Odense, Denmark

Figure 1. The municipality of Odense. Map data: Google, SIO, NOAA, U.S. Navy, NGA, GEBCO, Maxar Technologies, and TerraMetrics.

Construction of demolition waste (CDW) is one of the heaviest and most voluminous waste streams generated in the EU and as such, the European Union has identified it as a priority waste stream. It accounts for approximately 25% - 30% of all waste generated in the EU and consists of numerous materials, including concrete, bricks, gypsum, wood, glass, ceramics, metals, plastic, solvents, asbestos and excavated soil, many of which can be recycled. In this case study, the focus was on collection and management of bricks, sanitary ceramics and insulation materials from municipal sources.

This summary presents the main conclusions of one of the regional case studies conducted during the COLLECTORS project. The studies included a life cycle assessment, a cost-benefit assessment, and a circularity assessment. References to original research reports are provided at the end of this document.

Description of the region

Odense is the third largest city in Denmark with a population of 204,200. Odense is the commercial hub of Funen, and has a notable shopping district with a diversity of stores. Several major industries are located in the city including the Albani Brewery and GASA, Denmark's major dealer in vegetables, fruits and flowers.

CDW collection system

Odense has eight recycling stations (CAS), with over 40 containers for collecting different waste materials. The vast majority of containers are found at all the recycling stations in Odense. However, the smallest ones do not have space for all 40 containers. The CDW materials that are collected separately at the recycling stations include:

- Window glass with frames
- Window glass without frames
- Double glazing with Polychlorinated biphenyl (PCB)
- Asbestos and Ethernite
- Roofing board
- Gypsum
- Concrete and Bricks
- Mineral wool
- White toilets and washbasins
- Building waste with PCB
- Bricks only

The focus of this study was on collection of bricks, sanitary ceramics and insulation materials.

Actions to improve collection

Odense is a good example of a municipality involved in innovative CDW management schemes, leading the way in the reuse of old bricks which are being refurbished in Odense Renovation A/S's recycling centres. The actions are defined as the separate collection of the specific waste streams at the CAS and the subsequent transport to a dedicated recycling facility.

Previously, when bricks were delivered to Odense Renovation A/S, they were crushed and reused in construction projects, just like concrete and slate, but discarded bricks now have their own dedicated containers at the recycling centres. When a container is full, it is driven to the Gamle Mursten factory in Svendborg on Funen, where they are cleaned and sorted before being stacked on pallets ready for reuse in new constructions. Not all collected bricks, insulation and sanitary waste is suitable for recycling. Bricks are cleaned and reused in new buildings and constructions, but the brick material that is not suitable for reuse as bricks is crushed for use in road filling.

Odense also aims to collect both waste mineral wool insulation and waste ceramic sanitary ware separately in order to repurpose this material. The insulation waste is transported to Noreco and sanitary waste to KI Hansen. In contrast to bricks, sanitary ceramic ware (toilets, sink basins etc.) are not recycled into new sanitary ceramic ware. Instead, waste sanitary ceramic ware is used in the production of concrete as a replacement for aggregates (i.e. sand and gravel). The recovered mineral wool is assumed to replace the mineral wool in the production of new insulation.

The flow chart for CDW collection in Odense is presented in Figure 2.

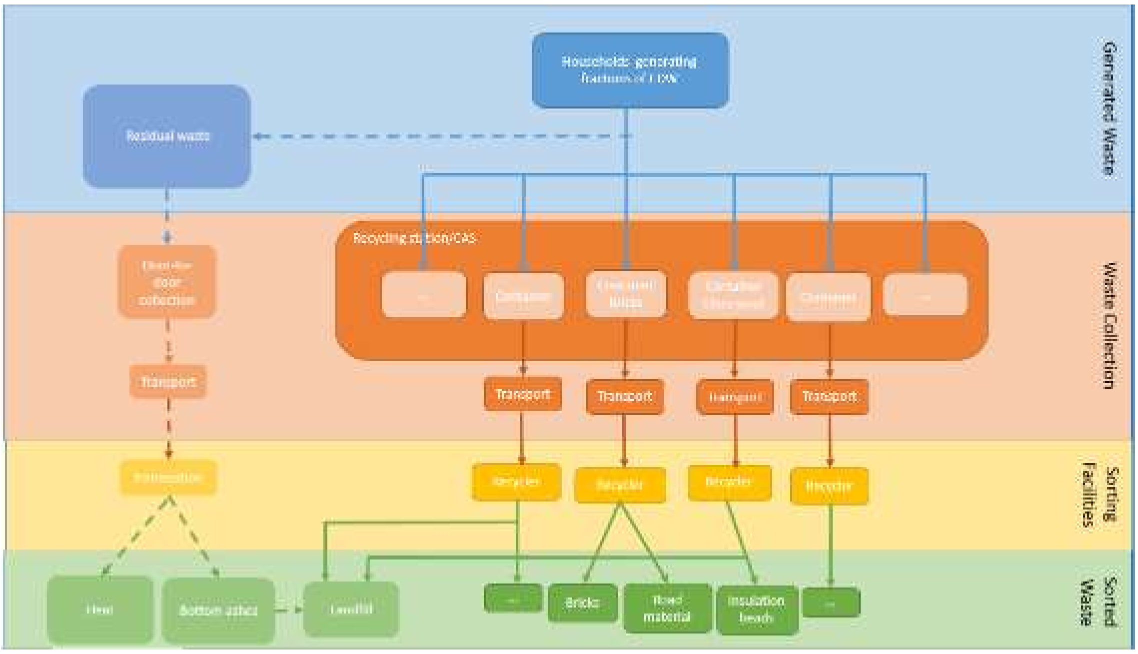

Figure 2. Flow scheme of CDW collection at CAS and corresponding recycling in Odense.

