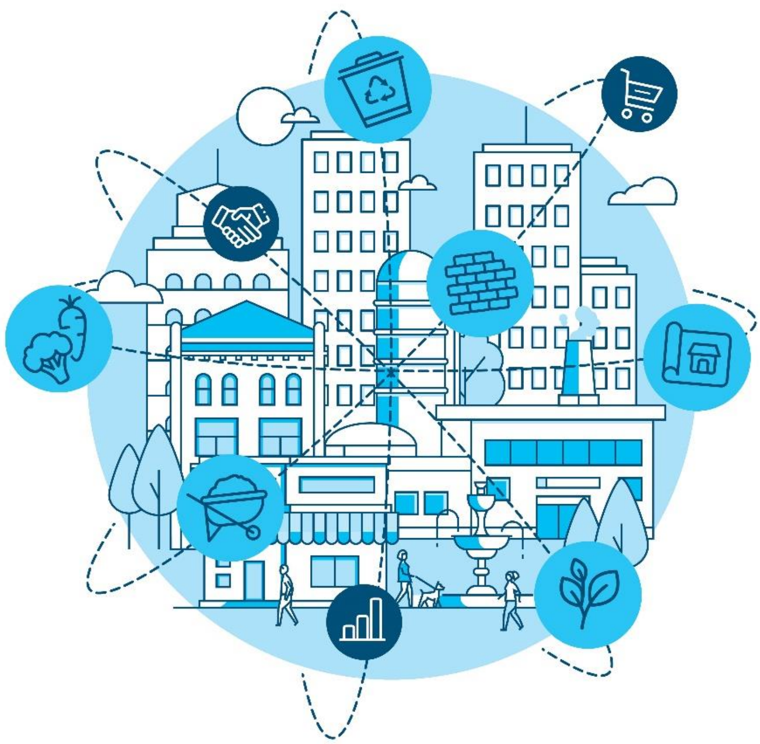
Circular demolition in Apeldoorn

Extract from the Demonstration Report

Apeldoorn, The Netherlands



Contents

This text describes Apeldoorn's experience in the demolition of Griffiersveld. The sections come from Apeldoorn's CityLoops demonstration report available here.

Demolition of Griffiersveld in Apeldoorn

During the last four years, the municipality of Apeldoorn, located quite centrally in the Netherlands, through the H2020 CityLoops project was able to take part in a circular transition process. The demonstration actions were all related to a residential road renovation project at Griffiersveld (see Figure 1 for the before situation and see Figure 2 for the situation after renovation). In Apeldoorn the CityLoops Demonstration project concentrates on the challenge to renovate as circular as possible a paved road named Griffiersveld, as well as the public space directly surrounding this road. Constructed in 1976, this road is located in a residential area called De Maten. The budget for the future contractor to team up in the last phase of the design process was set at € 50,000 and for executing the renovation € 500,000 was set aside.

***Figure 1**. An impression of the residential road Griffiersveld before renovation.*

***Figure 2.** Parking space after renovating Griffiersveld where old concrete pavers were reused*

Before renovation, the winding road Griffiersveld consisted of concrete pavers and concrete paving slabs covering a surface of approximately 4,845 m^2 (see Figure 3 and 4).

__Figure 3.__ The particular residential area with its winding road Griffiersveld.

__Figure 4.__ Impression of the local situation at Griffiersveld in the municipality of Apeldoorn before renovation.

Policy at the municipality of Apeldoorn is that the current status of her roads is recorded in an asset management software system. Once every two years, a visual inspection takes place on site. The results of these inspections are recorded within the asset management system. After a fixed number of years, as well as on the basis of a bad result at an inspection or due to complaints from users, maintenance and renovation activities are being planned. Griffiersveld qualified for a renovation trajectory.

Although every road section was inspected once every two years and a digital twin of these road sections is available in the asset management software, Griffiersveld was subject to two extra scanning trajectories to collect more detailed information on the road materials used (see for more information on these scans: Entrop, 2022a and Entrop, 2022b). This information was helpful to come to a project passport addressing the quantities and qualities of road materials.

The road was composed of concrete pavers and concrete paving slabs (30 cm x 30 cm). To keep things in place, concrete curb stones were applied. In Appendix A of the full demonstration report, a detailed drawing can be found showing all the paving materials with their quantities that needed to be taken out.

