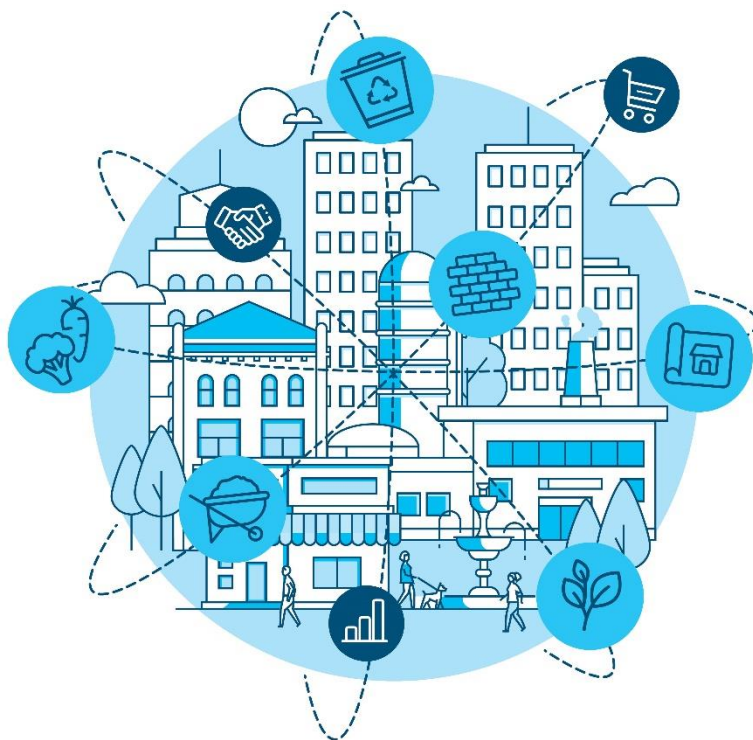





# Evaluation Plan: CDW and Biowaste sectors, Mikkeli

## Deliverable 6.2

Xamk and Miksei



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Abstract	This report details how the city of Mikkeli will evaluate the impact of the CityLoops tools and demonstration activities aimed at improving the circularity of the Construction and Demolition Waste and Biowaste sector.
Keywords	Evaluation, Indicators, City of Mikkeli, Construction and Demolition Waste, Biowaste
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# 1. Evaluation plan for CDW

## 1.1. Introduction (CDW)

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 both on the demonstration actions and on impacts at city scale.

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 each city. 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.

Mikkeli is a city located in eastern Finland, South-Savo Region, on the shores of the fourth largest lake in Europe, Lake Saimaa. Mikkeli has a population of 52,583 (2020) and covers an area of 3,229.57 km<sup>2</sup> of which 681.11 km<sup>2</sup> is water. Mikkeli has been involved in municipal climate work since the 1990s and has been part of the climate network since 1997. Finland's goal is to be carbon neutral by 2035 and Mikkeli will achieve carbon neutrality by 2030 at the latest. An important aspect of holistic development related to climate, environment and natural resources is the transition from waste management to a circular economy. The Finnish Waste Act, which will be reformed in 2021, is also based on this thinking. The priority is to use materials efficiently, avoid waste generation and utilize material flows in a way that makes sense for the whole. In 2020, Mikkeli adopted the Declaration of European Circular Economy Cities. In it, the city is committed to developing and promoting the circular economy and raising awareness.

Regarding construction and demolition waste (CDW), Mikkeli recycles 85% of the 33,000 tonnes of CDW it produces per year, using the recycled material mostly for road- and landfilling. Through CityLoops, it aims to substantially improve the rate of CDW reuse and recycling in the City of Mikkeli and create new business opportunities for local companies.

## 1.1.1. Demonstration action: Circular demolition of 2 buildings

Mikkeli's demonstration involves the demolition of two public buildings using circular material management methods, including digital tools: Pankalampi Health Care Centre (Figure 1) and Tuukkala hospital (Figure 2). In the preparation phase, Mikkeli Development Miksei Ltd and South-Eastern Finland University of Applied Sciences (XAMK) have engaged relevant stakeholders such as the municipality, the operations centre responsible for public equipment, and the public waste management company (Metsäsairila Ltd). To carry out the demolitions with circular material management, the sites will be scanned, and a pre-demolition audit will identify potentially recoverable materials and their characteristics. After a selective demolition procedure, salvaged materials will be incorporated into the digital databank and construction material marketplace. Miksei Mikkeli will promote use of the marketplace by other construction sector actors, private and public, both to offer and to obtain secondary construction materials. After evaluation of the pilot demolitions, the learnings and experience will be incorporated into a circular demolition operations model and generic demolition contract that can be applied in further public projects.



Figure 1. Demonstration building Pankalampi Health Center. (Photo Esa Hannus)



Figure 2. Demonstration building Tuukkala Hospital (Photo Esa Hannus)

CityLoops tools/processes tested during the demonstration action:

- *Life Cycle Assessment for demolition and renovated sites or assessment of environmental impacts of the CDW from the demonstration objects*: The methodology for a life cycle comparison of demolition and renovation sites developed by HTK/RK is tested in the demonstration sites.
- *Pre-demolition screening procedure & selective demolition guidelines*: A Pre-demolition inspection and operations model developed together with HTK/RK and Apeldoorn is tested in demonstration sites. The tool cover instructions and guidelines for resource mapping (pre-demolition audit), selective demolition and transformation to building materials. During demonstration actions, sampling and analysis will be performed in order to monitor environmental and health effects.
- *3D-modelling tool for tracking the flows of on-site CDW*: A model for drone imaging will be developed for the use on demolition sites to track material flows. Tool will be tested on the demonstration sites. This will allow the documentation and modelling of material flows during the demonstrations to help track and estimate the quantities of different material already on site.

- *Databank and digital market-place for recovered materials*: Two connected online platforms will be created. A materials databank will provide information on the quantities of different materials available on the demolition sites. This will allow an effective assessment of the Circular Economy opportunities where waste is generated and will serve as a tool for traceability. An online digital marketplace has been established and will be tested in the demo sites. It will enable the recycling of CDW and materials, services, logistics and workforce.

### **Expected outcomes**

The CityLoops project promotes both theory and practice of CE in European cities. Key impacts of the project as listed in the Grant Agreement are presented in Annex 1. The following city specific impacts listed for Mikkeli in the CityLoops project are related to this demonstration action (Circular demolition of 2 buildings).

- At the end of the project, several new local stakeholder partnerships and procedures with authorities and waste management and construction companies related to demonstration actions (3 stakeholder groups, 30 participating workshops/events/round tables, interviews, meetings, workshops)
- At the end of the project, the skills and knowledge of the citizens and companies in CDW sector (both in Mikkeli and national level) have increased as a result of several new/innovative/strengthened stakeholder engagement tools/procedures related to demonstration actions (webinars, press releases, media articles, newsletter, replication, national meetings).
- The circular economy has been taken into account in the procurement process for demo projects and the tender includes circular economy requirements.
- New planning instrument/tools have been tested in the City of Mikkeli for decision making and monitoring of demonstration projects. Identifying procurement tool for special characteristics in a tender has been updated based on the demo projects.
- Selective demolition has been used in demonstration cases. Over 95% of CDW is sorted onsite for recycling and material or energy recovery.
- Digital marketplace for secondary materials established and in use.
- At the end of the demonstration action, we expect a 10% increase in the cost effectiveness in the demolition of buildings (demolition, transport and treatment of CDW) as compared to the baseline values for similar demolition projects.
- At the end of the demonstration action several items (materials/equipment) have been prepared for reuse.
- At the end of the demonstration action, 5% of materials are retained and reused on demonstration sites.



### 1.1.2. City-wide application of tool A: Planning & Decision-Making Guidelines

A set of generic guidelines (e.g. procurement guidelines) is developed for incorporating circularity systemically in planning and decision-making processes for construction and demolition projects.

Miksei Mikkeli aims to have CityLoops planning and decision-making guidelines become part of a stable decision-making process with good buy-in from city-companies and city departments involved. Miksei Mikkeli will implement and test the guidelines before, during and after the demolition of the two buildings, including through workshops with stakeholders who impact the local building material and demolition value chain. Following the pilot demolitions, Miksei Mikkeli will consider application of the guidelines in other areas of the internal organisation and seek out the opportunity to apply them in other public construction and demolition projects of the city.

#### **Expected outcomes**

The following city-specific impacts listed for Mikkeli in the CityLoops project are related to this city-level application of planning and decision-making guidelines:

- 100% of the procurement of demolition projects in Mikkeli will include the new guidelines for screening and selective demolition, making these an essential part of the procurement processes within the City of Mikkeli.
- The City of Mikkeli wants to be a nationally well-known "Circular Economy City" and operates according to the CE closed loops principles. Circular economy is incorporated in new city-wide strategic objectives.
- At the end of the project, use of CDW (especially crushed concrete) to replace virgin construction materials (soil) have been increased as a result of new guidelines in planning and decision making. As a result, consumption of virgin construction materials within the city of Mikkeli has decreased by 5%.
- At the end of the project, 5% reduction in the emissions of CO<sub>2</sub> related to extraction, processing and transportation (incl. logistics) of construction materials (replacement of virgin soil material with crushed concrete).

### 1.1.3. City-wide application of tool B: Business Cases

Business cases for reuse, recycling and valorization of CDW are developed.

To explore the potential business case for scaling up circular CDW management practices, Miksei Mikkeli and XAMK are holding innovation workshops with stakeholders including the City of Mikkeli, local waste management company and the operational centre responsible for public equipment at least once per month during the preparation and implementation phase of the demonstrations.

One focus on business cases is to collect and analyse data in order to calculate a feasible, scalable model based on experience in the demonstrations. This involves active efforts from Miksei Mikkeli to encourage users (both supply and demand) of the digital material marketplace and find buyers for the salvaged building parts and equipment.

### **Expected outcomes**

Business case development aims to promote circular economy of construction and demolition waste and increase the reuse and recycling of materials. The following impacts listed for Mikkeli in the CityLoops project are specific for city-wide application of tool B (business cases):

- New products, service concepts and business models relating to the reuse/recycling and upcycling of the specific material flows addressed, leading to new business opportunities.
- At the end of the project, the project activities are a component of creating a greener environment and providing a more sustainable economy in the city of Mikkeli (new jobs: 20 – all external).
- At the end of the project, the recycling rate of CDW is close to 75% (CDW prepared for recycling and other material recovery, including backfilling) (95% if energy recovery included). 10% increase in recycling rate and 40% increase in upcycled amount of CDW as compared to baseline statistics from year 2019.
- At the end of the project, 5% reduction in the amount of CDW landfilled or incinerated as compared to the baseline statistics from year 2019.

## **1.2. Indicators to be monitored (CDW)**

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 specific processes and impacts related to the Demonstration Action activities and the application of CityLoops tools and serve to evaluate against the expected outcomes of the action. 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 and impact of demonstration- and city-wide actions towards improved circularity as well as the effectiveness of activities and tools.

- 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 (Annex 2) and the CityLoops project plans (Annex 1): 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).

Table 1 to Table 4 lists 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 (and if relevant, application of CityLoops tools outside the Demonstration Actions) they will evaluate.

A total of 21 indicators were selected from the CityLoops indicator set to monitor CDW. These indicators describe the aims and actions of the CityLoops project to promote circular economy related to construction and demolition waste streams in the City of Mikkeli. Most of selected indicators measure the impact of the project activities on demonstration sites Pankalampi and Tuukkala. Some of the indicators measure the development of the circular economy at the city level. For example, business cases are developed at the city level. City-level effects can also be measured with the statistics of waste management company. In Mikkeli, all the activities increasing circularity of CDW are developed and demonstrated in close collaboration with local and national stakeholders.

