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REPOSITIONING ORGANIC WASTE STREAMS IN THE URBAN AREA

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Abstract

The city of Zwolle values circularity and aims to become the fourth most circular city in the Netherlands, after Venlo, Rotterdam and Amsterdam. Circularity requires reducing, reusing and recycling. One of the challenges concerning circularity regards waste streams. Waste streams need to be reduced and repositioned. Especially in neighbourhoods with many blocks of flats, waste separation requires more attention. Currently, households have the possibility of separating plastic, paper, glass and residual waste, but not organic waste. This is bundled together with residual waste, which is where the problem lies. At this moment, it is impossible to fully separate organic waste from residual waste, which makes repositioning its value extremely difficult. As Zwolle wants to reuse as many raw materials as possible to come as close to zero residual waste as possible, it is important to find a way to separate the organic waste and reuse the valuable materials.

Key words*: biogas, compost, organic* waste*, separate collection.*

INTRODUCTION

Considering that half of the world's population lives in cities and this proportion is expected to increase to two-thirds by 2050 (UN DESA, 2018), it is essential to reassess our current patterns of production and consumption and to adopt more consciously the Circular Economy (CE) approach within the waste and resource sector (Vîrsta et al., 2020). It is the time to adopt a circular economy, in which output (waste) from one process to equals inputs (resources) for another because the current linear "produce-use-waste" economic system is unsustainable (Figure 1). Turning waste into a resource plays a central role of increasing resource efficiency and closing the loop in a circular economy vision (Vîrsta et al, 2020).

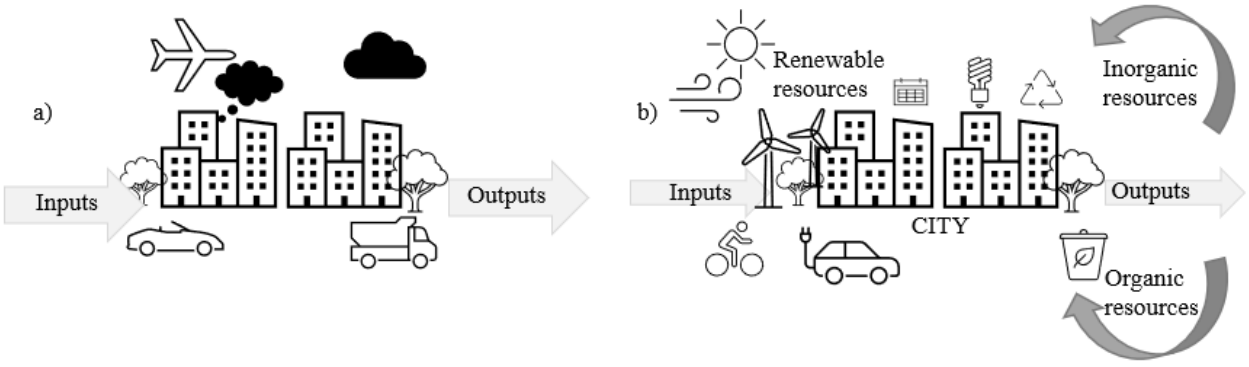

Figure 1. a) A linear model of inputs and outputs. b) A circular model reuses, recycles and recovers resources from urban waste streams, reducing resource inputs and outputs (after Wielemaker et al., 2016)

Urban residents generate growing quantities of waste with over 1.6 million tonnes of organic solid waste every day (Kaza et al., 2018).
Figure 2 shows the trends in municipal waste generation in the European Union (EU) from 2005 to 2020.
In urban areas people still lack access to improved sanitation facilities (WHO and UNICEF, 2017). The problem seems to lie in the lack of (proper) recycling in neighbourhoods with many blocks of flats. This is required to be able to re-add value to organic waste and reach the goal of circularity in the future.
In addition, they rely on unsanitary solid waste management systems, e.g. open dumpsites (Kaza et al., 2018). Overall, this results in huge quantities of urban waste that are discharged into the open environment, with negative implications for human and ecosystem health.

- *EU: estimate*
- *2019 data: Ireland, Italy, Greece and Austria*
- *2018 data: Bulgaria, Iceland and United Kingdom*

Figure 2. The amount of municipal solid waste generated in EU Member States in2005 and 2020, kg per person (Eurostat)

The aim of this paper is to demonstrate how the CE valorisation potential of various organic waste streams in urban areas can be determined through a case study of the city of Zwolle (Netherlands).
The Netherlands is a highly-urbanized country, one of the most urbanized countries in Europe with about three quarters of its population living and working in urban areas (Netherlands Environmental Assessment Agency, 2016).
The composition of the Netherlands residual waste is monitored annually. The results, as illustrated in Figure 3, shows that residual waste still contains large quantities of usable /valuable waste streams that could have been offered for recycling. More than one third of the residual waste consists of organic and garden waste, and more than 20% paper and cardboard.

