	5	Definition / Description of indicator	Assess the impact of demonstration actions or at sector/city level by estimating the increase in CE related jobs		
	6	Rationale	Creating CE related jobs is important for a social and economic sustainable development for Roskilde Municipality. The new business models in the demonstration actions creates new types of CE jobs. The indicator will be used in the same way with all the demonstration actions.		
	7	Methodology	For a selected time period (e.g. year, project period etc) estimate: # of new CE related jobs # of existing jobs becoming circular If deemed practical for the evaluation, jobs that have a range of responsibilities, of which some are related to circularity and some are not, can be assigned a "percentage of circularity". Using this principle, a change in the percentage can be assigned for existing jobs that become more circular.		
	8	Unit	Jobs		
Data	9	Baseline data / definition	CE related jobs in the beginning of the project (2019). The same methodology as used in this indicator will be used.		
	10	Data Sources / Relevant Databases	Statistics from Roskilde Municipality, personal communication and other relevant companies/organizations involved in the projects		
	11	Overall accuracy	Reliable data (number of jobs) Estimated data (percentage of circularity)		
Context	12	Sector coverage	CDW		
	13	Reference area / Spatial implementation scale	Demonstration actions: D1		
	14	Reference period	Project period 1.10.2019 – 30.9.2023, three times of monitoring (baseline, interim - M36/Sept22, final - M44/May23).		
	15	SDG Reference			
Other	16	Comments	Corresponds to the project plan: Impact 3, job creation. *New jobs in "disassembly" as opposed to demolition.*		

3.13. Reduced use of virgin materials

Metadata group	#	Metadata category	Fill in data for indicator		
Identifier	1	Indicator number	34		
	2	Indicator name	Reduced use of virgin materials		
Link to Circular City Definition	3	Vision Element		1. Local stakeholder actions	
				2. Circular business models and behavioural patterns	
			x	3. Closing material loops and reducing harmful resource use	
				4. Improving human well-being and reducing environmental impacts	
	4	Category	1		Engagement and capacity building
					Regulation and incentives
					Vision and urban management
			2		Circular design and business models
					Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3	x	Material/energy flow
					Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)
					Environment impacts (local)
					Economic impacts
					Impacts on urban resilience
Indicator definition and description	5	Definition / Description of indicator	Estimate the reduced use of virgin materials		
	6	Rationale	It is important to reduce (harmful) raw material consumption The expected outcome for the indicator is listed above under table 6		
	7	Methodology	Sum of reduced use of virgin materials		
	8	Unit	m3/tonnes		
Data	9	Baseline data / definition	The use of virgin materials from similar projects previously done by Roskilde Municipality		
	10	Data Sources / Relevant Databases	The data needed will be provided by Roskilde Municipality and other relevant organizations involved in the projects		
	11	Overall accuracy	Reliable with some estimation uncertainties.		
Context	12	Sector coverage	CDW		
	13	Reference area / Spatial	Demonstration action: D2		

		implementation scale	
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected three times (baseline, interim - M36/Sept22, final - M44/May23)
	15	SDG Reference	
Other	16	Comments	Corresponds to the project plan: Impact 2, Indicator 2a. *Increased recycling/reuse rate of CDW/soil and organic matter within the city boundaries.*

3.14. Quantity of material subjected to reuse

Metadata group	#	Metadata category	Fill in data for indicator		
Identi-fier	1	Indicator number	49		
	2	Indicator name	Quantity of material subjected to reuse		
Link to Circular City Definition	3	Vision Element			1. Local stakeholder actions
					2. Circular business models and behavioural patterns
			x		3. Closing material loops and reducing harmful resource use
					4. Improving human well-being and reducing environmental impacts
	4	Category	1		Engagement and capacity building
					Regulation and incentives
					Vision and urban management
			2		Circular design and business models
					Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3		Material/energy flow
				x	Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)
					Environment impacts (local)
					Economic impacts
					Impacts on urban resilience
Indicator definiti	5	Definition / Description of indicator	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.		

