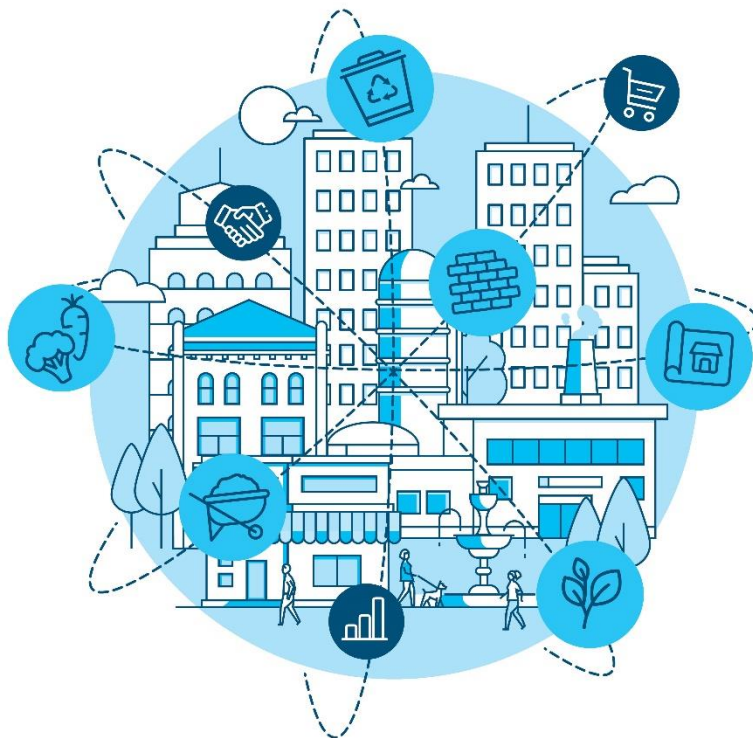





# Roskilde

# Optimised Implementation Plan – CDW

# Roskilde Kommune



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Abstract	This Optimised Implementation Plan explains how Roskilde will implement the tools and processes developed in the project preparation phase in its demonstration action, and how relevant local stakeholders and CityLoops project partners will be involved.
Keywords	Demonstration; implementation; plan
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# Circular urban development at the Musicon area

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

## 1. Demo action 1: Demolition of Hall 11/12 area, preserving the building structure and facilitating reuse of CDW

### 1.1. Short description

Hall 11 is a secondary building situated in the demonstration area. It will be demolished and materials from the demolition will be incorporated into other construction projects. The function of hall 12 was and will remain a skate hall. Beams and pillars and the main steel structure of hall 12 will be preserved - therein lies the greatest savings in materials and CO<sub>2</sub>. The building will get a new roof, new façade and new interior. Hall 12 will be connected with a new multi-storey car park by a roof spanning 12 x 45 metres.

The buildings had a pre-demolition screening and selective demolition will take place, keeping reusable elements in storage for reuse in new buildings and creating material passports documenting their quality and possible use. A virtual material bank will be created through design for disassembly using Building Information Modelling (BIM) for information on regulations, quantities, material types, etc. LCA on selected materials will aid in decision making by revealing the carbon emissions impacts of different handling options. Roskilde will also try to implement circular soil strategies in the project by minimising soil movement and facilitating reuse on site.

By May 2021, the buildings will have been screened by Golder (a contracted consultant) using the CityLoops pre-demolition guidelines. LCA on selected materials will have been performed by mid-2021 as well. Selective demolition will take place between March – August 2021, keeping the main structure intact. Concrete recovered from the demolition will be crushed for recycling into new concrete in the construction of a multi-storey car park.