*Table 1: List of indicators related to Vision Element 1 “Local Stakeholder Actions”. Demo action 1a: Demolition of Pankalampi health center. Demo 1b: Demolition of Tuukkala hospital. Tool application A. Guidelines for planning and decision-making, Tool application B. Business case development.*

Indicator #	Indicator name	Scope (Demo/ City)	Demo action	Tool app A	Tool app B
6	Circularity related stakeholder activities	D	X		
11	Communication measures on circular transformations and waste prevention	D	X		
12	Circularity requirements in procurement beyond existing levels	D	X	X	

15	Procurement with circularity requirements beyond existing levels: Impact	D	X	X	
19	Progress towards circular city strategy objectives	C		X	
21	New planning instruments/tools for improved circularity: Qualitative description	D or C	X	X	
22	New planning instruments/tools for improved circularity: Impact	D or C	X	X	

*Table 2: List of indicators related to Vision Element 2 “Circular business models and behaviour patterns”. Demo action 1a: Demolition of Pankalampi health center. Demo 1b: Demolition of Tuukkala hospital. Tool application A. Guidelines for planning and decision-making, Tool application B. Business case development.*

Indicator #	Indicator name	Scope (Demo/ City)	Demo action	Tool app A	Tool app B
23	Eco-innovation: Qualitative description	C			X
24	Eco-innovation: Impact	C			X
27	Increased share of materials retained and reused on demonstration sites	D	X		
28	Volume onsite sorting (Improved source separation)	D	X		
30	New digital material databank/marketplace: Qualitative description	D	X		
31	New digital material databank/marketplace: Impact	D	X		
32	Reduced costs due to improved circularity	D	X		
33	CE-based employment	C			X

*Table 3: List of indicators related to Vision Element 3 “Closing material loops and reducing harmful resource use”. Demo action 1a: Demolition of Pankalampi health center. Demo 1b: Demolition of Tuukkala hospital. Tool application A. Guidelines for planning and decision-making, Tool application B. Business case development.*

Indicator #	Indicator name	Scope (Demo/ City)	Demo action	Tool app A	Tool app B
35	Domestic material consumption (DMC) of virgin materials	C		X	
49	Quantity of material subjected to reuse	D	X		
55	EOL-RR (End of Life Recycling Rate)	D and C			X
59	Incineration rate	D and C			X
61	Landfilling rate	D and C			X

*Table 4: List of indicators related to Vision Element 4 “Improving human wellbeing and reducing environmental impacts”. Demo action 1a: Demolition of Pankalampi health center. Demo 1b: Demolition of Tuukkala hospital. Tool application A. Guidelines for planning and decision-making, Tool application B. Business case development.*

Indicator #	Indicator name	Scope (Demo/ City)	Demo action	Tool app A	Tool app B
85	GHG emissions per year	C/D		X	

Links between the selected indicators and the expected outcomes for the specific Demonstration Actions and 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 (Circular demolition of 2 buildings).*

Vision Element	Expected outcome	Indicator
<b>1 Local Stakeholder Actions</b>	By the end of the project, several new local stakeholder partnerships and procedures with authorities and waste management and construction companies established related to demo actions (3 stakeholder groups, 30 participating workshops/events/round tables, interviews, meetings, workshops)	6. Circularity related stakeholder activities
	By the end of the project, the skills and knowledge of the citizens and companies in CDW sector (both in Mikkeli and national level) have increased as a result of several new/innovative/strengthened stakeholder engagement tools/procedures related to demo actions (webinars, press releases, media articles, newsletter, replication, national meetings)	11. Communication measures on circular transformations and waste prevention
	The circular economy has been taken into account in the procurement process for demo projects and the tender includes circular economy requirements	12. Circularity requirements in procurement beyond existing levels 15. Procurement with circularity requirements beyond existing levels: Impact
	New planning instrument/tools have been tested in the City of Mikkeli for decision making and monitoring of demonstration projects. Identifying procurement tool for special characteristics in a tender has been updated based on the demo projects.	21. New planning instruments/tools for improved circularity: Qualitative description 22. New planning instruments/tools for improved circularity: Impact
<b>2 Circular business models and behaviour patterns</b>	At the end of the demonstration action, 5% of materials are retained and reused on demonstration sites.	27. Increased share of materials retained and reused on demonstration sites
	Selective demolition has been used in demonstration cases. Over 95%	28. Volume onsite sorting (Improved source separation)

Vision Element	Expected outcome	Indicator
	of CDW is sorted onsite for recycling and material or energy recovery.	
	Digital marketplace for secondary materials established and in use.	30. New digital material databank/marketplace: Qualitative description 31. New digital material databank/marketplace: Impact
	By the end of the demo action, a 10% increase in the cost effectiveness in the demolition of buildings (demolition, transport and treatment of CDW) compared to the baseline values for similar demolition projects	32. Reduced costs due to improved circularity
<b>3 Closing material loops and reducing harmful resource use</b>	At the end of the demonstration action several items (materials/equipment) have been prepared for reuse	49. Quantity of material subjected to reuse

Table 6. Linking expected outcomes to the selected indicators for city-wide application of Tool A: Planning & Decision-making guidelines

Vision Element	Expected outcome	Indicator
<b>1 Local Stakeholder Actions</b>	100% of the procurement of demolition projects include the new guidelines for screening and selective demolition, making these an essential part of the procurement processes within the City of Mikkeli.	12. Circularity requirements in procurement beyond existing levels 15. Procurement with circularity requirements beyond existing levels: Impact 21. New planning instruments/tools for improved circularity: Qualitative description 22. New planning instruments/tools for improved circularity: Impact
	The City of Mikkeli is well known as "Circular Economy City" and operates according to the CE closed loops principles. Circular economy is incorporated in new strategic objectives.	19. Progress towards circular city strategy objectives (City-level)

Vision Element	Expected outcome	Indicator
<b>3 Closing material loops and reducing harmful resource use</b>	At the end of the project, use of CDW (especially crushed concrete) to replace virgin construction materials (soil) has increased as a result of new guidelines in planning and decision making. 5% reduction in consumption of virgin construction materials within the city of Mikkeli.	35. Domestic material consumption (DMC) of virgin materials
<b>4 Improving human wellbeing and reducing environmental impacts</b>	By the end of the project, 5% reduction in the emissions of CO2 related to extraction, processing and transportation (incl. logistics) of construction materials (replacement of virgin soil material with crushed concrete).	85. GHG emissions per year (demo-level)

Table 7. Linking expected outcomes to the selected indicators for city-wide application of Tool B: Business cases

Vision Element	Expected outcome	Indicator
<b>2 Circular business models and behaviour patterns</b>	New products, service concepts and business models relating to the reuse/recycling and upcycling of the specific material flows established, leading to new business opportunities.	23. Eco-innovation: Qualitative description (City-level) 24. Eco-innovation: Impact (City-level)
	At the end of the project, the project activities are a component of creating a greener environment and providing a more sustainable economy in the city of Mikkeli (new jobs: 20 – all external).	33. CE-based employment (City-level)
<b>3 Closing material loops and reducing harmful resource use</b>	At the end of the project, the recycling rate of CDW is close to 75% (CDW prepared for recycling and other material recovery, including backfilling) (95% if energy recovery included). 10% increase in recycling rate and 40% increase in upcycled amount of CDW as compared to baseline statistics from year 2019.	55. EOL-RR (End of Life Recycling Rate) (city-level)
	At the end of the project, 5% reduction in the amount of CDW	59. Incineration rate (city-level) 61. Landfilling rate (city-level)

Vision Element	Expected outcome	Indicator
	landfilled or incinerated as compared to the baseline statistics from year 2019.	

## 1.3. Plan for monitoring CDW

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.

### 1.3.1. Circularity related stakeholder activities

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	6
	2	Indicator name	Circularity related stakeholder activities
Link to	3	Vision Element	1. Local stakeholder actions
	4	Category	Engagement and capacity building
Indicator definition and description	5	Definition / Description of indicator	Description of activity type and dialogue methods, which stakeholder groups and when in the process # of people involved
	6	Rationale	Several stakeholder actions are conducted during the CityLoops project and demonstration projects in the City of Mikkeli in order to develop tools and circular economy in close collaboration with local authorities and companies.  Expected outcomes: <ul style="list-style-type: none"> <li>- At the end of the project, several new local stakeholder partnerships and procedures with authorities and waste management and construction companies related to demonstration actions (3 stakeholder groups, 30 participating workshops/events/round tables, interviews, meetings, workshops)</li> </ul>



	7	Methodology	a) Identify stakeholder activity (stakeholder groups: 1. Waste and demolition group, 2. Construction and business cases, 3. Additional stakeholders) b) Describe process and when stakeholders are involved c) Identify dialogue methods used (e.g. meetings, networking meetings or interviews with local or national stakeholders) d) Number of people involved
	8	Unit	Qualitative data Number of people
Data	9	Baseline data / definition	Baseline 0 (only activities during the project are measured)
	10	Data Sources / Relevant Databases	Meeting memos Participant lists List of other networking meetings and interviews (date and participants)
	11	Overall accuracy	Not relevant for qualitative descriptions Reliable data (number of people)
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, Demo-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Monthly meetings with Group 1 Group 2-3: several meetings yearly
	15	SDG Reference	
Other	16	Comments	Networking meetings and interviews are organised also at national level (not only stakeholders from City of Mikkeli)

### 1.3.2. Communication measures on circular transformations and waste prevention

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	11
	2	Indicator name	Communication measures on circular transformations and waste prevention
Link to Circular	3	Vision Element	1. Local stakeholder actions

City Definition	4	Category	Engagement and capacity building
Indicator definition and description	5	Definition / Description of indicator	Describe type of communication measures, e.g. campaigns, provision of information, events for the public/companies.
	6	Rationale	<p>Several communication measures are conducted for general public and companies during the CityLoops project in the City of Mikkeli in order to increase knowledge on CE of CDW.</p> <p>The goal is to develop a process, which inspires individuals, groups, businesses, institutions and others to improve their interaction and to cooperate effectively for promoting circular economy.</p> <p>Expected outcomes:</p> <ul style="list-style-type: none"> <li>- At the end of the project, the skills and knowledge of the citizens and companies in CDW sector (both in Mikkeli and national level) have increased as a result of several new/innovative/strengthened stakeholder engagement tools/procedures related to demonstration actions (webinars, press releases, media articles, newsletter, replication, national meetings).</li> </ul>
	7	Methodology	<p>a) Number of communication measures (e.g. webinars/seminars organised by the project, CityLoops presentations in other webinars/seminars, press releases, articles in media, published research articles, newsletter, web pages) towards general public on CE transformation</p> <p>b) Number of people reached</p>
	8	Unit	<p>Number of communication measures</p> <p>Number of people</p>
	9	Baseline data / definition	Baseline 0 (only activities during the project are measured)
Data	10	Data Sources / Relevant Databases	<ul style="list-style-type: none"> <li>• Published press releases and articles in media (and edition of newspaper if available)</li> <li>• Published research articles (and number of editions of magazine or reports if available)</li> <li>• Participant lists of webinars and other events.</li> <li>• Number of visitors in web pages: number of hits on website. Internet visitor counter on the pages/articles of City Loops -project in <a href="http://www.mikseimikkeli.fi">www.mikseimikkeli.fi</a> and <a href="http://www.xamk.fi/cityloops">www.xamk.fi/cityloops</a> on CL</li> <li>• Number of recipients of a newsletter</li> <li>• List of publications / posts in social media (and number of viewers if available)</li> </ul>
	11	Overall accuracy	Reliable data (number of articles, number of participants in webinars/workshops organised by the project, number of visits in web pages)

			Uncertainty related to following data: number of editions are maybe not always available, number of participants in other webinars/events can be estimations)
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli and Finland, demo-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data collected continuously: Several articles, newsletters, workshops/webinars etc. per year
	15	SDG Reference	
Other	16	Comments	

### 1.3.3. Circularity requirements in procurement beyond existing levels

Metad ata group	#	Metadata category	Fill in data for indicator
Identifi-er	1	Indicator number	12
	2	Indicator name	Circularity requirements in procurement beyond existing levels
Link to Circular City Definiti on	3	Vision Element	1. Local stakeholder actions
	4	Category	Regulation and incentives
Indicator definition and description	5	Definition / of Description indicator	Description of requirements in procurements going beyond the current standard practices.
	6	Rationale	Procurement guidelines are prepared as a result of CityLoops project for City of Mikkeli to increase circularity in public demolition projects. Guidelines include new circular economy requirements beyond standard practice. The guidelines will be tested in demonstration sites Tuukkala hospital and Pankalampi health center and the impacts are assessed as demonstration level. Indicator 15 is selected together with indicator 12.  Expected outcomes: - The circular economy has been taken into account in the procurement process for demo projects and the tender includes circular economy requirements.