In tendering the contractor reuse and recycling options were already mentioned by the principle. In this situation, it is important to mention that there is for the municipality, being the principal, only one contractor. In their contractual agreement, one and the same contractor digs up the road, alters the stormwater facilities, does the logistics, and also paves the road. When it comes to buildings, quite often the demolition trajectory is done separately from the site preparations and the actual building activities.

When the contract was prepared and signed, the opportunity existed to work out the plans for selective demolition for this road project in more detail, as Figure 5 suggests. Considering that in this renovation project the waste material groups concrete, bricks, tiles and ceramics (EWC Code 1701) and soil, stones and dredging soil (EWC Code 1705) are mainly involved, the demolition is possibly not as complicated as for some buildings. Nevertheless, selective

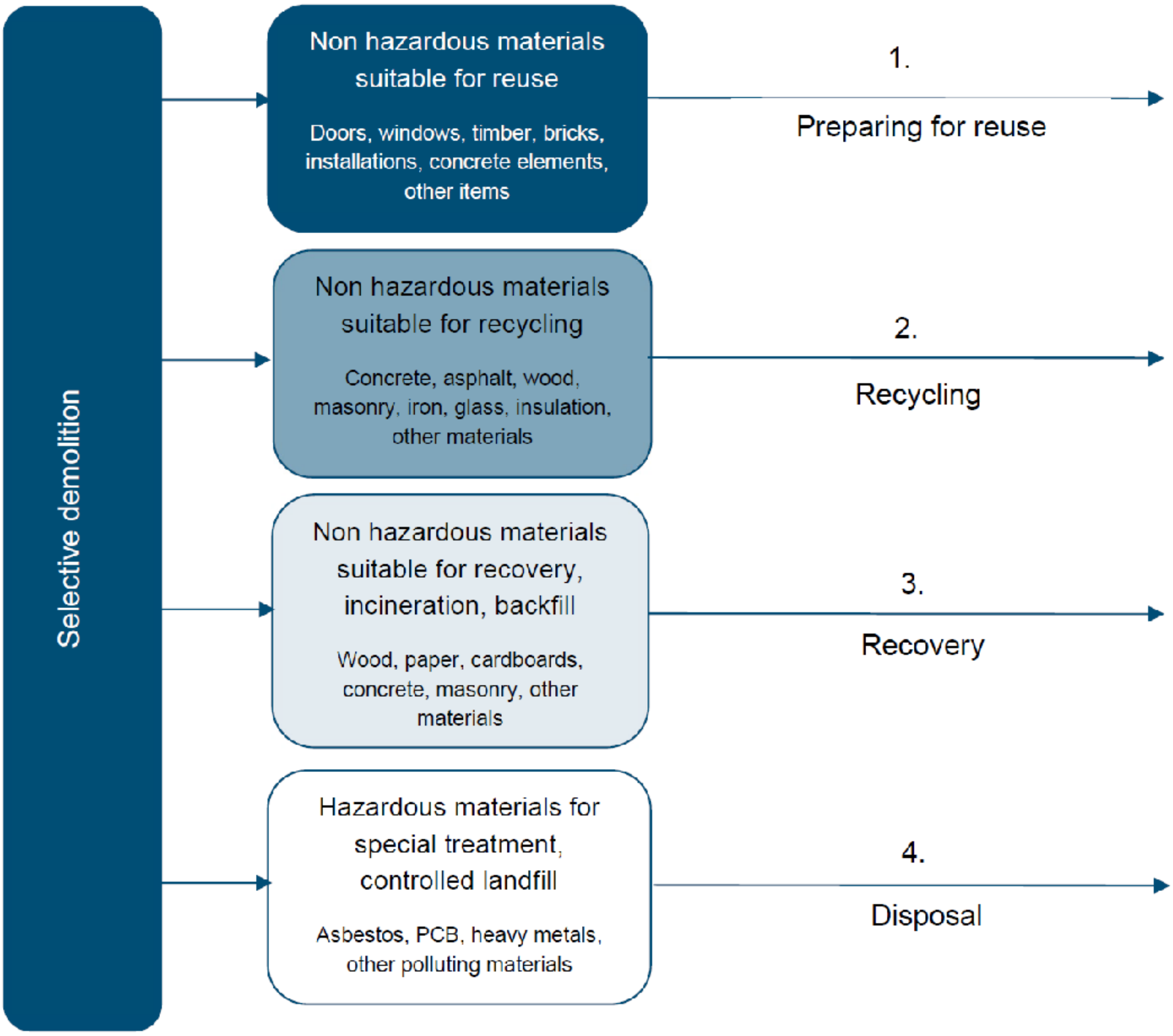


Figure 5. *Framework for decision-making on materials & waste management (Malk and Lauritzen, 2021, p.21).*

demolition did need and also received the necessary attention in this project. Typical handling processes for the first material group are crushing and recycling, and for the second material group reuse of clean soil, cleansing and recovery of soil containing hazardous substances.

From an aesthetic point of view, it was not acceptable to the urban planners to leave the old concrete pavers, concrete paving slabs and curb stones in place. However, the principal and contractor did come to actions that increased the reuse of products on and off-site. The CDW management will be set out for the two main material groups present on site, namely sand and concrete materials.

Sand