## 1.2. Activities

Activities	Timeline	Responsible partner
Tendering of screening procedure and demolition works	May 2020 – Sep 2020	RK
Screening of hall 11/12 to identify and document materials	June 2020 – May 2021	RK and Golder Associates (consultant)
Selective demolition of hall 11/12, keeping main structures and dismantling recoverable materials for other uses	March 2021 – March 2022	RK and demolition contractor

## 1.3. CityLoops tools/processes tested

### Lifecycle CO<sub>2</sub> calculator for construction materials

#### Lifecycle CO<sub>2</sub> calculator - soil

The tool calculates the CO<sub>2</sub> impact of excavating and moving soil from a site. In the demonstration phase, the methodology will be applied to planned soil movements in Musicon, including related to the demolition and reconstruction works of hall 11/12, and is also considered in the procurement/ bidding process for the demolition works, to encourage site soil balance.

#### Lifecycle CO<sub>2</sub> calculator - Concrete

The tool calculates the lifecycle CO<sub>2</sub> impact of using and demolishing concrete. This tool will be used in the Hall 11/12 pre-demolition screening to make decisions about the demolition and recycling of concrete. The tool will also be applied to other projects in the Musicon area.

#### Lifecycle CO<sub>2</sub> calculator - CDW

The LCA tool for CDW (various materials) will serve as a planning and decision making tool, specifically for the demolition process, helping you to make different decisions on whether to keep and refurbish, deeply renovate, or demolish a building by comparing a multi-material composite calculation. It will take into account pre-demolition state, and post-demolition state of the CDW. The tool is to be tested at Hall 11/12 and the methodology will be applied in other projects in Musicon.

### **Screening procedure and selective demolition**

Hall 11/12 has been screened for material inventory by Golder using the CityLoops guidelines. The selective demolition procedure will be applied to three buildings in the hall 11/12 area at Musicon, to identify and keep materials with potential for reuse.

### **Construction material passport, databank and digital market place for recovered materials**

A material passport will be created for selected materials from the demolished buildings. A virtual material bank is sketched and will be used for hall 11/12 - both for materials going out (in the selective demolition) and in the new renovated hall. The first version consists of an Excel sheet for each material, describing its lifespan, what kind of testing it has to go through, and where it could end up in future uses.

The virtual material passport and databank are merged in one database. The circular procurement strategy includes use of the virtual material bank to source and supply secondary construction materials. The data is extracted from BIM models and kept in a database. Roskilde asks for the BIM in the tendering process for each building to be built at Musicon, to ensure such documentation is available for the future. Contractors need to provide a Revit/BIM model level of detail of each building with amounts/ types of materials.

The tools can be seen here: [CityLoops Tool Factsheets](#)

## **2. Demo action 2: Construction of Multi-storey Car Parks**

### **2.1. Short description**

#### **Demo 2a: Construction of Car Park 1 'Indfaldet'**

Construction of Car Park 1 will be finished in mid-2021. When Roskilde started digging in preparation for the car park, they discovered a large amount of concrete obstacles in the ground stemming from the site's concrete production function in the past. The concrete unearthed in CityLoops was kept on site and crushed into a mixed fraction. The mixed fraction was used for material layers below the concrete, replacing virgin gravel. Other concrete recovered from the digging was cleaned and crushed, to be mixed on site and used in new concrete. This has made a very positive business case.

A criterion in the tender for the new car park was that the developer foresee design for disassembly, including scenarios for future recycling. Consequently, a report was delivered by the contracted developer (MT Højgaard). They created the multi-storey car park with a steel skeleton, premade components assembled by bolts and a minimal use of concrete. They made

calculations on CO<sub>2</sub> for future reuse/ recycling and have documented the benefits on future use of materials from the car park. The local Parkour club is to finish/ furnish their area of the Car Park 1 with materials from the material bank at Musicon.

### **Demo 2b: Construction of Car Park 2 ‘Pulsen’**

The second multi-storey car park will be built as a steel structure, and Roskilde is involving the market in risk model analysis and testing. 100% recycled coarse fraction and 50% recycled fine fraction of recycled concrete will go into the foundation for Car Park 2. It's a new construction, so circular strategies such as design for disassembly will be added. Roskilde will create a physical construction material bank in the ground floor of Car Park 2. There will be a roofed passageway between this car park and hall 12.