			- 100% of the procurement of demolition projects will include the new guidelines for screening and selective demolition, making these an essential part of the procurement processes within the City of Mikkeli.
	7	Methodology	a) Decide which procurements are relevant for analysis (e.g. demo action focused procurements only or a wider range of procurements) b) Describe current standard practice in terms of CE requirements. c) For each procurement case, describe additional requirements beyond standard practice. d) 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	Demands related to circularity in Mikkeli city's demolition contract procurement documents of recent demolition projects before project started. The baseline is described using the same method and data sources (procurement documents) as the post demonstration action values.
	10	Data Sources / Relevant Databases	Demolition contract offer documents of demonstration sites and earlier demolition projects and guide for the city of Mikkeli's demolition projects. Data from authorities, City of Mikkeli, Tilapalvelut). Data collection based on personal communication.
	11	Overall accuracy	Not relevant
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, Demo- and City level
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Qualitative description after the procurement/demolition process of the demonstration projects (baseline data already collected).
	15	SDG Reference	
Other	16	Comments	

### 1.3.4. Procurement with circularity requirements beyond existing levels: Impact

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	15

	2	Indicator name	Procurement with circularity requirements beyond existing levels: Impact
Link to Circular City Definition	3	Vision Element	1. Local stakeholder actions
	4	Category	Regulation and incentives
Indicator definition and description	5	Definition / Description of indicator	# of procurements with circularity requirements Value of procurement with circularity requirements
	6	Rationale	Procurement guidelines are prepared as a result of CityLoops project for City of Mikkeli to increase circularity in public demolition projects. Guidelines include new circular economy requirements beyond standard practice. The guidelines are applied to demonstration sites Tuukkala hospital and Pankalampi health center and the impacts are assessed as demonstration level. Indicator 15 is selected together with indicator 12.  Expected outcomes: <ul style="list-style-type: none"> <li>- The circular economy has been taken into account in the procurement process for demo projects and the tender includes circular economy requirements.</li> <li>- 100% of the procurement of demolition projects will include the new guidelines for screening and selective demolition, making these an essential part of the procurement processes within the City of Mikkeli.</li> </ul>
	7	Methodology	For each action: <ul style="list-style-type: none"> <li>• Type of procurement action</li> <li>• Value of procurement</li> </ul> For the whole period considered: <ul style="list-style-type: none"> <li>• Time period</li> <li>• Number of procurement contracts</li> <li>• Sum up the total value of these contracts.</li> </ul>
	8	Unit	Number of actions (changes in procurement documents) Monetary value of procurements (demonstration cases Tuukkala and Pankalampi) Number of qualitative demands, number of sorted waste fractions, fraction of unsorted material
	9	Baseline data / definition	Data from recent demolition projects of city of Mikkeli. The baseline is calculated using the same method and data sources (procurement documents) as the post demonstration action values.
Data	10	Data Sources / Relevant Databases	Demolition contract offer documents. Waste statistics of Metsäsairila Ltd. Waste report of contractor (from authorities, City of Mikkeli, Tilapalvelut). Data collection based on personal communication.
	11	Overall accuracy	Reliable data
Context	12	Sector coverage	CDW

	13	Reference area / Spatial implementation scale	City of Mikkeli, demo- and city level
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected after the procurement/demolition process of the demonstration projects (baseline data already collected).
	15	SDG Reference	
Other	16	Comments	

### 1.3.5. Progress towards circular city strategy objectives

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	19
	2	Indicator name	Progress towards circular city strategy objectives
Link to Circular City Definition	3	Vision Element	1. Local stakeholder actions
	4	Category	Vision and urban management
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	The CityLoops project contribute to the development of a circular economy in the city of Mikkeli.  Expected outcomes: - The City of Mikkeli wants to be nationally well-known "Circular Economy City" and operates according to the CE closed loops principles. Circular economy is incorporated in new strategic objectives.
	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	Mentions of circular economy objectives in city strategies and documents before the start of the project. The baseline is described using the same method and data sources (strategy documents etc.) as the post demonstration action values.
	10	Data Sources / Relevant Databases	The city's strategy documents, decisions and commitments on the promotion of CE. Open data.

	11	Overall accuracy	Not relevant
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, City-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected and analyzed on an annual basis and will be compared to a baseline established for the year 2019.
	15	SDG Reference	
Other	16	Comments	

### 1.3.6. New planning instruments/tools for improved circularity: Qualitative description

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	21
	2	Indicator name	New planning instruments/tools for improved circularity: Qualitative description
Link to Circular City Definition	3	Vision Element	1. Local stakeholder actions
	4	Category	Vision and urban management
Indicator definition and description	5	Definition / Description of indicator	Define and select planning instruments/ tools relevant to improve circularity (To be selected together with indicator #22)
	6	Rationale	<p>Several planning instruments/tools are developed and/or demonstrated during the CityLoops project in the City of Mikkeli in order to improve CDW circularity.</p> <p>Expected outcomes:</p> <ul style="list-style-type: none"> <li>- New planning instrument/tools have been tested in the City of Mikkeli for decision making and monitoring of demonstration projects. Identifying procurement tool for special characteristics in a tender has been updated based on the demo projects.</li> <li>- 100% of the procurement of demolition projects will include the new guidelines for screening and selective demolition, making these an essential part of the procurement processes within the City of Mikkeli.</li> </ul>

	7	Methodology	Qualitative description of the following instrument/tool 1. Guidelines for planning and decision making (e.g. procurement guidelines) 3. Life Cycle Assessment for demolition and renovated sites 4. Screening procedures and tool for selective demolition 5. 3D modelling tool for tracking the flows of on-site CDW
	8	Unit	Qualitative data
Data	9	Baseline data / definition	Qualitative description of practises related to demolition processes in the City of Mikkeli before CityLoops project.
	10	Data Sources / Relevant Databases	Project reports, e.g. Tool Factsheets
	11	Overall accuracy	Not relevant
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, demo-level or city-level (guidelines)
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected after demonstration actions (baseline already collected).
	15	SDG Reference	
Other	16	Comments	There are also two other instruments/tools, which are developed in Mikkeli during the CityLoops project. These tools are evaluated with separate indicators: <ul style="list-style-type: none"> <li>- Tool: Business case development: indicators 23-24</li> <li>- Tool: Databank and digital marketplace for recovered materials: indicators 30-31</li> </ul>

### 1.3.7. New planning instruments/tools for improved circularity: Impact

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	22
	2	Indicator name	New planning instruments/tools for improved circularity: Impact
Link to Circular	3	Vision Element	1. Local stakeholder actions



City Definition	4	Category	Vision and urban management
Indicator definition and description	5	Definition / Description of indicator	Quantify impact of all planning instruments/tools described in indicator # 21. (To be selected together with indicator #21)
	6	Rationale	<p>Several planning instruments/tools are developed and demonstrated during the CityLoops project in the City of Mikkeli in order to improve CDW circularity.</p> <p>Expected outcomes:</p> <ul style="list-style-type: none"> <li>- New planning instrument/tools have been tested in the City of Mikkeli for decision making and monitoring of demonstration projects. Identifying procurement tool for special characteristics in a tender has been updated based on the demo projects.</li> <li>- 100% of the procurement of demolition projects will include the new guidelines for screening and selective demolition, making these an essential part of the procurement processes within the City of Mikkeli.</li> </ul>
	7	Methodology	<ol style="list-style-type: none"> <li>1. Guidelines for planning and decision making <ul style="list-style-type: none"> <li>- number of guidelines produced.</li> <li>- # of projects, where guidelines were used</li> </ul> </li> <li>2. Life-Cycle Assessment for demolition and renovated sites <ul style="list-style-type: none"> <li>- # of projects where tool was used</li> <li>- Total mass of materials that the tool has impacted on per year (waste/material amounts in demonstration projects)</li> </ul> </li> <li>3. Screening procedures and tool for selective demolition <ul style="list-style-type: none"> <li>- # of projects where tool was used (e.g. pre-demolition audit)</li> <li>- Total mass of materials that the tool has impacted on per year.</li> <li>- # screenings/samples/analyses</li> </ul> </li> <li>4. 3D modelling tool for tracking the flows of on-site CDW <ul style="list-style-type: none"> <li>- # of projects where tool was used</li> <li>- # of drone flights</li> <li>- Total mass of materials that the tool has impacted on per year (e.g. waste/material amounts in demonstration projects)</li> </ul> </li> </ol>
	8	Unit	<p>Number of guidelines</p> <p>Number of projects, where tool was used.</p> <p>Tonnes / year</p>
Data	9	Baseline data / definition	Only qualitative description of practises related to demolition processes in the City of Mikkeli before CityLoops project (indicator 21). Quantitative data is not available (baseline 0).
	10	Data Sources / Relevant Databases	Project reports (data collected in demo projects Tuukkala and Pankalampi)

			Authorities (City of Mikkeli, Tilapalvelut), constructors (waste reports) and waste management company Metsäsairila Ltd. Data collection based on personal communication.
	11	Overall accuracy	Reliable data
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, demo-level or city-level (guidelines)
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected after demonstration actions
	15	SDG Reference	
Other	16	Comments	There are also two other instruments/tools, which are developed in Mikkeli during the CityLoops project. These tools are evaluated with separate indicators: <ul style="list-style-type: none"> <li>- Tool: Business case development: indicators 23-24</li> <li>- Tool: Databank and digital market place for recovered materials: indicators 30-31</li> </ul>

### 1.3.8. Eco-innovation: Qualitative description

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	23
	2	Indicator name	Eco-innovation: Qualitative description
Link to Circular City Definition	3	Vision Element	2. Circular business models and behavioural patterns
	4	Category	Private investments, jobs and gross value added
Indicator definition and description	5	Definition / Description of indicator	Describe the business model, including how it contributes to moving up the waste hierarchy (To be selected together with indicator #24)
	6	Rationale	Business cases for reuse, recycling and valorisation of CDW are developed during the CityLoops project in the City of Mikkeli.  Expected outcomes: <ul style="list-style-type: none"> <li>- New products, service concepts and business models relating to the reuse/recycling and upcycling of the specific material flows addressed, leading to new business opportunities.</li> </ul>
	7	Methodology	# of new CE business models

			For each model, a qualitative description of model, its circular strategy
	8	Unit	Qualitative data
Data	9	Baseline data / definition	Business models on circularity of CDW used in City of Mikkeli before the CityLoops-project (Toimintakeskus and Metsäsairila Ltd).
	10	Data Sources / Relevant Databases	Project reports (description of business cases and actions to promote upcycling on materials)
	11	Overall accuracy	Not relevant
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, City-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Baseline data (2019-2020) and in the end of the project
	15	SDG Reference	
Other	16	Comments	

### 1.3.9. Eco-innovation: Impact

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	24
	2	Indicator name	Eco-innovation: Impact
Link to Circular City Definition	3	Vision Element	2. Circular business models and behavioural patterns
	4	Category	Private investments, jobs and gross value added
Indicator definition and description	5	Definition / Description of indicator	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 indicator #23)
	6	Rationale	Business cases for reuse, recycling, and valorisation of CDW are developed during the CityLoops project in the City of Mikkeli.  Expected outcomes: - New products, service concepts and business models relating to the reuse/recycling of the specific material flows addressed, leading to new business opportunities. Actions have been made to promote upcycling of materials.
	7	Methodology	For each case of implementation of CE business models

			a) Monetary value b) Materials impacted
	8	Unit	Monetary value Tonnes / year
Data	9	Baseline data / definition	Only qualitative description: business models on circularity of CDW used in City of Mikkeli before the CityLoops-project (indicator 23). Quantitative data is not available, or data is not public (baseline 0).
	10	Data Sources / Relevant Databases	Theoretical potential of business cases (estimated monetary value and material flow, included to project's reports) Realized business cases (monetary value and material flow, data from collaboration companies)
	11	Overall accuracy	Significant level of uncertainty (theoretical monetary value and material flow are estimated)
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, City-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023
	15	SDG Reference	
Other	16	Comments	

### 1.3.10. Increased share of materials retained and reused on demonstration sites

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	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	2. Circular business models and behavioural patterns
	4	Category	Circular value chains and infrastructure
Indicator definition and description	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	Project tools and activities aim to develop recycling and reuse of materials and part of these materials could be retained and reused on demonstration sites.