	6	Rationale	Reusing materials are important for a sustainable development for Roskilde Municipality. Several of the demonstration projects aim to promote reuse of demolition materials. The expected outcome is listed above under demo actions. The indicator is merged with indicator 52 and will be used in the same way with all the demonstration actions.
	7	Methodology	Sum up mass of each waste material category subjected to recycling. Data may come from contractors, statistical offices, waste management companies or the Sector Circularity Assessment Method. The aim is to develop a methodology to differentiate high-value and low value recycling. CDW is already recycled in Denmark but to a low value. The aim is to increase the level of high-value recycling.
	8	Unit	tonnes/year
Data	9	Baseline data / definition	The quantity of material subjected to reuse from similar projects previously done by Roskilde Municipality
	10	Data Sources / Relevant Databases	The data needed will be provided by Roskilde Municipality and other relevant organizations involved in the projects
	11	Overall accuracy	Reliable with some estimation uncertainties.
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	Demonstration action: D1 and D2
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected three times (baseline, interim - M36/Sept22, final - M44/May23)
	15	SDG Reference	12
Other	16	Comments	Corresponds to the project plan: Impact 2, Indicator 2a. *Increased recycling/reuse rate of CDW/soil and organic matter within the city boundaries.*

3.15. Quantity of material subjected to recycling

Metadata group	#	Metadata category	Fill in data for indicator

Identi-fier	1	Indicator number	52		
	2	Indicator name	Quantity of material subjected to recycling		
Link to Circular City Definition	3	Vision Element			1. Local stakeholder actions
					2. Circular business models and behavioural patterns
			x		3. Closing material loops and reducing harmful resource use
					4. Improving human well-being and reducing environmental impacts
	4	Category	1		Engagement and capacity building
					Regulation and incentives
					Vision and urban management
			2		Circular design and business models
					Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3		Material/energy flow
				x	Re-use and recycling
					Waste generation/management
			4		Well-being
					Environment impacts (global)
					Environment impacts (local)
					Economic impacts
					Impacts on urban resilience
Indicator definition and description	5	Definition / Description of indicator	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	Rationale	Recycled materials are important for a sustainable development for Roskilde Municipality. Several of the demonstration projects aim to promote recycling of demolition materials. The expected outcome is listed above under demo actions. The indicator is merged with indicator 49 and will be used in the same way with all the demonstration actions.		
	7	Methodology	Sum up mass of each waste material category subjected to recycling. Data may come from contractors, statistical offices, waste management companies or the Sector Circularity Assessment Method. The aim is to develop a methodology to differentiate high-value and low value recycling. CDW is already recycled in Denmark but to a low value. The aim is to increase the level of high-value recycling.		
	8	Unit	tonnes/year		
Data	9	Baseline data / definition	The quantity of material subjected to recycling from similar projects previously done by Roskilde Municipality		
	10	Data Sources / Relevant Databases	The data needed will be provided Roskilde Municipality and other relevant organizations involved in the projects.		
	11	Overall accuracy	Reliable with some estimation uncertainties.		

Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	Demonstration actions: D1 and D2
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected three times (baseline, interim - M36/Sept22, final - M44/May23)
	15	SDG Reference	12
Other	16	Comments	Corresponds to the project plan: Impact 2, Indicator 2a. *Increased recycling/reuse rate of CDW/soil and organic matter within the city boundaries.*

3.16. GHG emissions per year

Metadata group	#	Metadata category	Fill in data for indicator		
Identi-fier	1	Indicator number	85		
	2	Indicator name	GHG emissions per year		
Link to Circular City Definition	3	Vision Element			1. Local stakeholder actions
					2. Circular business models and behavioural patterns
					3. Closing material loops and reducing harmful resource use
			x		4. Improving human well-being and reducing environmental impacts
	4	Category	1		Engagement and capacity building
					Regulation and incentives
					Vision and urban management
			2		Circular design and business models
					Circular value chains and infrastructure
					Private investments, jobs and gross value added
			3		Material/energy flow
					Re-use and recycling
					Waste generation/management
			4		Well-being
				x	Environment impacts (global)
					Environment impacts (local)
					Economic impacts
					Impacts on urban resilience
Indicator definiti	5	Definition / Description of indicator	The indicator measures annual emissions of the so called 'Kyoto basket' of greenhouse gases. The indicator is calculated for demonstration actions. Focus is on direct emissions.		

	6	Rationale	All the actions in the CityLoops project aim to have an impact on the reduction of GHG. Roskilde Municipality is part of 'DK2020', a partnership between Danish municipalities, that aims to develop climate action plans in line with the Paris Agreement and C40 framework. The reduction of GHG is an important element in this strategy. The expected outcome is listed above under demo actions. The indicator will be used in the same way with all the demonstration actions.
	7	Methodology	Direct GHG emissions per demo-project
	8	Unit	Tonnes CO2-equivalents / year
Data	9	Baseline data / definition	Demonstration level: Baseline 0
	10	Data Sources / Relevant Databases	Statistics from Roskilde Municipality. The green account, scope 3 and the CO2-calculator tools will be used.
	11	Overall accuracy	Medium accuracy, estimated
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	Demonstration actions: D1 and D2
	14	Reference period	1.10.2019 – 30.9.2023, yearly (or per demonstration case)
	15	SDG Reference	
Other	16	Comments	Corresponds to the project plan: Impact 1, Indicator 1c. *Reduced emissions of CO2, NOx and PM related to extraction, processing and transportation (incl. logistics) of construction and organic materials.*

4. References

Vangelsten, B.V., Bjarne Lindeløv, Nhien Nguyen, Jens Ørding Hansen, Are Jensen, Nikolai Jacobi, Simon Clement, Carolin Bellstedt, Aristide Athanassiadis, Pernille Kern Kernel, Edwin Keijsers (2021). Circular City Indicator Set. CityLoops Deliverable 6.1. 2021.