Finally, a third car park will be built in the Musicon area, which will be used for replication (and is therefore not included as a demonstration action here). The material and design strategies for Car Park 3 will draw upon learnings from the circular considerations of Car Parks 1 and 2.

## **2.2. Activities**

### **Car Park 1**

<b>Activities</b>	<b>Timeline</b>	<b>Responsible partner</b>
Tender for construction	Dec 2019 – Feb 2020	RK
Crushing of concrete for recycling	Nov - Dec 2020	RK
Replacement of dug out materials with crushed materials	Dec 2020 – Feb 2021	Contractor
Casting of concrete with recycled materials	March 2021	RK & MT Højgaard
LCA calculations on recycled materials and design for disassembly	Apr 2021 - Jul 2021	Contractor
Construction of car park	Apr 2020 – Sep 2021	Contractor

### **Car Park 2**

<b>Activities</b>	<b>Timeline</b>	<b>Responsible partner</b>
Conceptual design phase	Apr - Jul 2021	RK
Programming and design development	Aug - Dec 2021	RK
Tender and construction bidding	Jan - Jul 2022	RK
Construction and preparation for service	Aug 2022 – Sep 2023	Contractor

Establish material bank at ground floor	Sep 2023	RK
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## 2.3. CityLoops tools/processes tested

### Lifecycle CO<sub>2</sub> calculator for soil and concrete

LCA for soil and concrete will be used, applying the methodology to the mixed soil/concrete that was dug out and recycled to calculate CO<sub>2</sub>-savings thanks to the circular approach.

### Construction material passport and CDW materials databank

The construction of the car park will use reused/ recycled components and materials stored on-site from the demolition in the Hall 11/12 area. In Car Park 2, a physical material bank will be established on the ground floor. The Car Park 1 Pulsen was designed for disassembly, meaning that the building itself will be mapped and categorised for future use – as a material bank in itself.

The tools can be seen here: [CityLoops Tool Factsheets](#)

# 3. Demo Action 3: Circular Soil Management

## 3.1. Short description

This action focus on creating circular soil management at city level in order to keep excavation of soil to a minimum and use excess soil locally, instead of driving it further away. A draft of the framework for circular soil handling (tool 3) will be tested in the demonstration actions at Musicon and results will feed into a template for soil strategy developed at later stage in the project. An instrument for predicting how much soil will be excavated in the city is developed and tested at city level (tool 4), thus making it possible to feed into a soil strategy which adequately meets future challenges. Barriers to reusing soil will be uncovered by interviewing stakeholders, which will feed into the assessing soil reuse potential (tool 5). A methodology will be developed and tested for the identification and assessment of relevant sites/projects fit for soil reuse (tool 6).

In Musicon, soil is treated like any other waste stream: it is kept separate and kept track of. The LCA calculations proving the environmental impact of excavation and moving of masses are used as arguments for planning and decision making to keep soil in the ground or use it on-site. In the Hall 11/12 area, the plan is to keep soil on-site.

## 3.2. Activities

Activities	Timeline	Responsible partner
Prognosis: prediction of future excess soil in Roskilde, as a baseline study	Apr 2020 – Mar 2021	CRD and HTK
Interviewing stakeholders (developers and contractors) identifying barriers to why soil is not reused.	Jan - Apr 2021	HTK, RK, CRD
Incorporating a circular soil strategy for Roskilde in relevant urban development strategies and estate management strategies	Oct 2019 – Sep 2023	RK assisted by CRD
Adoption of the circular soil strategy by the City Council in Roskilde	Mar - Sep 2023	RK
Evaluating effect of circular soil initiatives on amounts of excess soil	Sep 2021 - Sep 2023	RK assisted by CRD

## 3.3. CityLoops tools/processes tested

### Framework for circular soil management

Roskilde will incorporate a circular soil strategy in urban development strategies as well as real estate management strategies. It will be a set of levers, procedures or tools that are developed as they go according to how to address each identified barrier. For tendering, prices are needed to be able to calculate more accurately the economic potential of circular soil management in the future. The effect of the circular soil strategy will be evaluated on an annual basis by comparing predicted soil volumes (tool 4) with soil volumes actually produced in corresponding years.