			Expected outcomes: - At the end of the demonstration action, 5% of materials are retained on demonstration sites.
	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	Baseline from earlier demolition projects in Mikkeli (2018-summer 2020). The baseline is calculated using the same method and data sources as the post demonstration action values.
	10	Data Sources / Relevant Databases	Data collected from the owner of the demonstration buildings Tuukkala and Pankalampi (City of Mikkeli, Tilapalvelut) and constructors (waste reports). Data collection based on personal communication.
	11	Overall accuracy	Reliable data
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, Demo-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected after the demonstration actions (baseline data already collected).
	15	SDG Reference	
Other	16	Comments	

### 1.3.11. Volume onsite sorting (Improved source separation)

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	28
	2	Indicator name	Volume onsite sorting (Improved source separation)
Link to Circular City Definition	3	Vision Element	2. Circular business models and behavioural patterns
	4	Category	Circular value chains and infrastructure

Indicator definition and description	5	Definition / Description of indicator	The relative share of waste materials produced and sorted on demonstration sites
	6	Rationale	Developing selective demolition and onsite sorting is an important part of project's tool "Screening procedures and tool for selective demolition" which is demonstrated in the City of Mikkeli.  Expected outcome: - Selective demolition has been used in demonstration cases. Over 95% of CDW is sorted onsite for recycling and material or energy recovery.
	7	Methodology	The mass of on-site waste materials sorted / the mass of total on-site waste materials
	8	Unit	Mass %
Data	9	Baseline data / definition	Baseline from earlier demolition projects in Mikkeli (2018-summer 2020). The baseline is calculated using the same method and data sources as the post demonstration action values.
	10	Data Sources / Relevant Databases	Register of the permitting authorities (constructor's waste reports) and Waste management company Metsäsairila Ltd. Data collection based on personal communication.
	11	Overall accuracy	Reliable data
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, Demo-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected after demonstration actions (baseline data already collected).
	15	SDG Reference	
Other	16	Comments	

### 1.3.12. New digital material databank/ marketplace: Qualitative description

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	30
	2	Indicator name	New digital material databank/marketplace: Qualitative description
Link to Circular	3	Vision Element	2. Circular business models and behavioural patterns

City Definition	4	Category	Circular value chains and infrastructure
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 (To be selected together with indicator #31)
	6	Rationale	Two connected online platforms - Databank and digital marketplace for recovered materials – are created during the CityLoops project by Xamk and Miksei Mikkeli to increase data management and marketing of demolition materials for reuse. Indicators 30-31 describe the platforms and measure their impacts.  Expected outcomes: - Digital marketplace for secondary materials established and in use.
	7	Methodology	See definition
	8	Unit	Qualitative data
Data	9	Baseline data / definition	Qualitative description of practices related to marketing of demolition materials in the City of Mikkeli before CityLoops project (e.g. tori.fi).
	10	Data Sources / Relevant Databases	Project reports, e.g. Tool fact sheet
	11	Overall accuracy	Not relevant
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, Demo-level (Pankalampi)
	14	Reference period	Project period 1.10.2019 – 30.9.2023, in the end of the project (baseline 2019-2020)
	15	SDG Reference	
Other	16	Comments	

### 1.3.13. New digital material databank/ marketplace: Impact

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	31
	2	Indicator name	New digital material databank/marketplace: Impact

Link to Circular City Definition	3	Vision Element	2. Circular business models and behavioural patterns
	4	Category	Circular value chains and infrastructure
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. (To be selected together with indicator #30)
	6	Rationale	Two connected online platforms - Databank and digital marketplace for recovered materials – are created during the CityLoops project by Xamk and MikseiMikkeli to increase data management and marketing of demolition materials for reuse. Indicators 30-31 describe the platforms and measure their impacts.  Expected outcomes: - Digital marketplace for secondary materials established and in use.
	7	Methodology	Mass of materials or number of items or data registered per time period.  Time period can be month or year (year for digital marketplace) Total mass or number of items should be registered, and optionally key material fractions
	8	Unit	Tonnes / time or number of items/ times Number of data saved to databank
Data	9	Baseline data / definition	Only qualitative description of practises related to marketing of demolition materials in the City of Mikkeli before CityLoops project (indicator 30). Quantitative data is not available (baseline 0).
	10	Data Sources / Relevant Databases	Data saved to databank. Items (mass, number and price) registered to digital marketplace
	11	Overall accuracy	Reliable data
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, Demo-level (Pankalampi)
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected yearly (digital marketplace) or after demonstration actions (databank)
	15	SDG Reference	
Other	16	Comments	



### 1.3.14. Reduced costs due to improved circularity

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	32
	2	Indicator name	Reduced costs due to improved circularity
Link to Circular City Definition	3	Vision Element	2. Circular business models and behavioural patterns
	4	Category	Private investments, jobs and gross value added
Indicator definition and description	5	Definition / Description of indicator	For selected cost type(s) (e.g. transport, virgin material costs, waste treatment costs), direct impacts on costs should be estimated.  Demolition costs and waste treatment costs selected in case of Mikkeli.
	6	Rationale	In long term, circular economy should increase the cost effectiveness. Impact of circularity to costs of demolition projects is important information to local government because price is typically selection criterion in procurement processes.  Expected outcomes <ul style="list-style-type: none"> <li>- At the end of the demonstration action, we expect a 10% increase in the cost effectiveness in the demolition of buildings (demolition, transport and treatment of CDW) as compared to the baseline values for similar demolition projects.</li> </ul>
	7	Methodology	Quantification of cost savings for the selected cost type (demolition costs, waste treatment costs) using a practical method. The estimate should be accompanied by a qualitative description of the method, which cost items are included and which are excluded, with a justification of the choice.
	8	Unit	Monetary value
Data	9	Baseline data / definition	Demolition costs (including also transport and treatment of CDW) from earlier demolition projects in Mikkeli.
	10	Data Sources / Relevant Databases	Demolition costs (including also transport and treatment of CDW) of demonstration cases (Tuukkala and Pankalampi). Data from authorities (City of Mikkeli, Tilapalvelut) or calculated according to amount of sorted waste fractions (from contractor's waste report) and price list of waste management company Metsäsairila Ltd. Demolition costs from authorities (City of Mikkeli, Tilapalvelut) Data collection based on personal communication.
	11	Overall accuracy	Reliable data

Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, demo-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected after demonstration actions
	15	SDG Reference	
Other	16	Comments	

### 1.3.15. CE-based employment

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	33
	2	Indicator name	CE-based employment
Link to Circular City Definition	3	Vision Element	2. Circular business models and behavioural patterns
	4	Category	Private investments, jobs and gross value added
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	Project activities promoting circular economy and new business cases aim to provide new jobs in the City of Mikkeli.  Expected outcomes - Social impacts: At the end of the project, the project activities are a component of creating a greener environment and providing a more sustainable economy in the city of Mikkeli (new jobs: 20 – all external).
	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	Number of jobs or estimated % of job becoming circular -related
Data	9	Baseline data / definition	Number of jobs in Metsäsairila Ltd and Toimintakeskus in the beginning of the project (year 2019). The baseline is calculated

			using the same method and data sources as the post demonstration action values.
	10	Data Sources / Relevant Databases	Number of jobs in Metsäsairila Ltd (open data from company's annual reports), Toimintakeskus (based on personal communication) and other relevant companies/organizations.
	11	Overall accuracy	Reliable data (number of personnel in chosen organization/companies). Significant level of uncertainty related to possible estimation of the circularity of the jobs
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, City-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023, two times during the project.
	15	SDG Reference	
Other	16	Comments	New jobs are not developed directly from demo actions but are effects of demos.

### 1.3.16. Domestic material consumption (DMC) of virgin materials

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	35
	2	Indicator name	Domestic material consumption (DMC) of virgin materials
Link to Circular City Definition	3	Vision Element	3. Closing material loops and reducing harmful resource use
	4	Category	Material/energy flow
Indicator definition and description	5	Definition / Description of indicator	The total amount of virgin materials directly used.
	6	Rationale	Project activities aim to increase utilization of reused and recycled materials (e.g. crushed concrete) instead of virgin materials (e.g. virgin soil material).  Expected outcomes: - At the end of the project, use of CDW (especially crushed concrete) to replace virgin construction materials (soil) have

			been increased as a result of new guidelines in planning and decision making. 5% reduction in consumption of virgin construction materials within the city of Mikkeli.
	7	Methodology	Amount of used virgin soil material in the City of Mikkeli
	8	Unit	tonnes/year or m <sup>3</sup> /year
Data	9	Baseline data / definition	Average consumption of used virgin soil material per year before the project's start, data from authorities (City of Mikkeli, based on personal communication). The baseline is calculated using the same method and data sources as the post demonstration action values.
	10	Data Sources / Relevant Databases	(Estimated) amount of used virgin soil material in the end of the project, data from authorities (City of Mikkeli).
	11	Overall accuracy	Slight level of uncertainty (estimated/average amounts from authorities)
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, City-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023, two times during the project Baseline: average consumption per year before the project's start
	15	SDG Reference	
Other	16	Comments	

### 1.3.17. Quantity of material subjected to reuse

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	49
	2	Indicator name	Quantity of material subjected to reuse
Link to Circular City Definition	3	Vision Element	3. Closing material loops and reducing harmful resource use
	4	Category	Re-use and recycling
Indicator definition and description	5	Definition / Description of indicator	Estimate mass of materials being reused at demonstration level. 'Reuse' means reuse of discarded yet still usable product, for the same purpose, by a different user.
	6	Rationale	Several project activities/tools aim to promote the reuse and upcycling of demolition materials in Mikkeli.  Expected outcomes:

			- At the end of the demonstration action several items (materials/equipment) have been prepared for reuse.
	7	Methodology	Sum up estimated mass or number of items (e.g. bricks, wood material, HVAC equipment, metal structures) subjected to reuse from demonstration site Pankalampi.
	8	Unit	tonnes/year or number of items
Data	9	Baseline data / definition	Baseline 0 (only activities during the project are measured) Data from earlier demolition projects in Mikkeli is not available; reused materials have not been registered.
	10	Data Sources / Relevant Databases	Toimintakeskus (materials to be sold by Toimintakeskus), City of Mikkeli (materials used in City internally). Data collection based on personal communication.
	11	Overall accuracy	Moderate level of uncertainty (mass of materials or number of items can be partly estimated).
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, Demo-level (Pankalampi)
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected after the demonstration actions
	15	SDG Reference	
Other	16	Comments	