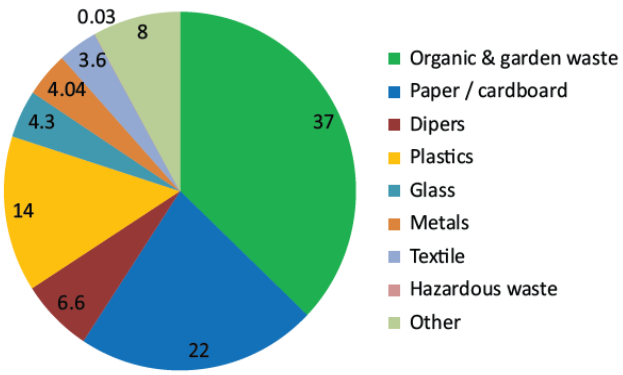

Figure 3. Composition of residual household waste in Netherlands (Goorhuis et al., 2012)

Zwolle is a city with a population of approximately 129 000 people. It is the capital of the province of Overijssel.
In city of Zwolle seem to be several reasons why people do not (properly) separate their (organic) waste in the neighbourhoods with many blocks of flats. Firstly, there is no option for organic waste separation (solely on request). Therefore, they could not do this even if they want to. Secondly, people lack both awareness of what happens to their waste and incentive to separate their waste.
There are two types of approachable solutions: social and technical solutions. Social solutions focusing on creating awareness among the population. Potential social solutions would need to focus on creating a behavioural change, which should be done by creating both awareness and an incentive. Technical solutions could either focus on improving the separation process of organic waste from residual waste or it could focus on making it easier for citizens to separate their waste, so that the effort required is as small as possible. Additionally, an incentive can be created for citizens by cycling the product of the organic waste back to the citizens making it easier for people to separate their waste. Both solutions will result in an improvement of the circular economy of Zwolle.

MATERIALS AND METHODS

The materials and methods were obtained after participating in the Wetskills professional competition, in September 2021. Wetskills is a two-week program in the field of environmental protection, with a focus on water-related issues, where young professionals work together to find innovative and sustainable solutions. This was the 50th edition and the 5th edition held in Romania, in which three teams participated. Our case was provided by City of Zwolle, and the theme was "How can we separate organic waste from general waste so that we can become more circular?".
In order to come up with a solution for our problem, we had many brainstorming sessions with many experts. We had a meeting with the municipality of Zwolle where we learned more about the situation in the city. We talked to the experts about the importance of circularity, about the side effects of not separating the waste and about the lack of awareness people have on this subject. We had a brainstorming session with Frank Tibben, Programme Manager and supervisor at the Wetskills -Romania 2021 programme, and Diana Vlad, former Wetskills participant, about how all this waste affects the water and how we could include water in our process. Finally, we had a meeting with Keimpe Sinnema, owner of Sinnema Advice Water Management and water management specialist where we talked about the mechanism and what we can implement. After that, we brainstormed together and did some background reading to come up with a solution.

RESULTS AND DISCUSSIONS

The first solution is rather simple, to provide flat inhabitants with the possibility for organic waste separation. Additional social measures that could be taken are educational. By teaching children in a playful way, you can also educate their parents. This however is a long-term process, of which the effects in waste separation may only be seen in 10 to 15 years. ROVA, the city's waste collector and recycling centres, are already focusing on the education of children (Leren en doen - ROVA, n.d.). Education could also take place during an event, either a new event or linked to an already existing event like the city's anniversary or the King's birthday. Showing them what happens to their waste is important, for example by inviting them to the ROVA's recycling centres or having a ROVA recycling pop-up stand in the city centre to bring the information to people instead of the other way. This could give inhabitants a sense of the importance of proper waste separation.
Education could also be done in the form of an event, by creating a waste challenge in areas where improvement is needed. This could be between neighbourhoods or between blocks of flats for example. The challenge could be to produce as little (residual) waste as possible with a reward that benefits the winning neighbourhood, e.g. a playground. Also, without a challenge, a reward can provide citizens with an incentive to separate their waste. A financial reward is likely to work best for citizens with little motivation to separate. One option would be to create a savings card where people receive an online stamp when reaching a certain

threshold of waste separation and reward them with a present or a discount in a shop when the card is full. People could also be rewarded with the 'Zwolse Pepermunt', which they can spend in one dedicated or several shops. It is important to make sure this is appealing to low-income citizens as well.

