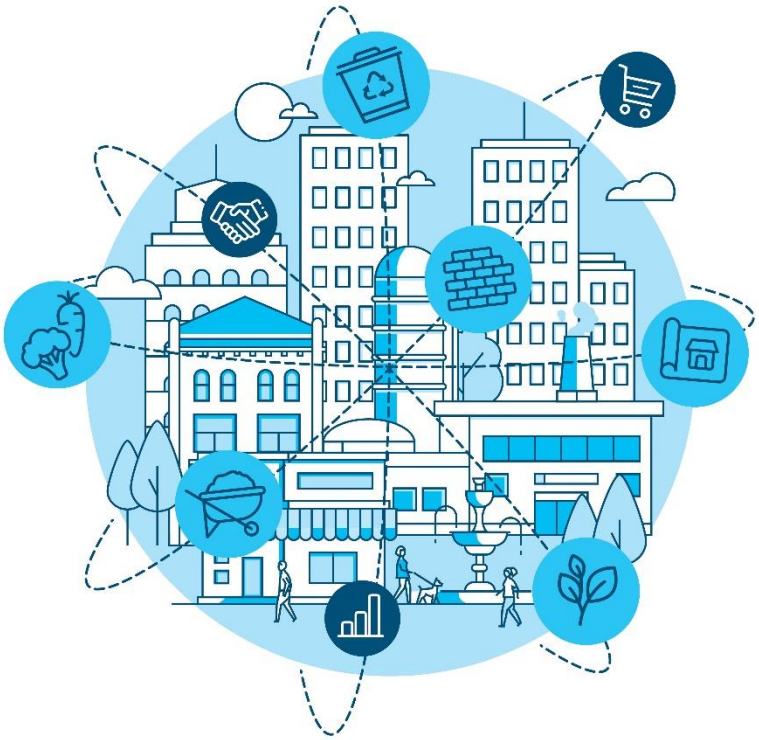
Business case in Apeldoorn

Description

Municipality of Apeldoorn, the Netherlands and Danish Association of Construction Clients, Denmark



Contents

This text describes Apeldoorn's business case in reusing road materials in the Griffiersveld residential road renovation project.

Reuse of road materials

National market conditions

In the Netherlands many initiatives, by means of applications, platforms, organisations, and companies started to better facilitate the reuse of construction materials in the last decade. For other products than building products, the second-hand market was already being boosted by an increasing number of second-hand shops and by a large online platform called http://www.marktplaats.nl (Dutch for marketplace). This website originates from 1999.

The Netherlands government expressed the ambition to have a fully circular economy in 2050. In 2030, as a target the use of virgin materials should have been reduced by fifty per cent. When evaluating the circular transition in 2023, it was said that 30.000 new circular companies had started in the last two years (PBL, 2023). Furthermore, significantly higher prices for (fossil) energy and virgin materials can be experienced also in the Netherlands, which of course translates in higher construction costs, offering possibilities for used materials to enter the market as quickly available of shelf products and, nowadays, for an interesting price. The environmental benefits were already addressed for multiple years, but till 2022 costs withhold a high adoption rate.

Although the market for used materials and the awareness to reduce fossil fuels at and around construction sites are growing, little money is offered for building materials, products and components coming from a demolition or renovation site. When sand, concrete products and concrete waste comes available, one often needs to pay for their transport to the next station in line and the treatment over there. Nevertheless, in our demonstration project in which a residential road was renovated, still some business cases have been considered.

The business case in a brief

Apeldoorn and Saxion have been exploring multiple circular business models, as is explained in the full demonstration report and in the report of Tartarin (2021) called “Developing a circular business model for the municipality of Apeldoorn”. An important staring point in this case is the fact that the municipality of Apeldoorn is the principal. Municipalities have a responsibility in providing safe and comfortable roads for their residents, visitors, and passers-by. Depending on the size and complexity of a road renovation project a certain budget is set within the municipal organization. The project was offered to the market and the maximum budget was communicated. Contractors are being asked to respond with a plan with a price. As part of the plan, the municipalities asked the contractors to give thoughts about circularity, hence closing the materials loops by proposing a number of actions. The municipality of Apeldoorn provides the contractor sand (mainly from her own soil and sand depot) and materials needed to renovate the street. The municipality has a contract with a manufacturer of concrete materials for roads.