### 1.3.18. EOL-RR (End of Life Recycling Rate)

Identifier	1	Indicator number	55
	2	Indicator name	EOL-RR (End of Life Recycling Rate)
Link to Circular City Definition	3	Vision Element	3. Closing material loops and reducing harmful resource use
	4	Category	Re-use and recycling
Indicator definition and description	5	Definition / Description of indicator	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. Several project activities aim to promote the recycling and upcycling rate of CDW materials in Mikkeli.
	6	Rationale	Expected outcomes: - At the end of the project, the recycling rate of CDW is close to 75% (CDW prepared for recycling and other material recovery, including backfilling) (95% if energy recovery)

			included). 10% increase in recycling rate and 40% increase in upcycled amount of CDW as compared to baseline statistics from year 2019.
	7	Methodology	For each material fraction, the End-of-Life recycling rate is defined as the End-of-Life mass recycled divided by the available mass of End-of-Life materials. It is the product of the Processing Rate and the Collection Rate (EoL RR = EoL PR x EoL CR).  EoL-RR is calculated for total CDW and for each material fraction if possible. In case of Mikkeli, recycling includes utilization of material in original or other use and also backfilling.
	8	Unit	% rate.
Data	9	Baseline data / definition	City-level: Amount of recycled CDW categories in waste management company Metsäsairila Ltd. in year 2019 (before project started). The baseline is calculated using the same method and data sources as the post demonstration action values.
	10	Data Sources / Relevant Databases	City-level: Yearly statistics of waste management company Metsäsairila Ltd. Data collection based on personal communication. The data includes CDW from demolition projects owned by City of Mikkeli and part of private demolition projects.
	11	Overall accuracy	Reliable data
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, City-level
	14	Reference period	Data will be collected and analysed on an annual basis and will be compared to a baseline established for year 2019.
	15	SDG Reference	
Other	16	Comments	

### 1.3.19. Incineration rate

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	59
	2	Indicator name	Incineration rate
Link to Circular City Definition	3	Vision Element	3. Closing material loops and reducing harmful resource use
	4	Category	Waste generation/management

Indicator definition and description	5	Definition / Description of indicator	Mass percentage of waste, which incinerated.
	6	Rationale	Project activities aim to increase reusing, recycling and upcycling of materials instead of incineration.  Expected outcomes: - At the end of the project, 5% reduction in the amount of CDW landfilled or incinerated as compared to the baseline statistics from year 2019.
	7	Methodology	Mass of materials incinerated divided by total amount of waste. Data from waste management companies.
	8	Unit	%
Data	9	Baseline data / definition	Share of CDW, which is incinerated (year 2019, before project started). The baseline is calculated using the same method and data sources as the post demonstration action values.
	10	Data Sources / Relevant Databases	Yearly statistics of waste management company Metsäsairila Ltd. Data collection based on personal communication. The data includes CDW from demolition projects owned by City of Mikkeli and part of private demolition projects.
	11	Overall accuracy	Reliable data
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, City level
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected and analysed on an annual basis and will be compared to a baseline established for year 2019.
	15	SDG Reference	
Other	16	Comments	

### 1.3.20. Landfilling rate

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	61
	2	Indicator name	Landfilling rate
Link to Circular City	3	Vision Element	3. Closing material loops and reducing harmful resource use

Definiton	4	Category	Waste generation/management
Indicator definition and description	5	Definition / Description of indicator	Mass percentage of waste, which landfilled.
	6	Rationale	Project activities aim to increase reusing, recycling and upcycling of materials instead of landfilling.  Expected outcomes: - At the end of the project, 5% reduction in the amount of CDW landfilled or incinerated as compared to the baseline statistics from year 2019.
	7	Methodology	Mass of materials landfilled divided by total amount of waste. Data from waste management companies.
	8	Unit	tons/year or %
Data	9	Baseline data / definition	Share of CDW, which is landfilled (year 2019, before project started). The baseline is calculated using the same method and data sources as the post demonstration action values.
	10	Data Sources / Relevant Databases	Yearly statistics of waste management company Metsäsairila Ltd. Data collection based on personal communication. The data includes CDW from demolition projects owned by City of Mikkeli and part of private demolition projects.
	11	Overall accuracy	Reliable data
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, City level
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data will be collected and analysed on an annual basis and will be compared to a baseline established for year 2019.
	15	SDG Reference	
Other	16	Comments	

### 1.3.21. GHG emissions per year

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	85
	2	Indicator name	GHG emissions per year



Link to Circular City Definition	3	Vision Element	4. Improving human well-being and reducing environmental impacts
	4	Category	Environment impacts (global)
Indicator definition and description	5	Definition / Description of indicator	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.
	6	Rationale	Project activities aim to increase circularity of CDW, which should lead positive environmental impacts and reduced CO <sub>2</sub> emissions.  Expected outcomes: - At the end of the project, 5% reduction in the emissions of CO <sub>2</sub> related to extraction, processing and transportation (incl. logistics) of construction materials (replacement of virgin soil material with crushed concrete).
	7	Methodology	Saved GHG emission pr. year when using crushed concrete instead of virgin soil material Direct GHG emissions pr. year city level
	8	Unit	Tonnes CO <sub>2</sub> -equivalents / year
Data	9	Baseline data / definition	CO <sub>2</sub> emissions of average consumption of virgin soil material and crushed concrete before the project's start. The baseline is calculated using the same method and data sources as the values at the end of the project.  Direct GHG emissions pr. year city level from year 2019. The baseline is calculated using the same method and data sources as the post demonstration action values.
	10	Data Sources / Relevant Databases	Calculated CO <sub>2</sub> emissions of used virgin soil material and crushed concrete per year in city level. Amount of used virgin soil material and crushed concrete from authorities  Direct GHG emissions pr. year city level from <a href="https://www.mikkeli.fi/sisalto/palvelut/ymparisto/ilmasto">https://www.mikkeli.fi/sisalto/palvelut/ymparisto/ilmasto</a> or <a href="https://paastot.hiilineutraalisuomi.fi/">https://paastot.hiilineutraalisuomi.fi/</a> . Open data.
	11	Overall accuracy	Moderate level of uncertainty (calculated values)
Context	12	Sector coverage	CDW
	13	Reference area / Spatial implementation scale	City of Mikkeli, City level
	14	Reference period	Project period 1.10.2019 – 30.9.2023 City-level: Data will be collected and analysed on an annual basis and will be compared to a baseline established for the year 2019. Demo-level: GHG-emissions will be calculated after the demonstration actions

	15	SDG Reference	
Other	16	Comments	

## 2. Evaluation plan for BW

### 2.1. Introduction (BW)

In the CityLoops project, Mikkeli is undertaking a series of demonstration actions, aimed at improving the recovery of nutrients from biowaste streams for new products and business models. Mikkeli also plans to improve the quality of the biowaste it collects from households by implementing new collection and sorting processes in collaboration with its citizens. Only 38% of the 6,900 tonnes of biowaste Mikkeli's citizens produce yearly is recycled, mainly as compost.

Mikkeli pursues to pioneer in the transition for a more circular economy. The city has been building EcoSairila development platform to enable closing material loops and to help create new sustainable businesses. Mikkeli has promoted and invested especially on the research, development and infrastructure of water technology, material cycles and renewable energy such as biogas from the new biogas plant BioSairila.

The focus of BW demonstration actions in Mikkeli will be on improving the recovery of nutrients from BW streams into recycled products, creating business opportunities for local companies. Based on a thorough analysis of BW streams and potential valorisation pathways, a series of innovative collection, treatment and product optimisation processes and techniques will be demonstrated. New collection and sorting processes will be implemented in a pilot district in collaboration with local citizens to upgrade the quality of BW collected. Below are the main biowaste demonstration actions in Mikkeli.

#### 2.1.1. BW collection and sorting: pilot project

In collaboration with citizens and local companies the collection of biowaste from the Mikalo Ltd apartment building area in the Peitsari district of Mikkeli will be improved. The goal is to increase the collection of biowaste in quality and quantity and simultaneously reduce the biowaste percentage in the collected mixed waste that is currently disposed of by incineration.

A new collection and sorting approach will be tested in a series of apartment buildings in the Peitsari district. The seven buildings, with a total of 278 apartments, are owned by the Mikalo Ltd municipal housing company. The aim is to increase the volume of quality biowaste collected separately, rather than ending up in the municipal solid waste collection.

The demonstration action was co-designed in collaboration with local residents and stakeholders, and will consist of:

- Distributing paper bags to residents for the collection of biowaste, which are less problematic for the new biogas plant in Mikkeli than biodegradable plastic bags which are often currently used.
- An information campaign to encourage residents to separate their biowaste.

To complement this demonstration there will be a series of ongoing dialogue process with key stakeholders to investigate further forms and models of separate biowaste collection and sorting, to analyse their potential in different areas of Mikkeli, and to establish whether viable business cases underlie these approaches. Potentially new ideas and approaches may be integrated into the Peitsari demonstration project, or in other parts of the city.

### **Expected outcomes:**

Below are the expected outcomes to be achieved in connection with demo action 1:

- Improved interactions in the field of biowaste collection and sorting between citizens, waste management companies and public authorities, through the establishments of stakeholder groups, i.e. one on biowaste and one on collection and sorting.
- New collection and sorting concepts and tools have been tested for biowaste, leading to improved opportunities in recycling and use of the material flow in Mikkeli.
- New collection and sorting concepts (i.e. distributing paper bags) for biowaste tested in the demonstration site.
- New circular job opportunities created in the area of biowaste collection and sorting
- Increase in quantity of biowaste collected at city level
- 15% increased separate collection rate of biowaste within the demonstration site.
- 10% reduction in the amount of organic waste landfilled or incinerated in Mikkeli by the end of project
- The recycling rate of organic waste has improved, which enables a 15% reduction in the greenhouse gas emissions

## **2.1.2. BW treatment: pilot and laboratory scale experiments**

Collected biowaste will be used to produce biogas as fuel for local buses, trucks and cars. The nutrients present in the residual streams from the biogas production will be used as soil amendments. On pilot and laboratory scale experiments will be performed to enhance the

production of biogas by mechanical pre-treatment and combining biowaste from households with the biowaste from gardens. Different processes will be tested to increase the value of the soil amendments. A techno-economic evaluation of the new processes will be performed to obtain possible business cases for Mikkeli.

This demonstration action explores new processing and end-product optimization techniques in a laboratory- and pilot-scale.

- The development and tests of mechanical pre-treatment methods such as crushing, mixing and sieving. The aim of these is to prepare biowaste flows before the actual waste treatment, biogas digestion.
- One area of research is the combined use of bio- and garden waste in biogas production.
- To increase the value of the remaining streams after biogas production at least five methods/technologies will be tested, with the aim of permanently establishing at least two innovative nutrition extraction and product creation technologies and related business models with local companies.
- One of the tested new methods/technologies will certainly be using biochar as an additive for organic material, which enables more complex functional properties of the produced fertilizer (e.g. water and nutrient storage).
- A second technology will be using electrochemical methods for the recovery of nutrients from rejection waters of dry digestion process.