### Instrument for predicting future excavated soil production

Roskilde has used this tool to predict annual volumes of future excavated soil within a period of 12 years (2020-2031). It will be evaluated by comparing predicted soil volumes with annual soil volumes reported. The prediction is based on a “business as usual” scenario, considering a situation where municipal planning and construction activities are performed without paying special attention to excavation and production of excavated soil. It is based on historical analysis and knowledge of major construction projects that will take place in the future. In the CityLoops demonstration phase, the prognosis will be used to explore what can be done: look at the big potential excavations, and mobilise planning efforts to avoid soil excavation, contamination and movement – creating both economic and CO<sub>2</sub> savings.

### Assessing soil re-use potential



Roskilde will perform a series of interviews to stakeholders about the barriers to implementing a great degree of soil reuse on site. This will link to the tool for assessing soil reuse-potential developed by the Capital Region Denmark and Høje-Taastrup.

The tools can be seen here: [CityLoops Tool Factsheets](#)

## 4. Expected outcomes & evaluation

The expected result of Roskilde's demonstration actions is that Hall 11 has been demolished and Hall 12 has been stripped, reusing the basic structure of the building for the new skater hall. The selective demolition will have provided materials for reuse or recycling e.g. in the construction of a new multi-storey car park. Soil from the construction activities is reused locally under Car Park 1 and for combined climate-adaptation and recreational purposes.

In 5 years, circular procurement will be a standard in all of Roskilde Municipality's larger construction projects, and the demand for reuse and recycling of construction and demolition waste will be a central focus point in the tender process. In 5 years, the municipality will be able to calculate the environmental effect of different CDW actions through tools partly developed in CityLoops

*Further information on Roskilde's demonstrations can be seen at:*

<https://cityloops.eu/cities/roskilde>

## 5. Planning & Decision Making Guidelines

Experiences from the tendering, preparatory works, demolishing and recycling will feed into the process of developing these guidelines. Roskilde has done a workshop on this with Roskilde University. The CityLoops planning and decision making guidelines are to be tested for new construction projects in Musicon and elsewhere in the municipality.

[Factsheet for Planning and Decision Making Guidelines](#)

## 6. Business Cases

Car Park 1 (Indfaldet): Roskilde will make a business case on Car Park 1, where they have saved almost 400 000 DKK by using a circular approach. Savings come from using the soil and concrete mix freed from under the car park for the unbound subbase, which could replace virgin gravel. Crushing concrete locally and reusing it on-site in construction has kept costs and carbon emissions down. This has proven to be an appropriate solution. The contractor was able to keep the construction site running continuously. As a developer, Roskilde was able to minimize costs associated with obstacles, e.g. additional cost associated with excavation of obstacles in the ground and various measures in connection with the framing of piles. This extra work would have had to be carried out in any case. The cost savings are compared to a conventional scenario, with waste handling fees for scrapping, loading and disposing of concrete residues, as well as delivery and installation of new gravel filling.

The Car Park 1 itself is built for disassembly with a steel skeleton and premade components assembled by bolts and minimal use of concrete. The CO<sub>2</sub>-savings from choosing this construction have been calculated. The economy of choosing this construction is good, but it is hard to provide a clear business case on the circular construction versus a conventional concrete based construction, as you would need to know the price of the alternative. Roskilde and Capital Region Denmark will see if it is possible to make a sensible business case.

[Factsheet for Business Cases](#)

## 7. Risks

Potential risk	Mitigation approach
The Coronavirus pandemic might delay things, as many stakeholders are being affected as well as the municipality's economy.	The pandemic did cause some slow processes, but risks should be largely passed by the time the demonstration phase begins. The CityLoops team remained persistent and well-organised to surpass this challenge.
Change of timetable due to political decisions	Roskilde's CityLoops team has to be resilient to adapt to changing urgencies and priorities, but the overall arc of the future of Musicon bends to circularity nonetheless.



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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