Our technical concept brings organic waste separation closer to people's homes, by collecting it either in the kitchen (organic crusher or vacuum) or in the hallway. After this it is transported through a piping system or a waste slide, where it is checked for metals and plastic (through monitoring and separation), crushed and stored before being transformed into biogas by a biogas compressor. The by-product of this biogas can be converted into compost and the biogas will cycle back to the building, thereby lowering the remaining energy needed and thus the costs for inhabitants. The excess biogas is stored. Cleaning of the piping system can be done using rainwater, which is separated from the organic waste by a bypass. This could be done to be even more circular. Since the compost could also be used to grow vegetables in community gardens, the inhabitants could both grow and cook their food with their organic waste (Figure 4). This concept creates both awareness of what happens to your waste and a financial incentive.

This concept can be applied in several ways, e.g. one could consider to include black water for the biogas production. Depending on the local conditions a tailor-made solution can be chosen.

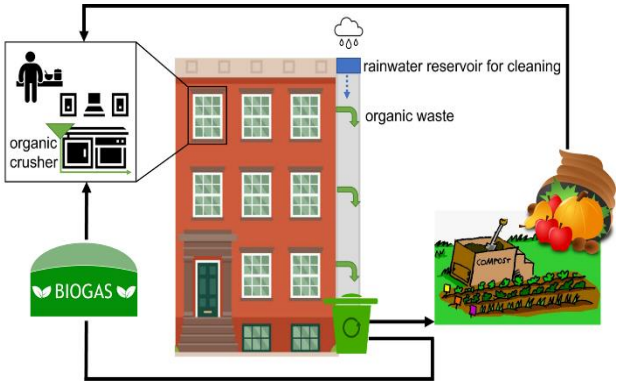

Figure 4. The concept of circular organic waste in city of Zwolle

The concept is a combination of several already existing techniques, which makes it both innovative and easier to implement. The concept of the 'waste slide' has existed for quite some time, as inhabitants of flats used to have access to a waste slide to dispose of their residual waste. In addition, one architectural firm has developed a 'waste/linen slide' for hotels and restaurants, for easier disposal of residual waste and linen (Stansz, 2019). In Rotterdam the idea of a 'waste slide' for different waste streams in a flat building was pitched (AD, 2017). The concept of a 'waste slide' for organic waste has the same purpose but is slightly different. The idea of using a rainwater reservoir for cleaning the pipe system and in this way further increasing circularity is innovative. On a household level it was already possible to transform your organic waste into biogas and/or into compost (New Atlas, 2019).

Our process is similar but on a larger scale and it is used to create an incentive to separate. Also, an organic kitchen crusher that discharges at the sewage system has been previously developed (KWR, 2021). Discharging the crusher to an organic waste collector instead of the sewage system, is not too far off. Our concept applies these separate processes on a different scale or in a different manner and combines them to form one new concept.

Our solution can be implemented in more cities, as it is a general solution for flats and/or apartments. In our case, we came up with a solution for future buildings and for older buildings. In the case of the new buildings, a crusher system (in combination with black water) will provide the organic waste for the biogas producer. Our concept consists of several pre-existing technologies: the piping system, a local biogas producer and an organic waste kitchen crusher. This will make the implementation both much quicker and easier.

CONCLUSIONS

We must learn how people perceives this concept and whether if the buildings are suitable for this solution. We came up with two solutions for two types of buildings: buildings that already exist and future buildings. After that, a calculation needs to be made to see if this concept can be implemented and if there will be enough organic waste to produce the biogas. Also, we calculated the costs for this project. If everything is fine and the municipality and the inhabitants accept it, the project can be

implemented. The Netherlands is phasing out the use of gas in apartment buildings. So, if buildings are no longer operating on gas for cooking purposes, electricity could be produced from the biogas instead.

E-CycloGas delivers citizens the service of organic waste separation, with as little effort as possible. Both the social solutions and the technical solution will help to improve the waste separation and the circularity of the city of Zwolle. Not only will the social solutions improve awareness of what happens to your waste, the technical solution will also do this, as inhabitants are 'reusing' the product of their own organic waste. It also provides them with the incentive to separate through lowering the energy costs of the building. E-CycloGas enhances the circularity of buildings and therefore the city.

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