### **Expected outcomes:**

Below are the expected outcomes to be achieved in connection with demo action 2:

- Improved interactions in the field of treatment between citizens, waste management companies and public authorities, through the establishment of stakeholder groups, i.e. on treatment and products.
- Promotion of circularity in the biowaste sector is embedded in Mikkeli's procurement practices.
- At least 5 new treatment and product optimization methods/technologies have been tested and evaluated (at demonstration level), considering technical viability, financial viability, and productivity. At least two treatment and product optimization methods/technologies will be established.
- New circular job opportunities created in the biochar, biogas and fertilizer business
- Consumption of virgin materials reduced by 5% at city level (compared to the start of the project)
- Increase in upcycled amount of organic waste by 50% by end of project (mass, volume or %) in the city of Mikkeli

- 10% reduced emissions of CO<sub>2</sub> related to reduced transport needs as well as substitution of fossil fuels (trucks) by biogas
- Validated potential to reduce consumption of virgin materials by 5% at city level (compared to the start of the project).
  - At least 5 new treatment and product optimization methods/technologies have been tested and validated (at demonstration level), considering technical viability, financial viability, and productivity. At least two treatment and product optimization methods/technologies are established in Mikkeli.
  - Promotion of circularity in the biowaste sector are embedded in Mikkeli's procurement practices.
  - Improved interactions in the field of treatment between citizens, waste management companies and public authorities, through the establishments of stakeholder groups, i.e. on treatment and products.
  - New business- and circular job opportunities created in the recycling of biowaste into new products such as biogas, fertilizers and soil improvers.
  - Increase in upcycled amount of organic waste 50% by end of project (mass, volume or %) in the city of Mikkeli.
  - 10% reduction of CO<sub>2</sub>-emissions related to reduced transport needs as well as substitution of fossil fuels (trucks) with biogas.

## 2.2. Indicators to be monitored (BW)

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 specific processes and impacts related to the Demonstration Action activities (and if relevant the application of CityLoops tools outside the scope of the demonstration actions) and serve to evaluate against the expected outcomes of the action. 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 and impact of demonstration- and city-wide actions towards improved circularity as well as the effectiveness of activities and tools.
- 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 (Annex 2) and the CityLoops project plans (Annex 1): 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).

Table 8 to table 11 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 8: List of indicators related to Vision Element 1 “Local Stakeholder Actions”*

Indicator #	Indicator name	Scope (Demo/City)	Demo action 1	Demo action 2
6	Circularity related stakeholder activities	D and C	x	x
11	Communication measures on circular transformations and waste prevention	D and C	x	x
12	Circularity requirements in procurement beyond existing levels	D		x
15	Procurement with circularity requirements beyond existing levels: Impact	D		x
21	New planning instruments/tools for improved circularity: Qualitative description	D and C	x	x
22	New planning instruments/tools for improved circularity: Impact	D and C	x	x

*Table 9: 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
23	Eco-innovation: Qualitative description	D		x
24	Eco-innovation: Impact	D		x
33	CE-based employment	C	x	x

*Table 10: 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
35	Domestic material consumption (DMC) of virgin materials	C		x
52	Quantity of material subjected to recycling	D /C	x	
53	Quantity of material for anaerobic digestion	C	x	
55	EOL-RR (End of Life Recycling Rate).	D/C	x	x
59	Incineration rate	C	x	
61	Landfilling rate	C	x	

Table 11: 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
85	GHG emissions per year	C and D	x	x

Links between the selected indicators and the expected outcomes for both Demonstration Actions are shown in table 12 and 13:

Table 12: Linking expected outcomes to the selected indicators for demonstration action 1. Biowaste collection and sorting.

Vision Element	Expected outcome	Indicator
<b>1 Local Stakeholder Actions</b>	Improved interactions in the field of biowaste collection and sorting between citizens, waste management companies and public authorities, through the establishments of stakeholder groups, i.e. one on biowaste and one on collection and sorting.	6. Circularity related stakeholder activities 11. Communication measures on circular transformations and waste prevention
	New collection and sorting concepts and tools have been tested for biowaste, leading to improved opportunities in recycling and use of the material flow in Mikkeli.	21. New planning instruments/tools for improved circularity: Qualitative description 22. New planning instruments/tools for improved circularity: Impact
	New collection and sorting concepts (i.e. distributing paper bags) for biowaste tested in the demonstration site.	21. New planning instruments/tools for improved circularity: Qualitative description



Vision Element	Expected outcome	Indicator
		22. New planning instruments/tools for improved circularity: Impact
<b>2 Circular business models and behaviour patterns</b>	New circular job opportunities created in the area of biowaste collection and sorting	33. CE-based employment
<b>3 Closing material loops and reducing harmful resource use</b>	Increase in quantity of biowaste collected at city level	52. Quantity of material subjected to recycling (city-level)
	15% increased separate collection rate of biowaste within the demonstration site.	52. Quantity of material subjected to recycling
	10% reduction in the amount of organic waste landfilled or incinerated in Mikkeli by the end of project	59. Incineration rate 61. Landfilling rate
<b>4 Improving human wellbeing and reducing environmental impacts</b>	The recycling rate of organic waste has improved, which enables a 15% reduction in the greenhouse gas emissions	85. GHG emissions per year

Table 13: Linking expected outcomes to the selected indicators for demonstration action 2. biowaste treatment: pilot and laboratory scale experiments

Vision Element	Expected outcome	Indicator
<b>1 Local Stakeholder Actions</b>	Improved interactions in the field of treatment between citizens, waste management companies and public authorities, through the establishment of stakeholder groups, i.e. on treatment and products.	6. Circularity related stakeholder activities 11. Communication measures on circular transformations and waste prevention
	Promotion of circularity in the biowaste sector is embedded in Mikkeli's procurement practices.	12. Circularity requirements in procurement beyond existing levels 15. Procurement with circularity requirements beyond existing levels

Vision Element	Expected outcome	Indicator
<b>2 Circular business models and behaviour patterns</b>	At least 5 new treatment and product optimization methods/technologies have been tested and evaluated (at demonstration level), considering technical viability, financial viability, and productivity. At least two treatment and product optimization methods/technologies will be established.	23. Eco-innovation: Qualitative description 24. Eco-innovation: Impact
	New circular job opportunities created in the biochar, biogas and fertilizer business	33. CE-based employment
<b>3 Closing material loops and reducing harmful resource use</b>	Consumption of virgin materials reduced by 5% at city level (compared to the start of the project)	35. Domestic material consumption (DMC) of virgin materials
	Increase in upcycled amount of organic waste by 50% by end of project (mass, volume or %) in the city of Mikkeli	53. Quantity of material for anaerobic digestion
<b>4 Improving human wellbeing and reducing environmental impacts</b>	10% reduced emissions of CO <sub>2</sub> related to reduced transport needs as well as substitution of fossil fuels (trucks) by biogas	85. GHG emissions per year

## 2.3. Plan for monitoring BW

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.

### 2.3.1. Circularity related stakeholder activities

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	6
	2	Indicator name	Circularity related stakeholder activities
Link to Circular City Definition	3	Vision Element	1. Local stakeholder actions
	4	Category	Engagement and capacity building
Indicator definition and description	5	Definition / Description of indicator	Description of activity type and dialogue methods, which stakeholder groups and when in the process # of people involved
	6	Rationale	<p>Several stakeholder actions are conducted during the CityLoops project and demonstration projects in the City of Mikkeli in order to develop tools and circular economy in close collaboration with local authorities and companies.</p> <p>Awareness raising and promotional actions – Undertaking awareness raising and capacity building for improving the collection and further use of biowaste in developed products. The qualitative description on the involvement of different stakeholder groups: 1. Collection and sorting, 2. treatment and final product, 3. BW group.</p> <p>Expected outcome:</p> <ul style="list-style-type: none"> <li>Improved interactions in the field of treatment between citizens, waste management companies and public authorities, through the establishments of stakeholder groups, i.e. on treatment and products (DA2)</li> <li>Improved interactions in the field of biowaste collection and sorting between citizens, waste management companies and public authorities, through the establishments of stakeholder groups, i.e. one on biowaste and one on collection and sorting (DA1)</li> </ul>
	7	Methodology	<p>a) Identify stakeholder activity (3 groups of stakeholders)</p> <p>b) Describe process and when stakeholders are involved (process is described in the stakeholder engagement plan)</p> <p>c) Identify dialogue methods used (meetings/workshops)</p>

			d) Number of people involved
	8	Unit	Qualitative data Potential quantitative impact data
Data	9	Baseline data / definition	Baseline 0, only activities during the project are measured, previous similar activities are not known/measured in Mikkeli.
	10	Data Sources / Relevant Databases	Memos of meetings, participant lists.
	11	Overall accuracy	reliable data, number of stakeholders involved
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	City of Mikkeli, demo-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023, constant data collection.
	15	SDG Reference	
Other	16	Comments	DA1 and DA2

### 2.3.2. Communication measures on circular transformations and waste prevention

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	11
	2	Indicator name	Communication measures on circular transformations and waste prevention
Link to Circular City Definition	3	Vision Element	1. Local stakeholder actions
	4	Category	Engagement and capacity building
Indicator definition and description	5	Definition / Description of indicator	Describe type of communication measures, e.g. campaigns, provision of information, events for the public/companies.
	6	Rationale	Several communication measures are conducted for general public and companies during the CityLoops project in the City of Mikkeli in order to increase knowledge on CE of BW.  Strategy of the City of Mikkeli 2018-2021:

		<p>Increasing the recycling of bio-waste by improving sorting and collection- Residential waste, waste recycling: Baseline 98.6% / Target 99%</p> <p>Expected outcome:</p> <ul style="list-style-type: none"> <li>• Improved interactions in the field of biowaste collection and sorting between citizens, waste management companies and public authorities, through the establishments of stakeholder groups, i.e. one on biowaste and one on collection and sorting (DA1)</li> <li>• Improved interactions in the field of treatment between citizens, waste management companies and public authorities, through the establishments of stakeholder groups, i.e. on treatment and products (DA2)</li> </ul>	
	7	Methodology	<p>a) Number of communication measures towards general public on CE transformation (e.g. webinars organised by the project, CityLoops presentations in other webinars, residential workshops, press releases, articles in media, published research articles, newsletter, web pages, )</p> <p>b) Number of people reached</p>
	8	Unit	<p>Number of communication measures</p> <p>Number of people</p>
Data	9	Baseline data / definition	Baseline 0, only activities during the project are measured. Only CityLoops activities are appropriate for this indicator.
	10	Data Sources / Relevant Databases	<ul style="list-style-type: none"> <li>• Published press releases and articles in media. Potential number of readers through circulation volume or edition of paper</li> <li>• Participant lists of webinars and other events.</li> <li>• Number of visitors in web pages: number of hits on website. Internet visitor counter on the pages/articles of City Loops -project in <a href="http://www.mikseimikkeli.fi">www.mikseimikkeli.fi</a> and <a href="http://www.xamk.fi/cityloops">www.xamk.fi/cityloops</a> on CL</li> <li>• Number of leaflets are handed out</li> </ul>
	11	Overall accuracy	medium accuracy as whole indicator, exact or estimated number of participants/readers. For articles data collected based on circulation/volume /edition.
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	City of Mikkeli, demo-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023. constant data collection (some automated in internet) and once for published articles.
	15	SDG Reference	

Other	16	Comments	Barriers/obstacles and framework conditions that may determine whether and to what extent the expected impacts will be achieved: in Mikkeli, monitoring to the obstacle of citizens not being active enough in improving recycling.  DA1 and DA2
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### 2.3.3. Circularity requirements in procurement beyond existing levels

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	12
	2	Indicator name	Circularity requirements in procurement beyond existing levels
Link to Circular City Definition	3	Vision Element	1. Local stakeholder actions
	4	Category	Regulation and incentives
Indicator definition and description	5	Definition / Description of indicator	Description of requirements in procurements going beyond what is current standard practice
	6	Rationale	<p>Procurement guidelines are prepared as a result of CityLoops project for City of Mikkeli to increase circularity of organic waste streams in public procurement processes. Procurement guidelines include new circular economy requirements beyond standard practice. The impacts are assessed as demonstration level (more efficient use of the end product of the biogas plant in landscaping in the city of Mikkeli and utilization of biomethane from biogas plant in urban transport). Indicator 12 is selected together with indicator 15.</p> <p>Strategy of the City of Mikkeli 2018-2021:</p> <p>Reducing traffic emissions -increasing the use of biofuels in the city for transportation and in transport contracts with stakeholders. Adding coverage of the biofuel distribution network and the number of biofuel vehicles used in the city.</p> <p>Expected outcomes:</p> <ul style="list-style-type: none"> <li>Promotion of circularity in the biowaste sector are embedded in Mikkeli's procurement practices</li> </ul>