Findings from environmental assessment

Bricks

Substantial impact reduction can be achieved by reusing the (undamaged) bricks. All other activities, including collection and sorting, recycling and disposal, as well as transportation are of minor importance only. This means that also the recycling of bricks for road material yields only minor benefits, which can be explained by the fact that it replaces gravel, which is a relatively low-impact material.

Sanitary ceramics

The environmental benefits of recycling sanitary ceramics in concrete are, although existent, very small compared to the production of ceramics. This is mainly due to the fact that disposed of sanitary ceramics are not used to displace primary sanitary ceramics, but are instead used to replace sand and gravel in concrete, which is associated low environmental compared to the production of sanitary ceramics. However, the benefits associated with the recycling of sanitary ceramics are reduced with increasing transportation distance.

Insulation materials

For insulation material, the substitution of virgin through recycled insulation material yields high environmental benefits across all assessed environmental impact categories. The only other activity that consistently contributes to environmental impacts is the recycling process for insulation materials due to its energy and water consumption.

Recommendations for improving environmental performance related to CDW management

Bricks and sanitary ceramics both had secondary material flows that replaced a primary production of aggregate. For waste bricks, material that is not suitable for reuse as bricks is crushed for use in road filling, meanwhile sanitary ceramics can be crushed to be used in concrete. One of the natural ways of reusing inorganic industrial wastes is their use in the production of building materials, especially as raw materials in the concrete manufacture. This manner of recycling has positive impact on the environment; reducing the amount of deposited waste and limiting the mining of mineral aggregate deposits. Inorganic ceramic waste has an additional advantage – it needs no special processing when used as an aggregate; for instance, the technology of producing the concrete mix with aggregate using recycled sanitary ceramics is the same as it is in the production of concrete mix with traditional aggregate. However, the environmental benefits to be gained via the replacement of conventional aggregate materials are considerably lower than reducing the need for other materials. For instance, reusing waste bricks in new buildings as bricks results in much higher environmental savings. Environmental benefits related to the reuse of bricks could be further increased, if the capture rate and the proportion of undamaged bricks could further be increased.

In the case of insulation materials, important environmental benefits are associated with a closed-loop recycling of these materials. However, these are partially offset by the additional energy and material inputs required during the recycling processes (this is strongly related to the environmental impacts of the energy mix and thus in the future, with an increased share of renewables, we expect the impact linked to the recycling processes to decrease). Transport is also an important source of environmental impacts when managing CDW wastes due to their weight, particularly compared to PPW and WEEE

While we find that there are generally rather large environmental benefits associated with the reuse and recycling of CDW, it is important to 1) identify the best options for reuse and recycling using an LCA approach (preferring reuse whenever possible and considering in parallel economic and social drivers), and 2) balancing the optimal reuse and recycling options with transport as to not transport the material too far.

Findings from economic assessment

The economic assessment was done from the financial perspective of Odense Waste Management Ltd. The costs, benefits and savings from other waste streams (than bricks, sanitary ceramics and insulation wool) collected at the CAS are not included in the assessment.

With a limited investment, Odense managed to implement a financially viable practice for separate collection and recycling of insulation and sanitary waste. Brick waste, as shown in Table 1 below, is a little more expensive mainly due to the increase in transport costs and therefore financially challenging. The values in the table are calculated based on 2018 figures.

Table 1. Evaluation of Odense results.

Total investment	**€ 33.000**
Investment per inhabitant	€ 0.16 per inhabitant
Total disposal cost recycling bricks	€ 11,70 per ton
Total disposal cost landfill bricks	€ 11,52 per ton
Total disposal cost recycling insulation	€ 90,39 per ton
Total disposal cost landfill insulation	€ 100,45 per ton
Total disposal cost recycling sanitary	€ 55,18 per ton
Total disposal cost landfill sanitary	€ 100,45 per ton

For more information, please see

D2.4 Report on solutions for tackling systemic and technical boundary conditions. Available at: https://www.collectors2020.eu/results/analysis-of-boundary-condition/

D2.5 Report on implemented solutions and key elements in selected cases for societal acceptance. Available at: https://www.collectors2020.eu/wp-content/uploads/2020/06/Collectors-Deliverable2.5.pdf

D3.2 Report on the economic and financial performance of waste collection systems. Available at: https://www.collectors2020.eu/wp-content/uploads/2020/04/Deliverable3.2_COLLECTORS-project-1.pdf

D3.3 Report of recommendations for improvement of single systems and optimum operation conditions. Available at: https://www.collectors2020.eu/results/environmental-impact/

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Disclaimer

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