Lessons learned and conclusion

The results shown in facts and details taught us that by reusing available materials, a total reduction of 78% of greenhouse gas emissions on materials and their transport to the project could potentially be

realized. In case of the Griffiersveld project the decision was made to use a very specific type of street paver, which was not available in reused form. Therefore, the reduction in the Griffiersveld project in terms of materials and transport resulted to 49 tonnes CO_2 equivalents, or 17% of the greenhouse gas emissions.

The business case in facts and details

With the model, the consequences for greenhouse gas emissions can be calculated for decisions made throughout the project. This has been done for a number of project decisions in the Griffiersveld project, as explained below:

The reference situation with 100% virgin materials

When 100% virgin materials are being used in the project and everything would have been replaced (both the street and the underlying sand), the greenhouse gas emissions of all used materials and their transport are calculated to be 286 CO_2 equivalent tonnes.

Reusing the road foundation

The decision to reuse the sand under the street, by simply leaving it there, has led to a reduction of greenhouse gas emissions with approximately 25 tonnes of CO_2 equivalents (8.7% of the total material and transport emissions); In the calculation model, the resulting emission of 261 tonnes of CO_2 equivalents has been used as the reference amount for the project. In the calculation model it can be seen that a relatively small amount of sand was still needed to be added, even though the bulk of the available sand remained in place. On the commercial market, prices found for virgin soil, street sand and debris are € 47.67 /ton, € 49.- /ton and € 48.50 /ton respectively. When the contractor or municipality have already some available in their depot or even at site, prices are estimated to be € 33.- /ton, € 11.- /ton and € 10.33 /ton.

Fig. 1: Sand was used as road base foundation instead of crushed stone and concrete.

Fig. 2: The local sand and soil site of the municipality of Apeldoorn during a visit of CityLoops partners.

Fig. 3: Old concrete pavers are taken out of Griffiersveld to be reused.

Fig. 4: Old concrete pavers reused as inlay of a parking spot at Griffiersveld.

Reusing old concrete pavers for parking

The decision to reuse a certain type of concrete pavers (for parking places) reduced the greenhouse gas emissions by approximately 24 tonnes CO_2 equivalents (8.4% of the total material and transport emissions). The reuse of these pavers did not result in direct financial benefits, because prices of new virgin pavers and used pavers are comparable. Concrete pavers, curb stones or slabs often end up as a granulate for new fresh concrete. However, the market for clay pavers might be more interesting due to their higher prices and reuse value.

Reusing concrete paving slabs for flat roof photovoltaic systems

The contractor offered old 30 cm by 30 cm concrete paving slabs to a company that installs photovoltaic energy systems. When these systems are installed on flat roofs, ballast is needed to withstand high wind velocities. Normally new concrete paving slabs are being used, generating an emission of 47.27 kg of CO_2 equivalents per m^2 during their production. No financial benefits were derived from this

transaction for the municipality or contractor. The company does not need to pay around € 9,35 per m^2 for new concrete paving slabs, which maybe can cover the costs of transporting the used materials.

Fig. 5: An example of how new concrete paving slabs are being used as ballast for a photovoltaic flat roof system.

Fig. 6: An example of how concrete paving slabs can be reused as ballast for a photovoltaic flat roof system.

The ideal situation with 100% reused materials

Using reused concrete pavers for the entire street instead of new 'virgin' pavers could have reduced the greenhouse gas emissions with an extra approximately 174 tonnes of CO_2 equivalents (60.8% of the total material and transport emissions).

Fig. 7: An example of how used public space products are stored at the material depot of the municipality of Apeldoorn.

Fig. 8: Concrete pavers were being reused at the different farms nearby the renovation project.

