

Deliverable 4.9: Energy and resource station connection to Republica

WP4, Task 4.8

Date of document

27/07/2023 (M45)

Deliverable Version:	D4.9, V2.0
Dissemination Level:	PU ¹
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4	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO	TNO	Netherlands
5	FUNDACION CARTIF	CARTIF	Spain
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29	ZABALA INNOVATION CONSULTING. S.A.	ZABALA	Spain
30	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	Fraunhofer	Germany

Document History

Project Acronym		ATELIER	
Project Title		AmSTERdam and BiLBao citizen drivEn smaRt cities	
Project Coordinator		Frans Verspeek ATELIER.EU@amsterdam.nl City of Amsterdam	
Project Duration		01/11/2019 – 31/10/2024 (60 Months)	
Deliverable No.		D4.9 Energy and resource station connection to Republica	
Diss. Level		Public (PU)	
Deliverable Lead		Partner short name	
Status			Working
			Verified by other WPs
	x		Final version
Due date		31/10/2022	
Submission date		28/07/2023	
Work Package		WP4 - Amsterdam PED Demo	
Work Package Lead		WATNL	
Contributing beneficiary(ies)		-	
DoA		Connecting Republica to the Waste energy and resources recovery station. Main part of the task is the innovative piping system (vacuum tubes) from the building to the station.	
Date	Version	Author	Comment
28/07/2023	1.1	Ellen Breed	Draft version
09/07/2023	1.2	R.A. Rooth	Review by AMST
27/07/2023	2.0	Ellen Breed, Rebecca Beemster	Final version

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Table of Contents

0. Executive Summary	6
1. Introduction	7
1.1. Purpose and Target Group.....	8
2. Objectives and Expected Impact	8
2.1. Objectives	8
2.2. Expected Impact	8
3. Background of the New Sanitation project	8
4. New Sanitation actions within the ATELIER project.....	9
5. Timeline of affairs in the New Sanitation project 2019-2022	9
6. Revised plan	10
7. Realization	11
8. Future outlook	13
9. Output for other tasks in WP4	13
Annex A Final proposal of Task 4.8 change	14

Table of Tables

Table 1 Contributions of Partners.....	5
Table 2 Abbreviations and Acronyms.....	5

Table of Figures

Figure 1-1 Infographic of the New Sanitation system.....	7
Figure 7-1 Location of the vacuum pipelines in the ATELIER demonstration area.....	11
Figure 7-2 Connection site of the vacuum station	12
Figure 7-3 Underground piping of the vacuum system	12
Figure 7-4 Connection to the vacuum sewage on the Republica side.....	13

Contributions of Partners

Partner short name	Contributions
WATN	Overall content

Table 1 Contributions of Partners

Abbreviations and Acronyms

Acronym	Description
RRS	Resource Recovery Station
LAP	Landelijk Afvalstoffen Plan (National Waste Plan)
GFe	Groente, Fruit en etensresten (Vegetables, Fruits and food scraps)
PED	Positive Energy District

Table 2 Abbreviations and Acronyms

0. Executive Summary

Municipal waste water contains raw materials (plant nutrients) and energy (heat and biogas). The current centralized wastewater treatment system in The Netherlands is very efficient and the treatment quality is high.

Nevertheless, the current system is a linear system, not designed for a circular economy. All the waste water is collected in one stream: black water, grey water, and also often rain water. This limits the possibilities to recover energy and nutrients.

Nutrients and energy can be harvested much more efficiently if the waste water is separated at the source into black water from the toilets and grey water from showers, washing machines etc. In the Netherlands this concept is called 'New Sanitation' or 'resource - oriented sanitation'.

Waternet has been looking for a suitable location (i.e. a new construction project) to put this concept into practice on a serious scale, and found it in Buiksloterham.

Implementation of the new Sanitation system faced serious setbacks. The completed Resource Recovery Station was destroyed by human error by the end of 2019. It took two years to rebuild. In the meantime, vacuum toilets deployed showed noise problems and maintenance issues. This led to withdrawal from a housing corporation from the project. This resulted in station input below a threshold feasible for operation.

Fortunately for the ATELIER project and the future of the New Sanitation project it appeared to be possible to find an intermediate solution for GFe (Vegetable and fruit) grinders planned in the Republica building. A temporary deviation of the Dutch waste directives was needed for this. The implementation consisted of connecting the Republica GFe grinders and the Schoonschip vacuum toilets to a vacuum station with temporary disposal of the sewage in the regular sewage system.

Amsterdam decided in spring 2023 to make budget available for a restart of the New Sanitation project and is currently looking for a suitable additional plot in Buiksloterham to continue the pilot. Given the development time of construction projects, it is expected that the system will not be operational before 2024/2025.

