




Mikkeli

Optimised Implementation Plan – Biowaste

South-Eastern Finland University of Applied
Sciences (XAMK)



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Abstract	This Optimised Implementation Plan explains how the City of Mikkeli will implement the tools and processes developed in the project preparation phase in its demonstration actions, and how relevant local stakeholders and CityLoops project partners will be involved.
Keywords	Demonstration; implementation; plan
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1. Biowaste Demonstrations in Mikkeli

South-Eastern Finland University of Applied Sciences Xamk and Mikkeli development Miksei Ltd are responsible for the demonstration actions related to biowaste (BW) in Mikkeli, together with Metsäsairila Ltd (waste management company), Mikalo Ltd (rental house company) and BioSairila Ltd (biogas company). Thus, within the framework of the project, demonstration actions promoting the circular economy of bio-waste will be carried out in the City of Mikkeli.

Improving waste treatment and the end of life options for organic materials are key for achieving a circular economy. BW is both a large fraction of waste and a source of circular opportunity. However, its recycling is not as efficient as it could be and in Mikkeli alone, a significant amount of bio-waste ends up among the mixed waste (approximately 35 % of mixed waste). In the future, the separate collection of bio-waste needs to be intensified, so that larger amounts can be collected separately and commercialized into biogas and soil amendments.

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. The main demonstration actions in Mikkeli are:

Demonstration 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.

Demonstration 2: BW treatment: pilot and laboratory scale experiments

Collected biowaste will be used for the production of biogas as fuel for local buses. 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 pretreatment 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.



Picture. Mikkeli wants to improve the recovery of nutrients from bio-waste streams (Picture Manu Eloaho, Xamk).

2. Demo action 1: Biowaste collection and sorting: pilot project

2.1. Short description

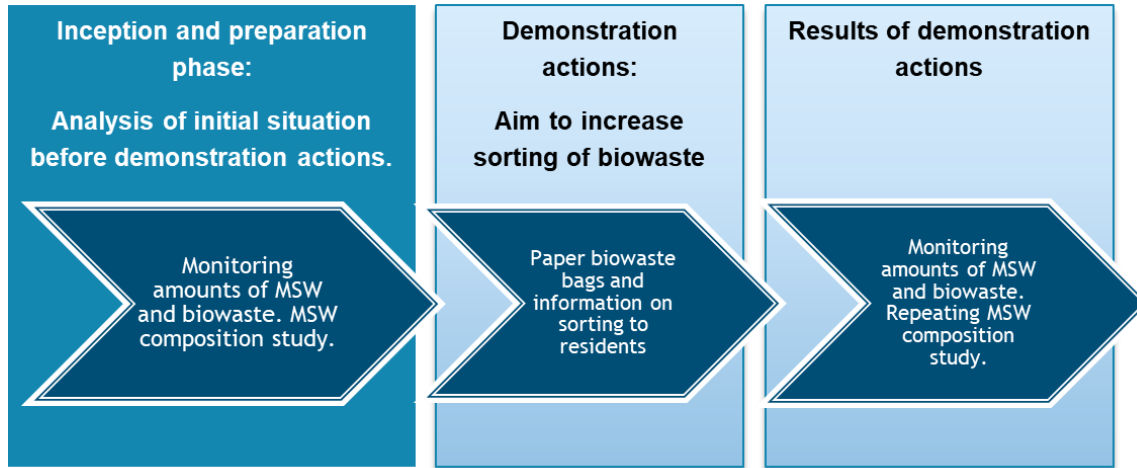
A new collection and sorting approach will be tested in a series of apartment buildings in the Peitsari district. The seven buildings, with a total of 278 apartments, are owned by the Mikalo Ltd municipal housing company. The aim is to increase the volume of quality biowaste collected separately, rather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

The demonstration action lead partner is Xamk. Miksei will support the action.



Picture. Increase sorting of bio-waste in the city of Mikkelä.