5. Annex 1: CityLoops impacts as listed in the Grant Agreement

Scientific impacts

- Sector and City-Wide Material Flow and Stock Accounting Methodology
- Development of an open-source urban metabolism data repository
- Circular Procurement tools and indicators
- Operationalisation of EC circular economy monitoring framework to small and medium cities
- IT decision making support tools
- Planning and decision-making framework for reuse and recycling of CDW

Innovation/economic impacts

- Increased CE jobs potential in demonstration and replication cities
- New innovative CE related procurement partnerships and dialogues in demonstration and replication cities
- Growth in green economy (e.g. increase in reuse / recycling infrastructure capacity)
- Business cases for valorisation of CDW and soil
- Increased use of new decision-making support tools to improve circular management practices
- Optimised and new links between the social economy and other sectors, promoting circularity (e.g. links between food distribution sector and the social economy sector decreasing food waste production)

Societal impacts

- Sustained community benefits including skills, training and green jobs
- Improved Well Being (e.g. QoL indicators)
- Provision of food support to economically disadvantaged families in the social economy sector
- New jobs for currently unemployed people due to development of CE

Environmental impacts

- Increased reuse and recycling of CDW and soil resulting in reduced energy consumption, improved resource efficiency, reduced heavy-duty transport
- Recycling of OW
- Reduced landfill

- Reduced greenhouse gas emissions

6. Annex 2: Strategic objectives defined in D6.1

Vision element 1 “local stakeholder actions”: strategic objectives

- Facilitation of repair and reuse platforms, and the secondary materials market
- Increased capacity building on CE for public employees and other local stakeholders
- Increased collaboration with local and regional stakeholders in CE planning and implementation, and the promotion of regional upscaling
- Increased engagement with national and international policy makers and researchers on the CE
- Increased provision of information on CE to local stakeholders
- Improved regulatory framework to support circularity
- Increased use of economic incentives and fiscal measures to promote circularity as well as removal of subsidies hindering circularity
- Integration of circularity principles into public procurement and financing processes
- Existence of city-wide strategy on CE with measurable objectives translated into targeted actions
- Integration of circularity principles into asset management, including publicly owned land, buildings and infrastructure
- Integration of circularity principles into urban planning decisions such as zoning and planning decisions, construction and demolition permits, and mobility planning

Vision element 2 “circular business models and behaviour patterns”: strategic objectives

- Increased asset lifetimes, including through flexible design and use
- Increased provision of local, sustainable and healthy food
- Increased rate of exploitation of assets (including equipment, machinery, buildings, infrastructure)
- Increased sustainable urban mobility options
- Enhanced waste collection, treatment and processing systems, including increased on-site reuse and treatment of waste
- Increased cooperation among sectors
- Increased use of repair and reuse platforms, and the secondary materials market
- Localisation of supply chains

- Increased gross value added of circular economy activities (repair, reuse, sharing, recycling)
- Increased number of jobs in the local circular economy (repair, reuse, sharing, recycling, ecodesign)

Vision element 3 “closing material loops and reducing harmful resource use”: strategic objectives

- Reduced (harmful) raw material consumption
- Reduced overall energy demand and increased share of renewable energy
- Increased share of renewable and secondary raw materials in overall material demand
- Increased self-sufficiency / self-reliance
- Increased quantity of materials available for the next cycle
- Reduced waste generation
- Reduced incineration and landfilling activities and amounts subjected

Vision element 4 “improving human wellbeing and reducing environmental impacts”: strategic objectives

- Improved education
- Improved public health
- Improved recreational services
- Improved access to basic services
- Reduced unemployment
- Reduced poverty and inequality
- Human-centred land-use and urban planning
- Biodiversity loss and deforestation
- Improved water quality
- Improved air quality
- Reduced soil degradation
- Mitigate climate change
- Reduce global adverse environmental impact of local consumption
- Transformed, sustainable local economy
- Increased resilience of local economy
- 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.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 821033.

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