	7	Methodology	<p>e) Decide which procurements are relevant for analysis (e.g. demo action focused procurements only or a wider range of procurements)</p> <p>f) Describe current standard practice in terms of CE requirements</p> <p>g) For each procurement case, describe additional requirements beyond standard practice</p> <p>h) In case of several relevant procurements, summarize relevant progress beyond existing levels</p>
	8	Unit	<p>Qualitative data</p> <p>Potential quantitative impact data</p>
Data	9	Baseline data / definition	Existing level in year 2019 on current circular economy requirements in transportation procurement contracts used.
	10	Data Sources / Relevant Databases	Public transportation service contracts and documents of the demo procurement.
	11	Overall accuracy	not relevant
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	Demo level
	14	Reference period	Project period 1.10.2019 – 30.9.2023
	15	SDG Reference	
Other	16	Comments	DA2

### 2.3.4. Procurement with circularity requirements beyond existing levels: Impact

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	15
	2	Indicator name	Procurement with circularity requirements beyond existing levels: Impact
Link to Circular City Definition	3	Vision Element	1. Local stakeholder actions
	4	Category	Regulation and incentives

Indicator definition and description	5	Definition / Description of indicator	# of procurements with circularity requirements Value of procurement with circularity requirements
	6	Rationale	Procurement guidelines are prepared as a result of CityLoops project for City of Mikkeli to increase circularity of organic waste streams in public procurement processes. Procurement guidelines include new circular economy requirements beyond standard practice. The impacts are assessed as demonstration level (more efficient use of the end product of the biogas plant in landscaping in the city of Mikkeli and utilization of biomethane from biogas plant in urban transport). Indicator 15 is selected together with indicator 12.  Strategy of the City of Mikkeli 2018-2021: Reducing traffic emissions -increasing the use of biofuels in the city for transportation and in transport contracts with stakeholders. Adding coverage of the biofuel distribution network and the number of biofuel vehicles used in the city.  Expected outcome: <ul style="list-style-type: none"> <li>Promotion of circularity in the biowaste sector are embedded in Mikkeli's procurement practices</li> </ul>
	7	Methodology	For each action: <ul style="list-style-type: none"> <li>Type of procurement action</li> <li>Value of procurement</li> </ul> For the whole period considered: <ul style="list-style-type: none"> <li>Time period</li> <li>Number of procurement contracts</li> <li>Sum up the total value of these contracts</li> </ul>
	8	Unit	Number of actions (procurement contracts) Number of clean buses Amount of biogas plant end product used for landscaping (tonnes)
Data	9	Baseline data / definition	Year 2019: Number of clean buses in local transportation service, amount of biogas plant end product used for landscaping
	10	Data Sources / Relevant Databases	Based on the city procurement documents and measuring the masses of end-products used for landscaping (demo level). Data collected based on communication with city officials.
	11	Overall accuracy	reliable data,
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	Demo level
	14	Reference period	Project period 1.10.2019 – 30.9.2023
	15	SDG Reference	
Other	16	Comments	DA2



## 2.3.5. New planning instruments/tools for improved circularity: Impact

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	21
	2	Indicator name	New planning instruments/tools for improved circularity: Impact (see also #22)
Link to Circular City Definition	3	Vision Element	1. Local stakeholder actions
	4	Category	Vision and urban management
Indicator definition and description	5	Definition / Description of indicator	Define and select planning instruments/ tools relevant to improve circularity. (To be selected together with indicator #22)
	6	Rationale	<p>Several planning instruments/tools are developed and/or demonstrated during the CityLoops project in the City of Mikkeli in order to improve OW circularity.</p> <p>Strategy of city of Mikkeli 2018-2021: Establishing new opportunities from the use of material flows in Mikkeli.</p> <p>Expected outcome:</p> <ul style="list-style-type: none"> <li>• New collection and sorting concepts and tools have been tested for biowaste, leading to improved opportunities in recycling and use of the material flow in Mikkeli. (City-level)</li> <li>• New collection and sorting concepts (i.e. distributing paper bags) for biowaste tested in the demonstration site (Demo-level)</li> </ul>
	7	Methodology	<p>Qualitative description of each instrument/tool</p> <p>5. OW quality assessment and business cases</p> <p>6. Procurement guidelines for OW products</p> <p>7. OW collection and sorting processes</p> <p>8. Treatment and final product optimization</p>
	8	Unit	Qualitative data

Data	9	Baseline data / definition	Baseline 0, only activities during the project are measured. Only CityLoops activities are appropriate for this indicator.
	10	Data Sources / Relevant Databases	The reports: tools fact sheets/description of tools, project reports.
	11	Overall accuracy	Not relative
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	City of Mikkeli, demo-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023, constant collection of data during project.
	15	SDG Reference	
Other	16	Comments	DA1

## 2.3.6. New planning instruments/tools for improved circularity: Impact

Metadata group	#	Metadata category	Fill in data for indicator
Identifier	1	Indicator number	22
	2	Indicator name	New planning instruments/tools for improved circularity: Impact (see also #21)
Link to Circular City Definition	3	Vision Element	1. Local stakeholder actions
	4	Category	Vision and urban management
Indicator definition and description	5	Definition / Description of indicator	Quantify impact of all planning instruments/tools described in indicator # 21. (To be selected together with indicator #21)
	6	Rationale	<p>Several planning instruments/tools are developed and/or demonstrated during the CityLoops project in the City of Mikkeli in order to improve OW circularity.</p> <p>Strategy of Mikkeli city 2018-2021: Establishing new opportunities from the use of material flows in Mikkeli.</p> <p>Expected outcomes:</p> <ul style="list-style-type: none"> <li>New products, service concepts and business models relating to the reuse/recycling of the specific material flows</li> </ul>

			<p>addressed, leading to new business opportunities and job creation</p> <ul style="list-style-type: none"> <li>• New collection and sorting concepts and tools have been tested for biowaste, leading to improved opportunities in recycling and use of the material flow in Mikkeli. (City-level)</li> <li>• New collection and sorting concepts (i.e. distributing paper bags) for biowaste tested in the demonstration site (Demo-level)</li> </ul>
	7	Methodology	<p>For each instrument/tool:            # of projects where tool was used (procurement guidelines)            Total mass of materials that the tool has impacted on per year            Recirculated mass of materials that the tool has impacted on per year</p>
	8	Unit	Number of tools and tonnes/year or % of material
Data	9	Baseline data / definition	<p>-amount of biowaste collected in Mikkeli. Baseline year 2019.            -Share (%) of biowaste within municipal solid waste (collected in demo-area, in sorting tests) year 2020            -number procurement guidelines made for OW-sector during project implementation. Baseline 0.</p>
	10	Data Sources / Relevant Databases	<p>-Waste companies' data on mass: collected amount of biowaste in Mikkeli. This data is collected and published in Metsäsairila's annual report.            -Data collected in Peitsari area sorting tests (demo).            Procurement guidelines used during project for additional data in city-level. Data collected based on communication with city officials.</p>
	11	Overall accuracy	medium accuracy. Estimates of tonnes/year or % for masses, and number of projects.
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	City of Mikkeli, demo-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023 Data collected from Metsäsairila 1/year, Demo 2/project, city: 1/project
	15	SDG Reference	
Other	16	Comments	DA1

### 2.3.7. Eco-innovation: Qualitative description

Identifier	1	Indicator number	23
	2	Indicator name	Eco-innovation: Qualitative description

Link to Circular City Definition	3	Vision Element	2. Circular business models and behavioral patterns
	4	Category	Private investments, jobs and gross value added
Indicator definition and description	5	Definition / Description of indicator	Describe the business model, including how it contributes to moving up the waste hierarchy (To be selected together with indicator #24)
	6	Rationale	<p>Business cases for reuse, recycling and valorisation of OW are developed during the CityLoops project in the City of Mikkeli.</p> <p>Strategy of the City of Mikkeli 2018-2021: Increasing the recycling of bio-waste by improving sorting and collection- Residential waste, waste recycling: Baseline 98.6% / Target 99%</p> <p>Expected outcome:</p> <ul style="list-style-type: none"> <li>At least 5 new treatment and product optimization methods/technologies are tested and evaluated (in demonstration level), considering technical viability, financial viability, and productivity. At least two treatment and product optimization methods/technologies will be established.</li> </ul>
	7	Methodology	<p># of new CE business models For each model, a qualitative description of model, its circular strategy.</p> <p>Qualitative description of the business models used to upgrade and sell the products made from biowaste such as biogas, fertilizers, and soil products and how the recycled raw material has been valorised to rise in the waste hierarchy (instead of being incinerated).</p>
	8	Unit	Qualitative data
Data	9	Baseline data / definition	Baseline 0, only activities during the project are measured. Only CityLoops activities are appropriate for this indicator.
	10	Data Sources / Relevant Databases	Project reports
	11	Overall accuracy	not relative
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	Demo level
	14	Reference period	Project period 1.10.2019 – 30.9.2023, constant data collecting during project.
	15	SDG Reference	
Other	16	Comments	DA2

## 2.3.8. Eco-innovation: Impact

Identifier	1	Indicator number	24
	2	Indicator name	Eco-innovation: Impact
Link to Circular City Definition	3	Vision Element	2. Circular business models and behavioral patterns
	4	Category	Private investments, jobs and gross value added
Indicator definition and description	5	Definition / Description of indicator	For each case of implementation of CE business models in indicator #23, describe impact in terms of value creation and material flow
	6	Rationale	<p>Business cases for reuse, recycling and valorisation of OW are developed during the CityLoops project in the City of Mikkeli.</p> <p>Strategy of the City of Mikkeli 2018-2021: Establishing new opportunities from the use of material flows in Mikkeli.</p> <p>Expected outcomes:</p> <ul style="list-style-type: none"> <li>At least 5 new treatment and product optimization methods/technologies are tested and evaluated (in demonstration level), considering technical viability, financial viability, and productivity. At least two treatment and product optimization methods/technologies will be established.</li> </ul>
	7	Methodology	<p>For each case of implementation of CE business models</p> <p>a) The monetary value (in euros) for biogas, soil improvement products (Phosphorus, nitrogen, potassium) and soil products.)</p> <p>b) materials impact amount of biowaste handled</p>
	8	Unit	Monetary value, tons/year
Data	9	Baseline data / definition	Baseline year 2020,
	10	Data Sources / Relevant Databases	<p>Number of new business models created</p> <p>Theoretical potential of business cases (estimated monetary value and material flow, included to project's reports)</p> <p>Realized business cases (monetary value and material flow, data from collaboration companies)</p>
	11	Overall accuracy	Estimated values, medium accuracy
Content	12	Sector coverage	OW
	13	Reference area / Spatial	Demo level

		implementation scale	
	14	Reference period	Project period 1.10.2019 – 30.9.2023, once/project
	15	SDG Reference	
Other	16	Comments	DA2

### 2.3.9. CE-based employment

Identifier	1	Indicator number	33
	2	Indicator name	CE-based employment
Link to Circ	3	Vision Element	2. Circular business models and behavioral patterns
	4	Category	Private investments, jobs and gross value added
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	<p>Project activities promoting circular economy and new business cases aim to provide new jobs in the City of Mikkeli.</p> <p>Valorisation of biowaste into new products through preliminary- and technical treatment is to enhance its regional market opportunities. In this process new job opportunities are being created.</p> <p>Strategy of Mikkeli city 2018-2021: Establishing new opportunities from the use of material flows in Mikkeli.</p> <p>Expected outcome:</p> <ul style="list-style-type: none"> <li>• New circular job opportunities created in the area of biowaste collection and sorting (DA1)</li> <li>• New business- and circular job opportunities created in the recycling of biowaste into new products such as biogas, fertilizers, and soil improvers (DA2)</li> </ul>
	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	number of Jobs or estimated, % of jobs becoming circular-related.
Data	9	Baseline data / definition	Number of circular jobs (% of jobs) from year 2019