2.2. Tasks

Tasks	Timeline	Responsible partner
Sorting test/composition study 1.	2020	Xamk, with support from Metsäsairila Ltd and Mikalo Ltd.
Implementation of improved BW collection pilot in Peitsari, involving: <ul style="list-style-type: none"> Residential event in autumn 2021: encouraging residents to sort biowaste Delivering paper biowaste bags Further ongoing communication actions towards residents 	April 2021 – May 2023	Xamk and Miksei, with support from Metsäsairila Ltd and Mikalo Ltd.
Sorting test/composition study 2 in Peitsari demo area	May 2023	Xamk, with support from Metsäsairila Ltd and Mikalo Ltd.

Monitoring waste amounts (MSW and bio-waste) in Mikkeli and Peitsari demo area	June 2020 – May 2023	Xamk, with support from Metsäsairila Ltd
Stakeholder dialogue in new collection and sorting service design	April 2021- May 2023	Xamk, with support from Metsäsairila Ltd and Mikalo Ltd.
Evaluation of the demonstration action and revision of the procedures and tools, and sharing them with others interested in using them.	May 2021 – September 2023	Miksei and Xamk

2.3. Preparation

Prior to the implementation of the demonstration action, Mikkeli carried out two preparatory studies:

- An analysis of the current waste collection and treatment system for biowaste in Finland and more concretely in Mikkeli. This outlined volumes and composition of municipal solid waste (MSW) and biowaste collected, challenges and opportunities for better collection and sorting approaches, and potential business models for final products.
- An implementation plan for new collection and sorting processes for household organic waste, including a set of instructions for citizens, designed to increase the amount and quality of the collected biowaste. This report also contains the results of a study which measured the composition of municipal solid waste (especially the proportion of biowaste) in the demonstration area. This study will be repeated following the demonstration action to measure impact

All CityLoops biowaste tools and reports can be found here: [CityLoops - Biowaste](#)

2.4. Planned activities

Peitsari demonstration action

The new collection and sorting processes will be tested in Mikalo apartment houses in Peitsari.

At the start of the demonstration, Xamk and Miksei will activate the demo area citizens to sort biowaste: events for residents, newsletters, delivering compostable biowaste paper bags (new collection and sorting method) together with Metsäsairila Ltd and Mikalo Ltd.

The effect of the demonstration on the volume of biowaste collected, the quality of the biowaste and the mixed waste will be established and compared with the situation prior to the demonstration.

Afterwards, the demonstration will be evaluated and Xamk and Miksei Mikkeli will prepare for upscaling, in cooperation with stakeholders involved.

Potentially new ideas and approaches deriving from the stakeholder dialogue activities described below, may be integrated into the Peitsari demonstration project, or in other parts of the city.

Stakeholder dialogue

A Mikkeli **Biowaste stakeholder group** has been established (with a first meeting in Feb. 2021), consisting of citizens from Peitsari, waste management companies and municipal bodies. Over the course of the project 2-3 meetings per year where the progress of the demonstration project will be examined the results will be presented, and any optimisation adjustments discussed. At these meetings alternative collection models (e.g. joint collection bins, collection fees) and citizen engagement actions aimed at maximising volume and quality of collected biowaste will also be discussed to feed into later replication and upscaling activities.

In addition a **Collection and sorting stakeholder group** has been established involving the organisations directly involved in the operation of biowaste collection and sorting in the Mikkeli region, namely: Metsäsairila Ltd (municipal waste management company), City of Mikkeli, Mikalo (municipal housing company). This group has met multiple times in the preparation of the demonstration action, and will continue to meet 6-10 times per year. This group will also analyse and discuss on an ongoing basis different collection and sorting models, and will be ultimately responsible for operationalising future activities across the city.

Both groups will be involved in a specific workshop to be held (likely in autumn 2021) on collection and sorting service design. This workshop will serve to identify which methods of collecting would best motivate and serve the customers of the waste companies, covering different types of district in the Mikkeli region, including more sparsely populated areas. *Service*

design is the activity of planning and arranging people, infrastructure, communication and material components of a service in order to improve its quality, and the interaction between the service provider and its users. Service design may function as a way to inform changes to an existing service or create a new service.