Apeldoorn Griffiersveld overview

Material needs	# of units	Total weight transported in tonnes	100% Virgin: Virgin materials total emissions in tonnes CO2 equivalents	100% Virgin: Virgin materials total price	
Under the road surface					
Soil (1 tonne)	246 tonnes	246	4,58	€	11.726,82
Street sand (1 tonne)	150 tonnes	150	2,79	€	7.350,00
Debris (granulate) (1 tonne)	105,4 tonnes	105,4	1,36	€	5.111,90
Road surface					
1 m2 steen D+D Newtone Donkerbruin A-37 + Andesiet 27 105x210x80 mm 1	3560 items	640,80	178,38	€	68.565,60
1 m2 dubbelklinkers zwart/basalt	190 items	34,20	9,52	€	3.659,40
1 m2 Parkeervakken straatstenen havanna	370 items	66,60	18,54	€	7.126,20
1 m2 Parkeervakken betonstraatstenen anthraciet	500 items	90,00	25,05	€	6.637,50
1 verkeersdrempel	3 items	0,00	0,00	€	-
1 verkeersremmer	1 items	0,00	0,00	€	-
1 m2 betontegels grijs halfsteen	75 items	13,50	3,76	€	701,25
1 m2 dubbelklinkers grijs/anthraciet	65 items	11,70	3,26	€	1.251,90
Other materials					
1st. deklaag opsluitband	1460 items	1,46	0,69	€	730,00
1st. opsluitband 100/200 HBH-M4-002 onderbeton banden 15-7-2022	625 items	29,31	4,62	€	2.093,75
1st. opsluitband 120/250 HBH-M4-002 onderbeton banden 15-7-2022	75 items	5,28	0,58	€	446,25
1st. gazonband 120/250 HBH-M4-002 onderbeton banden 15-7-2022	760 items	34,81	5,61	€	3.534,00
inritband	62 items	4,28	0,48	€	1.215,20
molgoot havanna halfsteensverband	195 items	15,02	1,53	€	3.480,75
Total			260,75 tonnes	€	123.630,52

Fig. 9: The material uses in renovating Griffiersveld and the accompanying emissions in a reference situation (based on computations made by Jacques Bazen of Saxion UAS).

Apeldoorn Griffiersveld overview

Material needs	Maximum circular given availability of materials: Max. % circular total emissions in tonnes CO2 equivalents		Max. % circular total price	100% Circular: Reused materials total emissions in tonnes CO2 equivalents		Reused materials total price
Under the road surface						
Soil (1 tonne)	1,50	€	9.668,00	1,50	€	9.668,00
Street sand (1 tonne)	0,92	€	3.200,00	0,92	€	3.200,00
Debris (granulate) (1 tonne)	0,64	€	2.639,13	0,64	€	2.639,13
Road surface						
1 m2 steen D+D Newtone Donkerbruin A-37 + Andesiet 27 105x21(	178,38	€	68.565,60	3,92	€	35.600,00
1 m2 dubbelklinkers zwart/basalt	9,52	€	3.659,40	0,21	€	1.900,00
1 m2 Parkeervakken straatstenen havanna	18,54	€	7.126,20	0,41	€	3.700,00
1 m2 Parkeervakken betonstraatstenen anthraciet	0,38	€	-	0,38	€	-
1 verkeersdrempel	0,00	€	-	0,00	€	-
1 verkeersremmer	0,00	€	-	0,00	€	-
1 m2 betontegels grijs halfsteen	3,76	€	701,25	0,08	€	750,00
1 m2 dubbelklinkers grijs/anthraciet	3,26	€	1.251,90	0,07	€	650,00
Other materials						
1st. deklaag opsluitband	0,69	€	730,00	0,01	€	730,00
1st. opsluitband 100/200 HBH-M4-002 onderbeton banden 15-7-20	4,62	€	2.093,75	0,18	€	2.093,75
1st. opsluitband 120/250 HBH-M4-002 onderbeton banden 15-7-20	0,58	€	446,25	0,03	€	446,25
1st. gazonband 120/250 HBH-M4-002 onderbeton banden 15-7-20	5,61	€	3.534,00	0,21	€	3.534,00
inritband	0,48	€	1.215,20	0,03	€	1.215,20
molgoot havanna halfsteensverband	1,53	€	3.480,75	0,09	€	3.480,75
Total	230,42 tonnes	€	108.311,43	8,69 tonnes	€	69.607,08

Fig. 10. The emissions of renovating Griffiersveld when different levels of circularity are reached (based on computations made by Jacques Bazen of Saxion UAS).

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.

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