	10	Data Sources / Relevant Databases	Number of jobs and job descriptions of Metsäsairila Ltd and Biosairila Ltd, and other relevant companies from year 2019
	11	Overall accuracy	Accurate. Exact number of jobs or estimated, % of job responsibility being circular
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	City of Mikkeli, sector-level
	14	Reference period	Project period 1.10.2019 – 30.9.2023, two times during project.
	15	SDG Reference	
Other	16	Comments	DA1 and DA2

### 2.3.10. Domestic material consumption (DMC) of virgin materials

Identifier	1	Indicator number	35
	2	Indicator name	Domestic material consumption (DMC) of virgin materials
Link to Circular City Definition	3	Vision Element	3. Closing material loops and reducing harmful resource use
	4	Category	Material/energy flow
Indicator definition and description	5	Definition / Description of indicator	The total amount of virgin materials directly used.
	6	Rationale	<p>Project activities aim to increase utilization of reused and recycled organic materials instead of virgin materials (e.g. phosphorus, nitrogen and potassium, biogas instead of using virgin fossil fuels).</p> <p>Strategy of Mikkeli city 2018-2021: Establishing new opportunities from the use of material flows in Mikkeli.</p> <p>Expected outcome:</p> <ul style="list-style-type: none"> <li>Potential to reduce consumption of virgin materials by 5% at city level (compared to the start of the project)</li> </ul>
	7	Methodology	In producing soil improvement, using nutrients from biowaste saves virgin material such as phosphorus, nitrogen and potassium.

			In producing biogas from biowaste instead of using virgin fossil fuels, how much virgin material is saved/year and what is its market value.
	8	Unit	tonnes/year, m <sup>3</sup> /year
Data	9	Baseline data / definition	Products sold/tons/2020/2021
	10	Data Sources / Relevant Databases	Metsäsairila, Biosairila, Etelä-Savon Energia <ul style="list-style-type: none"> <li>Amount of sold soil improvement, Metsäsairila</li> <li>Amount of sold biogas, Etelä-Savon Energia</li> </ul> Data available through communication to stakeholders.
	11	Overall accuracy	estimates of tons/year and euros/year
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	City of Mikkeli, sector level
	14	Reference period	Project period 1.10.2019 – 30.9.2023, 2 times/project
	15	SDG Reference	
Other	16	Comments	DA2

### 2.3.11. Quantity of material subjected to recycling

Identifier	1	Indicator number	52
	2	Indicator name	Quantity of material subjected to recycling
Link to Circular City Definition	3	Vision Element	3. Closing material loops and reducing harmful resource use
	4	Category	Re-use and recycling
Indicator definition and description	5	Definition / Description of indicator	Estimate material subjected to recycling at demo, <del>sector and city</del> level. 'Recycling' means processing of materials to achieve the original high-quality or reduce to low quality <sup>6</sup> .
	6	Rationale	Several project activities/tools aim to promote the recycling and upcycling of OW materials in Mikkeli.  Strategy of Mikkeli city 2018.2021: Establishing new opportunities from the use of material flows in Mikkeli.  Expected outcomes: <ul style="list-style-type: none"> <li>15% increased separate collection rate of biowaste within the demonstration site</li> </ul>



			<ul style="list-style-type: none"> <li>Increase in quantity of biowaste collected at city level</li> </ul>
	7	Methodology	At demo level it is needed to explore the share of biowaste in sorting tests and the mass of separately collected biowaste from weighing tests from demo area (amount in %).
	8	Unit	%
Data	9	Baseline data / definition	2020 first sorting test
	10	Data Sources / Relevant Databases	Demo -data on collected mixed waste and amount of biowaste.
	11	Overall accuracy	% amount
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	Demo level
	14	Reference period	Twice/year for demo level.
	15	SDG Reference	
Other	16	Comments	E.g. OW: share of biowaste in sorting tests, mass of separately collected biowaste from weighing tests from demo area. DA1

### 2.3.12. Quantity of material for anaerobic digestion

Identifier	1	Indicator number	53
	2	Indicator name	Quantity of material for anaerobic digestion
Link to Circular City Definition	3	Vision Element	3. Closing material loops and reducing harmful resource use
	4	Category	Re-use and recycling
Indicator definition and description	5	Definition / Description of indicator	Estimate mass of materials going to anaerobic digestion.
	6	Rationale	<p>Several project activities/tools aim to promote the recycling and upcycling of OW materials in Mikkeli.</p> <p>Strategy of the City of Mikkeli 2018-2021: Reducing traffic emissions -increasing the use of biofuels in the city for transportation and in transport contracts with stakeholders. Adding coverage of the biofuel distribution network and the number of biofuel vehicles used in the city.</p> <p>Expected outcomes:</p>

			<ul style="list-style-type: none"> <li>Increase in upcycled amount of organic waste 50% by end of project (mass, volume or %) in the city of Mikkeli</li> </ul>
	7	Methodology	<p>Sum of organic material going to anaerobic digestion. Data may come from waste management companies</p> <p>Weigh of biomass used in Biosairila's biogas plant/tonnes/year.</p>
	8	Unit	tonnes/year
Data	9	Baseline data / definition	starting from year 2020 the mass of organic material used in biogas plant of Biosairila
	10	Data Sources / Relevant Databases	Data from Biogas plant of Biosairila. Acquired through direct communication with Biosairila.
	11	Overall accuracy	Medium-good accuracy. Tonnes/year, weighted/estimate
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	City of Mikkeli
	14	Reference period	1.1.2020 – 30.9.2023, once/year
	15	SDG Reference	
Other	16	Comments	DA2

### 2.3.13. Incineration rate

Identifier	1	Indicator number	59
	2	Indicator name	Incineration rate
Link to Circular City Definition	3	Vision Element	3. Closing material loops and reducing harmful resource use
	4	Category	Waste generation/management
Indicator definition and description	5	Definition / Description of indicator	Mass percentage of waste which incinerated.
	6	Rationale	<p>- Several project activities/tools aim to promote the recycling and upcycling of OW materials in Mikkeli instead of incineration.</p> <p>- Strategy of the City of Mikkeli 2018-2021: Increasing the recycling of bio-waste by improving sorting and collection- Residential waste, waste recycling: Baseline 98.6% / Target 99%</p>

			Expected outcomes: <ul style="list-style-type: none"> <li>10% reduction in the amount of organic waste landfilled or incinerated in Mikkeli by the end of project</li> </ul>
	7	Methodology	Mass of materials incinerated divided by total amount of waste. Data from waste management companies.
	8	Unit	% of mass
Data	9	Baseline data / definition	demo-action data from 2020 and Metsäsairila's data from 2019
	10	Data Sources / Relevant Databases	Metsäsairila's waste company (annual report), demo actions report.
	11	Overall accuracy	Medium accuracy, estimated
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	City of Mikkeli, <del>demo level</del>
	14	Reference period	1.10.2019– 30.9.2023, Metsäsairila once a year, demo twice during project.
	15	SDG Reference	
Other	16	Comments	Demo information of the % of biowaste within MSW would be used to estimate the incineration rate at city level. Not very accurate, but interesting. Not possible to get accurate information of biowaste going to incineration at city level. (This is already measured in ind. 52 in a way for demo level.) DA1

### 2.3.14. Landfilling rate

Identifier	1	Indicator number	61
	2	Indicator name	Landfilling rate
Link to Circular City Definition	3	Vision Element	3. Closing material loops and reducing harmful resource use
	4	Category	Private investments, jobs and gross value added
Indicator definition and	5	Definition / Description of indicator	Mass percentage of waste which is landfilled.
	6	Rationale	- Project activities aim to increase reusing, recycling and upcycling of materials instead of landfilling.

			- Strategy of the City of Mikkeli 2018-2021: Increasing the recycling of bio-waste by improving sorting and collection- Residential waste, waste recycling: Baseline 98.6% / Target 99%  Expected outcomes: <ul style="list-style-type: none"><li>• 10% reduction in the amount of organic waste landfilled or incinerated in Mikkeli by the end of project</li></ul>
	7	Methodology	Mass of materials landfilled divided by total amount of waste.  Data from waste management companies.
	8	Unit	tons/year or %
Data	9	Baseline data / definition	amounts collected/landfilled from year 2019
	10	Data Sources / Relevant Databases	Yearly statistics of waste management company Metsäsairila Ltd.
	11	Overall accuracy	Accurate, exact values
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	City of Mikkeli, sector level
	14	Reference period	1.10.2019 – 30.9.2023, once/year
	15	SDG Reference	
Other	16	Comments	DA1

### 2.3.15. GHG emissions per year

Identifier	1	Indicator number	85
	2	Indicator name	GHG emissions per year
Link to Circular City Definition	3	Vision Element	4. Improving human well-being and reducing environmental impacts
	4	Category	Environment impacts (local)
Indicator definition and description	5	Definition / Description of indicator	The indicator measures CO <sub>2</sub> emissions in the demonstration actions.
	6	Rationale	- Developing processes and products that are more environmentally friendly, helps the city in its way of sustainability. - The amount of biogas sold instead of fossil fuel gas and its reduced greenhouse gas emissions.

			<p>- The amount of biogas used in waste transportation (used public transportation if data available) instead of using fossil fuels and how it reduced emissions of GHGs</p> <p>- Strategy of the City of Mikkeli 2018-2021: Sustainable development and combating climate change -favoring the introduction of energy solutions that are less harmful to the environment (solar, geothermal, hydro and district heating) -favoring the use of local biogas and electricity in city vehicles. indicators: - baseline CO2 equals 2017 is 5.5 - The target for 2021 is 4.8 t CO2eq / inhabitant</p> <p>Expected outcomes:</p> <ul style="list-style-type: none"> <li>• The recycling rate of organic waste have improved, which enables a 15% reduction in the greenhouse gas emissions (DA1)</li> <li>• 10% Reduced emissions of CO2 related to reduced transport needs as well as substitution of fossil fuels (trucks) with biogas (DA2)</li> </ul>
	7	Methodology	<p>Direct GHG emissions pr. year demo level</p> <p>Direct GHG emissions pr. year city level</p>
	8	Unit	Tonnes CO <sub>2</sub> -equivalents / year
Data	9	Baseline data / definition	Etelä-Savon Energia: sold amount of biogas from year 2020 demo-action data from 2020. (Slightly changed to suit demo level.)
	10	Data Sources / Relevant Databases	Etelä-Savon Energia on amount of biogas sold (through direct communication). Amount % increase in collected biowaste in demo site and how much biofuel can be produced from it. Demo-data (project reports), and literary knowledge on the amount of GHGs emitted through Biogas vs fossil fuels. (Slightly changed to suit demo level.)
	11	Overall accuracy	Medium-good accuracy. Tonnes CO <sub>2</sub> -equivalent/year
Context	12	Sector coverage	OW
	13	Reference area / Spatial implementation scale	Demo level
	14	Reference period	Project period 1.10.2019 – 30.9.2023, 2 times/project
	15	SDG Reference	
Other	16	Comments	<p>The outcome (DA1) moved from DA2 to DA 1 and changed to suit DA1. The original text from amendment: The recycling rate and treatment techniques of organic waste have improved, which enables a 15% reduction in the greenhouse gas emissions after the end of the project.</p> <p>DA1 and DA2</p>

## 3. 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 Keijzers (2021). Circular City Indicator Set. CityLoops Deliverable 6.1. 2021.

## 4. Annex 1: City Loops 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



## 5. 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 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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