Business cases: Collection and logistics system

Alongside the demonstration actions and stakeholder dialogues an analysis of the business cases underlying different separated collection and logistics systems will be explored. Two issues particularly to be considered are:

- Analysis of nutrient recovery potential based on the current estimated volumes of biowaste in municipal solid waste, and nutrient content in biowaste. The amount of nitrogen and phosphorus found in biowaste is critical to the value of products. The more biowaste is collected, the more material can be used in biogas production and as soil improvers, which have also economic benefits.
- Other issues affecting profitability of biowaste collection, such as logistics and separated collection systems in sparsely populated area as well as possible barriers (eg. legislation related to collection and treatment, citizen engagement)

This work will draw on literature, interviews with experts and the organisation of the workshop on collection and sorting service design described above. It will also draw on the discussions within the stakeholder activities described above, and on any potential further approaches piloted in other parts of the city.

2.5. Expected outcomes & evaluation

The demonstration action will deliver:

- Results from the demonstration site, indicating the success of the new biowaste sorting and collection approach in increasing the volume and quality of separated biowaste
- Improved recycling and treatment techniques, in combination with demo action 2, enabling a 15% reduction in the greenhouse gas emissions
- An assessment of the business cases underlying different separated collection and logistics systems in the Mikkeli region
- An upscaling and replication approach for improving separate biowaste collection across the region of Mikkeli, covering different models of service design.
- Improved interactions in the field of biowaste between citizens, waste management companies and public authorities, including through the newly established “biowaste group”

In the longer term: within 5 years of the end of the project, the City of Mikkeli wishes to be recognised nationally as a “Circular Economy City”, offering possibilities for CE and new business opportunities through different networks. The City is aiming within 20 years to be fully operating according to CE principles.

The success and outcomes of the demonstration actions will be assessed using the following tentative list of indicators. More information can be found in the Evaluation Plan of the City of Mikkeli

Evaluation Plan: demo action 1 indicators:

6. Circularity related stakeholder activities
11. Communication measures on circular transformations and waste prevention
21. New planning instruments/tools for improved circularity: Qualitative description
22. New planning instruments/tools for improved circularity: Impact
23. Eco-innovation: Qualitative description
24. Eco-innovation: Impact
33. CE-based employment
52. Quantity of material subjected to recycling
53. Quantity of material for anaerobic digestion

55. EOL-RR (End of Life Recycling Rate)

59. Incineration rate

61. Landfilling rate

85. GHG emissions per year

2.6. Risks

Potential risk	Mitigation approach
Personnel changes	There are many people at work in organisations/stakeholders. Specialists working in their organisations as a stakeholder role with CityLoops may change their employee. This will be mitigated through a deputy procedure
Pandemic situation: Covid-related delays	Online meetings will be organised. A transparent approach to work facilitates to less risks in case of illnesses.

3. Demo action 2: Biowaste treatment: pilot and laboratory scale experiments

3.1. Short description

Biowaste is an important raw material for biogas production. However, its recycling is not as efficient as it could be and in Mikkeli alone, a significant amount of biowaste ends up among the mixed waste (approximately 35 % of mixed waste). In the future, the separate collection of bio-waste needs to be intensified (as addressed in demo action 1), so that larger amounts can be commercialized into biogas and soil.

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

The project develops and tests mechanical pre-treatment methods such as crushing, mixing and sieving. The aim of these are 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.

Demo action lead partner is Xamk, supported by Miksei.



Picture. The use of the end product in landscaping in the city of Mikkeli (Picture Panu Jouhkimo, Miksei).

3.2. Tasks

Tasks	Timeline	Responsible partner
Laboratory and pilot-scale tests: mechanical preliminary treatment, waste treatment process (e.g biogas) and final product optimisation together with stakeholders involved.	March 2021 - May 2023	Xamk
Development of Business cases: - Market analysis (e.g biogas, fertilizer, soil products). Viability of new products - Economic analysis	March 2021 - May 2023	Miksei
Testing procurement guidelines together with city of Mikkeli and stakeholders.	March 2021 - May 2023	Miksei
Evaluation of the demonstration action and	May 2021 – September 2023	Miksei and Xamk

revision of the procedures and tools, and sharing them with others interested in using them.		
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3.3. Preparation

Prior to the implementation of the demonstration action, a series of pre-trials were carried out to provide some preliminary analysis, and test the equipment required to deliver the laboratory tests of the innovative treatment and final product optimization processes and techniques to be carried out in the demonstration action itself.