Already for many years, the municipality of Apeldoorn is managing surpluses and shortages of sand and soil by means of a depot. Although the initial idea was to replace the sand beneath the concrete pavers with a nowadays more common and stronger foundation of rubble, this idea was reconsidered by the principal and contractor. The heaviest form of transport in the street will probably consist of the garbage truck, passing once each week and for which this foundation of rubble is not necessarily needed. This significantly reduced the need of removing sand and supplying rubble, reducing the environmental impact and financial costs a lot.

Concrete

Although many of the current concrete road products in Griffiersveld are already being used for more than forty years, the quality of at least a part of the pavers can be assessed as good. Therefore, the inner part of individual parking spaces will be paved reusing the old anthracite concrete pavers (see Figure 6). The total surface is expected to sum up to around 500 m^2, being 10% of the total paved surface in the project.

Although the anthracite concrete pavers are being directly reused in the project, the old grey concrete pavers will leave Griffiersveld to be reused at farms in the direct surrounding area. The farmers will reuse the pavers as floors of their silage facility to store cattle feed.

Some of the grey 30 cm by 30 cm concrete paving slabs are broken, but those that aren't will be used as ballast in flat roof photovoltaic systems. In this way, these used products even help in the energy transition. In the past the photovoltaic systems provider bought new concrete or stone products to use as ballast to keep the systems on flat roofs with high wind speeds.

Figure 6. *Used anthracite concrete pavers waiting on site to be reused in the parking spots.*

Broken concrete pavers, paving slabs, curb stones and parts of the old stormwater system will be collected in containers. These containers will be transported to a crushing facility of a third party nearby. Given the small amount of concrete waste and that the road is in a residential area, a mobile crusher on site was not economically and environmentally acceptable.