1. Introduction

Municipal waste water contains raw materials (plant nutrients) and energy (heat and biogas). The current centralized wastewater treatment system in The Netherlands is very efficient and the treatment quality is high. The efficiency in terms of reducing energy use, footprint, and costs is also very good, while resource recovery is becoming ever more important.

Nevertheless, the current system is a linear system, not designed for a circular economy. All the waste water is collected in one stream: black water, grey water, and also often rain water. The mix of wastewater and rain water is treated mostly aerobically in predominantly large scale treatment plants, consuming large amounts of energy. Plant nutrients such as nitrate, phosphate, potassium and organic matter are mostly removed or destroyed, while energy (heat and biogas) is recovered in limited amounts at best.

Nutrients and energy can be harvested much more efficiently if the waste water is separated at the source into black water from the toilets and grey water from showers, washing machines etc. In the Netherlands this concept is called 'New Sanitation' or 'resource - oriented sanitation'².

Waternet has been looking for a suitable location (i.e. a new construction project) to put this concept into practice on a serious scale, and found it in Buiksloterham.

The Buiksloterham district in the North of Amsterdam is a post-industrial area that is being developed into a neighbourhood with high circular ambitions from all the stakeholders. Waternet has built an experimental bio refinery here: a small-scale 'New Sanitation' waste water treatment facility to serve housing projects in the Buiksloterham.

The bio refinery itself is a small-scale waste water treatment plant. The design capacity is 2.500 'inhabitants equivalents' (i.e.). Initially only the black water will be treated, recovering biogas and phosphate.

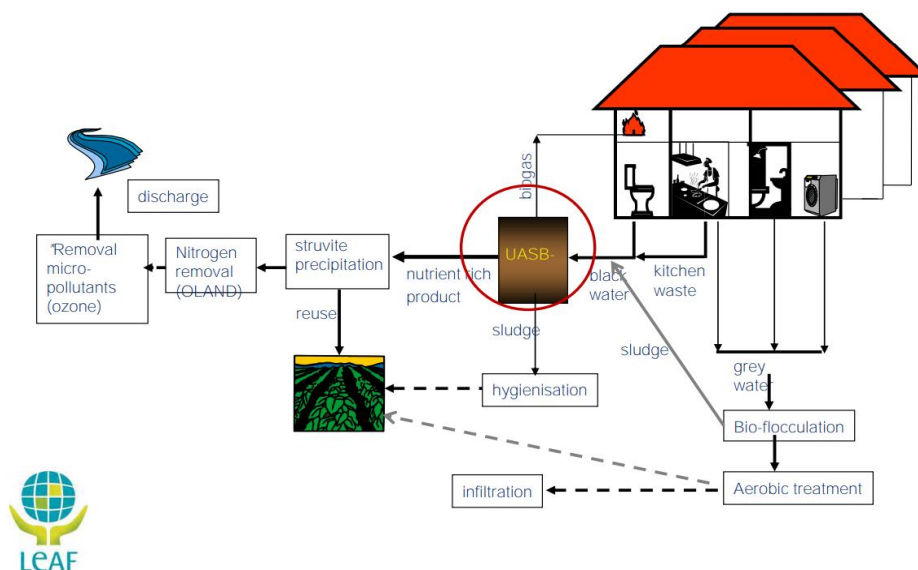


Figure 1-1 Infographic of the New Sanitation system

² <https://run4life-project.eu/wp-content/uploads/2018/06/10-180517-R4L@IFAT-Grietje-Zeeman.pdf>

1.1. Purpose and Target Group

The purpose of this deliverable is to report the state of affairs related to the New Sanitation project in Buiksloterham in relation to the ATELIER positive energy district project. Further it serves as evidence that the works have been executed and completed as agreed in the plan provided in Annex A.

Target group is the European Commission and further all stakeholders involved in implementation of innovative sewage systems, i.e. local governments, waste processing authorities, water boards, housing cooperations and the wider public.

2. Objectives and Expected Impact

2.1. Objectives

Realization of a vacuum sewage system for toilet waste and GFe (Groente Fruit and etensresten) grinders for saving fresh water, recovery of energy and minerals.

2.2. Expected Impact

40 MWh/a of biogas production as contribution to the energy balance of the PED.

3. Background of the New Sanitation project

Since 2016, Waternet has been developing the New Sanitation pilot in Buiksloterham on behalf of the municipality of Amsterdam and the AGV (Amstel, Gooi en Vecht) water board. A feature of the pilot is that toilet water is collected separately via a vacuum sewer system and purified in a local treatment plant: the resource recovery station (RRS). The aim is to reuse as much raw materials (phosphate, clean water) and energy (biogas, thermal energy) from waste water as possible. The application of the vacuum sewage system also offers the possibility of collecting vegetable and fruit residues via a food residue grinder from which biogas can be produced.