An implementation report has been produced, outlining the different processes and techniques to be tested, and equipment required.

In addition, two sets of procurement guidelines have been produced for use by the city of Mikkeli during the demonstration project:

1. A procurement guide for usage of biogas as a motive power in transportation and logistics services.
2. A general guide for biowaste management in public procurement.

All CityLoops biowaste tools and reports can be found here: [CityLoops - Biowaste](#)

3.4. Planned activities

Demonstrations actions of CityLoops will serve as a platform for the development of new products: Treatment of biowaste, the use of biochar in the production process or the end product to add desirable properties to them. During the demonstrations three interdependent actions will be performed:

- A. Lab scale tests to establish technical data concerning the proposed technologies and products
- B. Business case development for the proposed technologies and products for the region of Mikkeli, including market analysis and economic profitability

C. Testing of procurement guidelines on two selected cases.

Laboratory testing of pre-treatment, treatment and final product optimization techniques

Xamk will test a series of new treatment techniques in laboratory and pilot scale together with local companies, to allow the development of new products:

- Pre-treatment (sieving, crushing and mixing)
- Materials to be treated are biowaste and garden waste: optimization of dry fermentation process
- Using biochar as an additive component in biogas process and in final product (which enables more complex functional properties of the productized fertilizer e.g. water and nutrient storage).
- Final product optimization
 - Separation of liquid and solid fraction
 - Testing electrochemical methods
 - Fractioning, pelletizing, drying of digestate
 - Ecotoxicity tests

Business cases: valorisation pathways

Miksei will produce a market analysis on the valorisation of biowaste. This business case analysis will focus on three types of end product:

- Transport biomethane (produced directly by the new biogas plant)
- Fertiliser (produced as a by-product of biomethane production)
- Soil improvement products (produced as a by-product of biomethane production)

This business case work will examine the viability of these products and the economic factors involved. The work will be carried out in collaboration with a ***New treatment and final product/stakeholder group***, consisting of Metsäsairila Ltd (municipal waste company), Biosairila (biogas plant) and Etelä-Savon Energia (distributor of biogas in Mikkeli), and will be managed by Miksei.

The work will utilise information obtained from literature, looking into the main factors influencing the developed products such as markets, EU directives and law as well as municipal decision making. Through interviewing stakeholders involved, more information about the local markets, manufacturing processes, volumes, obstacles and uncertainty's of the

businesses where attained. An economic evaluation will be made for the different valorisation options for the region of Mikkeli.

Procurement guidelines

The procurement guidelines developed during the preparation phase will be tested during demonstration phase within two specific cases:

- Case 1: More efficient use of the end product of the biogas plant in landscaping in the city of Mikkeli
- Case 2: Utilization of biomethane from biogas plants in urban transport: buses and city-owned cars.

3.5. Expected outcomes & evaluation

After completion of demonstration actions, the objective is to establish at least two innovative nutrition extraction and product creation technologies and business opportunities in Mikkeli.

One of these innovative technologies will focus on developing new products and business opportunities for biowaste, while another one focuses on the use of biochar as an additive for organic material and electrochemical methods for the recovery of nutrients and biowaste: 5 cases evaluated.

The success and outcomes of the demonstration actions will be assessed using the following tentative list of indicators. More information can be found in the Evaluation Plan of the City of Mikkeli

Evaluation Plan: demo action 2 indicators:

6. Circularity related stakeholder activities
11. Communication measures on circular transformations and waste prevention
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
23. Eco-innovation: Qualitative description

- 24. Eco-innovation: Impact
- 33. CE-based employment
- 35. Domestic material consumption (DMC) of virgin materials
- 52. Quantity of material subjected to recycling
- 53. Quantity of material for anaerobic digestion
- 85. GHG emissions per year

3.6. Risks

Potential risk	Mitigation approach
Personnel changes	There are many people at work in organisations/stakeholders. Specialists working in their organisations as a stakeholder role with CityLoops may change their employee. This will be mitigated through a deputy procedure.
Pandemic situation: Covid-related delays	Online meetings will be organised. A transparent approach to work facilitates to less risks in case of illnesses.



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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