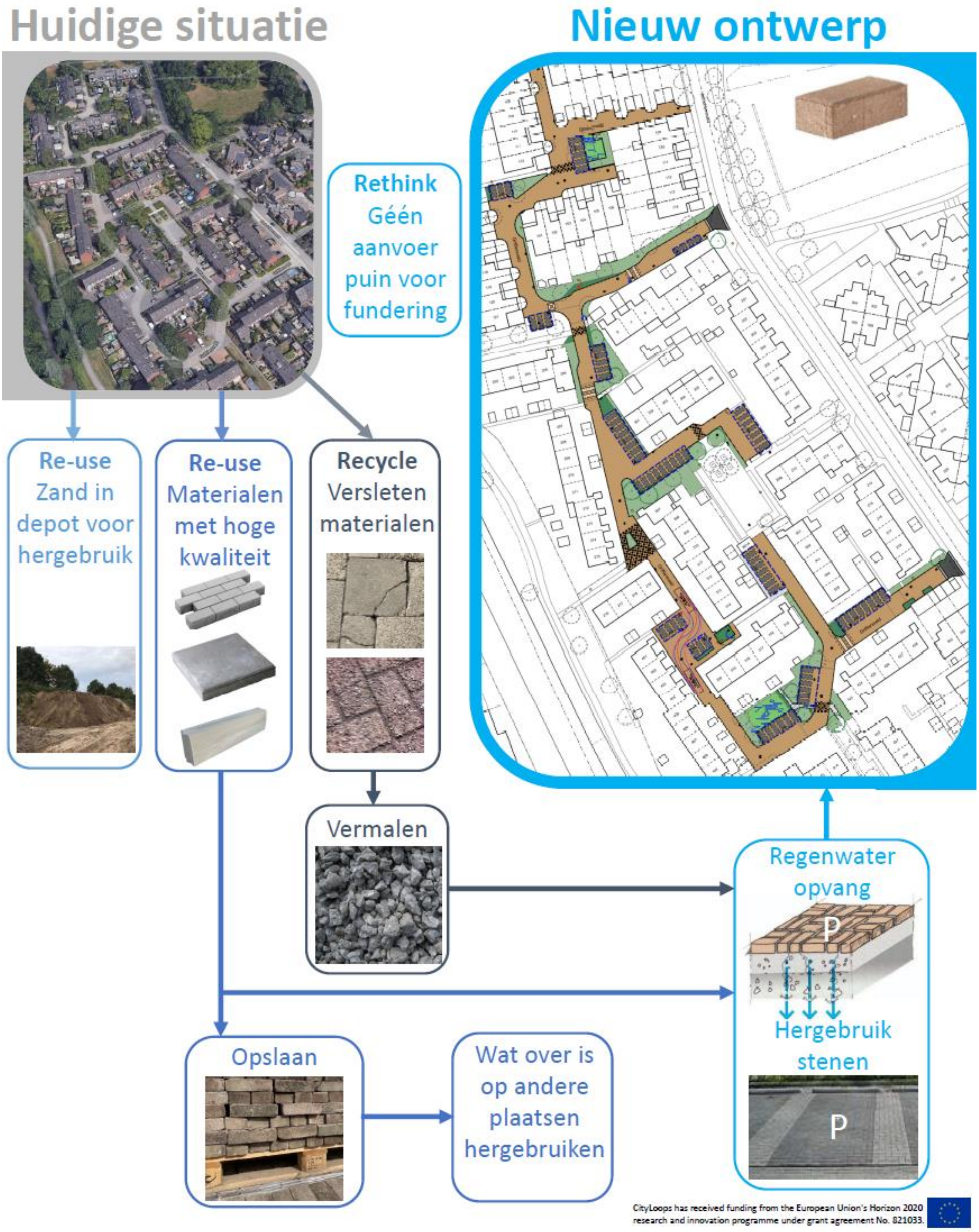


Figure 7: The poster showing how materials were handled as presented to the residents of Griffiersveld.

Developing a CO_2 indicator

Within the CityLoops project, Kellermann (2021) developed a tool to calculate the CO_2 emissions of earth-moving lorries. This tool is adapted to a Dutch version by including specific transport emissions with a focus on the transport of concrete (products), soil, and asphalt. By allowing the user to enter specific lorry and route characteristics, we expect this tool to be able to provide more accurate insights into the CO_2 emitted due to transport. Furthermore, also emissions of other forms of transport were regarded, for example that of a tractor with a tipper, an excavator and a crane (see Figure 8 and 9).

Figure 8. *Tractor with tipper and in the back an excavator at Griffiersveld in July 2022 (by courtesy of Bram Entrop).*

Figure 9. *A crane transporting kerb stones at Griffiersveld in September 2022 (by courtesy of Lisanne Hagen).*

This Dutch version was used to calculate the CO_2 emissions during the transport of materials that have been supplied and taken away by lorries during the renovation project of Griffiersveld in the municipality of Apeldoorn. To calculate these transport emissions, the CO_2 transport calculator requires the input as presented in Table 1. The parties working on the renovation project provided insights and data for this input.