4. New Sanitation actions within the ATELIER project

ATELIER is participating in this pilot through inclusion of toilet water from floating community Schoonschip and through inclusion from food residue grinders from development site Republica to the local Resource Recovery station.

- To solve part of the waste issues in Amsterdam the plan was to put kitchen grinders in all dwellings in the Republica buildings group. The grinded fruit and vegetables waste would be transported by the sewage system and produce biogas in the local energy and resource recovery station.
- To reduce the amount of energy leaving through the boundary of the district, the plan was to put in place an innovative techniques for separating waste streams. This stimulates the recovery of energy and resources from sewage.

5. Timeline of affairs in the New Sanitation project 2019-2022

For the pilot as a whole there were a few annoying setbacks in the field of planning, technical-legal issues, financial concerns and just plain bad luck. The spatial planning of Buiksloterham turned out to offer few options for integrating the pilot. Pipelines in the street were not much of a problem, but there was no room left for the vacuum station and the raw materials station in the planned building blocks. The only solution was to place the vacuum station underground and to place the raw material station in the form of a floating ark in the Johan van Hasselt Canal. This solution did increase the costs and a floating treatment plant later turned out to have an important disadvantage.

The second planning problem was related to legal objection procedures. In 2017, housing corporation De Alliantie decided to participate in the pilot with approximately 500 homes, but surrounding companies objected to the housing construction. As a result of the objection procedure, De Alliantie was only able to continue with its plan development in 2019. Because of this procedure, the pilot remained uncertain for a long time whether the homes of De Alliantie could still participate at all and if so, how much and when.

In the course of 2019, De Alliantie was able to continue with its plan development and the integration of New Sanitation in the housing designs, but in various test setups the flushing noise of the selected vacuum toilet always exceeded the standards of the Building Decree. In the meantime, the completion date of a number of apartments was getting too close and De Alliantie decided in October 2019 to rebuild 340 homes to traditional sanitation. Waternet, the municipality and De Alliantie then sat down again in November 2019 to jointly look for a solution to the noise problem of the vacuum toilets. Fortunately, at the beginning of 2020, a supplier was found who could supply a soft sound vacuum toilet system that did meet the noise standards. At that time, De Alliantie's construction schedule still offered the potential to connect

154 homes in Plot C to New Sanitation, but the additional structural costs of the toilets - according to contractors several thousand euros per home - were increasingly worrying the housing corporation. De Alliantie decided to withdraw from the pilot, because of the noise of the vacuum toilets. Which means that only the 47 dwellings of Schoon Schip could be connected to vacuum sewerage. This number is too low to be able to put the RRS into operation. This requires at least 160 additional dwellings to be connected.

In the meantime, the Resource Recovery station had sailed from the yard to Buiksloterham in September 2019. But to make matters worse, the ark on which the purge was built sank on October 14, 2019 in the holding port. This was another major setback for the project. After lifting the ark, the damage was extensive. In the meantime, the station is being rebuilt, but it will take until the autumn of 2021 before it is ready

6. Revised plan

The direct consequence of the temporization is that the GFe (vegetable and food waste) from Republica cannot be treated in the RRS. However, this does offer Waternet the opportunity to start a manageable pilot study on the behaviour of GFe in regular sewage systems.

In principle the kitchen waste of Republica is not allowed to mix in the normal sewage route. But the Directorate Waste and Resources of Amsterdam, who is in charge of waste collection, is willing to support the pilot under the following conditions:

- The processing of the GFe waste of the households have to comply with LAP3 legislation after the pilot (fermentation and composting). This means that the design of the new sanitation system must be suitable for disconnecting the GFe pipes and processing the waste separately.
- The Directorate Waste and Resources of Amsterdam must be and remain the director of the collection and processing process of the GFe. Waternet will be designated as waste collector. For this, Waternet will install measuring equipment on the basis of which volumes and qualities of the GFe will be registered.
- The Directorate Waste and Resources of Amsterdam is involved in all relevant developments in the project.
- Waternet is making every effort to develop a feasible and scalable solution that complies with legislation and regulations, in particular LAP3, based on the experience with the new sanitation project Republica.

Originally the assumption was that Republica could be connected to the vacuum pipeline of Schoon Schip. But because the processing of the GFe (vegetable and fruit waste) waste of the households have to comply with LAP3 (national waste streams plan) legislation after the pilot (fermentation and composting). This means that the design of the new sanitation system must be suitable for disconnecting the GFe pipes and processing the waste separately. To meet these requirements a precondition is that Republica must be connected directly to the vacuum station to prevent mixing the GFe with the wastewater from Schoon Schip.