Table 1. *Instrument's input parameters (Hagen and Entrop, forthcoming).*

Input parameter	Unit
Loading capacity of the lorry	tons
Unloaded weight of the lorry	tons
Total distance of the route	km
Highway distance of the route	km
Amount of materials	tons

In case the lorry characteristics would have been unknown, it was still possible to choose a certain lorry type in the developed tool. In that case, the calculated CO_2 emissions will be less accurate. However, the ratio between routes will be similar, and thereby the lowest CO_2 emitted route can still be selected. The “total distance” and the “highway distance” of multiple routes need to be entered in the CO_2 transport calculator to compare different routes. With this feature, the tool can be especially useful in the preparation phase, before executing a project, to decide what route is favoured to emit the least CO_2.

The CO_2 transport calculator uses Dutch emission factors expressed in kg CO_2/km for road transport with a weight higher than 20 tons. Since the weight of a material-transporting lorry easily exceeds 20 tons, the main factor in calculating the CO_2 transport emissions in this calculator is the distance driven by the lorry. Emission factors expressed in kg CO_2/t·km would be better. When knowing the emission factors of other countries expressed in kg CO_2/km, these can replace the Dutch values to use the calculator for that country. For emission factors expressed in kg CO_2/t·km, the instrument is still usable but might need some small adjustments in relation to the total mass of vehicle and the goods together.

DUTCH CO_2 TRANSPORT CALCULATOR
Material loops should be closed to minimize waste and the extraction of raw materials. This means that materials in the end-of-life phase of a construction should be reused or recycled in other (construction) projects. However, transporting these materials will emit CO_2. The Dutch CO_2 transport calculator is designed by Saxion UAS based on the CO_2 calculator of Kellermann (2021). This Dutch version calculates the CO_2 emission, based on Dutch emission factors, for transporting concrete (products), soil, or asphalt via a certain route. With this instrument, it was possible to calculate the CO_2 emission of the routes driven by lorries to supply and take away materials from the renovation project Griffiersveld. It is possible to calculate the emissions before the execution phase and thereby choose the route with the lowest CO_2 emission.
Lessons learned The main contractor of the renovation project Griffiersveld has a contract with the municipality of Apeldoorn, stating that information about their driven routes needs to be shared. Therefore, the transport distances, routes, transported material, and transported weights could be collected to calculate the CO_2 emissions per route. During the execution of the renovation, it is experienced that the main contractor was able to recognize various practical possibilities within its network to reuse materials instead of considering them as waste. These possibilities were recognized at short distances from the project location and were arranged within a short time.
Tool Factsheet “CO_2 transport calculator for Dutch demolition and construction sites” **Paper** Lisanne Hagen and Bram Entrop are preparing a paper that provides insights in how the Dutch CO_2 transport calculator was developed and applied to Griffiersveld. Data was collected during the renovation process.
Impact

Expected outcome: Reduced CO_2 emissions from reduced transport and through reusing and recycling material (≥3,000 m^2 road), compared to conventional street development projects.			
Indicator	Baseline result	Intermediate result	Final result
87. Annual CO_2 emissions per unit of GDP	Zero	An adapted version of the CO_2 calculator developed by the CityLoops Danish partners has been adapted to include typical Dutch emissions data.	CO_2 calculator has been developed. The parameters have been defined and the instrument was adapted towards Dutch (road), machinery, types of lorries etc. The results are still under review and the paper to be published.
Outcome review The CO_2 calculator was used in the demonstration action Griffiersveld. This to test and validate the calculator in comparison to the model of Klaus Kellerman.			

References

Entrop, B., 2022a. Collecting and storing data in a circular road renovation process. H2020 CityLoops, Saxion UAS, Enschede, The Netherlands.

Entrop, B., 2022b. The Road to Circularity: a Framework for and Experiences in Collecting Road Data in a Circular Renovation Process. *Acta Polytechnica CTU Proceedings, 38, pp. 275-280.* https://doi.org/10.14311/APP.2022.38.0275

Malk, V., and Lauritzen, E., 2021. *CityLoops guide for pre-demolition audit.*

CITYLOOPS

CityLoops is an EU-funded project focusing on construction and demolition waste (CDW), including soil, and bio-waste, 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 soil, and bio-waste, 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 aspects of CityLoops are stakeholder engagement and circular procurement.

CityLoops started in October 2019 and will run until September 2023.

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

Disclaimer: The sole responsibility for any error or omissions lies with the editor. The content does not necessarily reflect the opinion of the European Commission. The European Commission is also not responsible for any use that may be made of the information contained herein.