7. Realization

Because the municipality of Amsterdam, Waternet and Republica found it important that the pilot under the ATELIER project proceeded (and thereby maintaining the ambition and outlook for energy and resources recovery from sewage and GFe), we realized the direct connection to the vacuum station. A vacuum line had been realized to the Ridderspoorweg. Via a borehole under the Ridderspoorweg this pipeline is connected to the vacuum station.

- This implementation is significantly deviating from the original plan:
- No vacuum toilets at Republica (but GFe grinders in Republica Food and Beverage facilities)
- Connection to a vacuum station rather than the resource recovery station
- No processing of the sewage waste during the lifetime of ATELIER

These deviations have been subject of detailed discussion with the ATELIER project officer in Brussels, the plan was informally approved and is now part of a project amendment (under development). This plan and its financial consequences can be found in Appendix A.

On the next pages some pictures of the realization can be found.



Figure 7-1 Location of the vacuum pipelines in the ATELIER demonstration area



Figure 7-2 Connection site of the vacuum station



Figure 7-3 Underground piping of the vacuum system



Figure 7-4 Connection to the vacuum sewage on the Republica side.

8. Future outlook

Amsterdam decided in spring 2023 to make budget available for a restart of the New Sanitation project and is currently looking for a suitable additional plot in Buiksloterham to continue the pilot. Given the development time of construction projects, it is expected that the system will not be operational before 2024/2025. An advantage of this temporization is that it offers the opportunity to solve a number of bottlenecks.

9. Output for other tasks in WP4

The result of task 4.8 ensures that the future outlook for the GFe waste processing of Republica and the sewage from the vacuum toilets in Schoonschip is positive. This processing will then contribute to diminishing the loss of energy from the PED by producing biogas.

Annex A Final proposal of Task 4.8 change

Justification of Waternet change of plan with vacuum sewage

September 2021

Since 2016, Waternet has been developing the New Sanitation pilot in Buiksloterham on behalf of the municipality of Amsterdam and the AGV (Amstel, Gooi en Vecht) water board. A feature of the pilot is that toilet water is collected separately via a vacuum sewer system and purified in a local treatment plant: the resource recovery station (RRS). The aim is to reuse as much raw materials (phosphate, clean water) and energy (biogas, thermal energy) from waste water as possible. The application of the vacuum sewage system also offers the possibility of collecting vegetable and fruit residues via a food residue grinder from which biogas can be produced.

ATELIER is participating in this pilot through inclusion of toilet water from floating community Schoonschip and through inclusion from food residue grinders from development site Republica.

Developing partner De Alliantie (external from ATELIER) recently decided to withdraw from the pilot, which means that only the 47 dwellings of Schoon Schip are currently connected to vacuum sewerage. This number is too low to be able to put the RRS into operation. This requires at least 160 additional dwellings to be connected. Amsterdam is currently looking for a suitable plot in Buiksloterham to continue the pilot. Given the development time of construction projects, it is expected that the system will not be operational before 2024/2025. An advantage of this temporization is that it offers the opportunity to solve a number of bottlenecks.

The direct consequence of this temporization is that the GFe (vegetable and food residue) from Republica cannot be treated in the RRS during that period. However, this does offer Waternet the opportunity to start a manageable pilot study on the behaviour of GFe in regular sewage systems.

The Directorate Waste and Resources of Amsterdam is in charge of waste collection and is willing to support this pilot study under the following conditions:

- The processing of the GFe waste of the households have to comply with LAP3 legislation after the pilot (fermentation and composting). This means that the design of the new sanitation system must be suitable for disconnecting the GFe pipes and processing the waste separately.
- The Directorate Waste and Resources of Amsterdam must be and remain the director of the collection and processing process of the GFe. Waternet will be designated as waste collector. For this, Waternet will install measuring equipment on the basis of which volumes and qualities of the GFe will be registered.
- The Directorate Waste and Resources of Amsterdam is involved in all relevant developments in the project.

- Waternet is making every effort to develop a feasible and scalable solution that complies with legislation and regulations, in particular LAP3, based on the experience with the new sanitation project Republica.

To meet these requirements a precondition is that Republica must be connected directly to the vacuum station to prevent mixing the GFe with the wastewater from Schoon Schip. Unfortunately, the costs of this measure require restructuring of the Waternet budget in ATELIER. Originally the assumption was that Republica could be connected to the vacuum pipeline of Schoon Schip. See the image.

Overview of site as of September 2021



Because the municipality of Amsterdam, Waternet and Republica find it important that the pilot under the ATELIER project can proceed (and thereby maintaining the ambition and outlook for energy and resources recovery from sewage and GFe), we propose to modify the allocations of the Waternet budget in order to be able to build the vacuum sewer for Republica as in the Excel file attached. (below)

