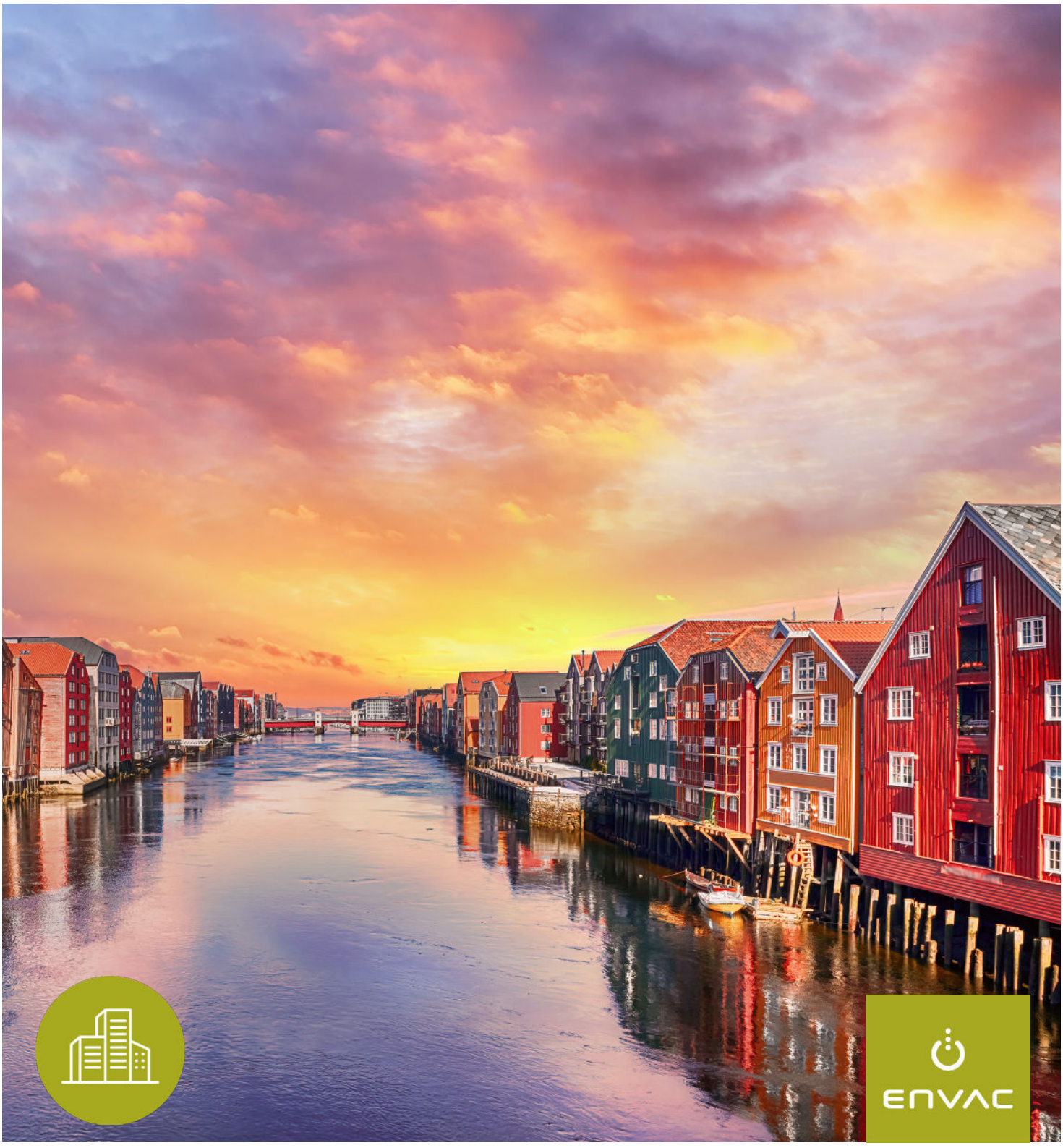
SMART CITY

TRONDHEIM



FUTURE-DRIVEN WASTE COLLECTION

THE CITY IS MAKING REMARKABLE PROGRESS IN WASTE COLLECTION BY IMPLEMENTING MODERN TECHNOLOGY

Trondheim is a breathtaking city nestled in the heart of Norway, boasting a unique blend of cultural richness and architectural beauty. The city has made a point of having an innovative best practice apporach to waste management. Adding and installing effective and eco-friendly vacuum waste system, mainly from Envac, has contributed to this development. With a focus on reducing, reusing, and recycling waste, Trondheim's waste management system has significantly increased recyling rates and decreased their residual waste. This approach is a testament to the city's commitment to sustainability and protecting the environment. Trondheim is a future-driven smart city that has successfully integrated an automated waste collection system into its infrastructure, which is truly inspiring.

HOW WASTE IS SORTED IN TRONDHEIM

The city's residents sort their waste into different categories: paper, plastic, glass, food, residual, hazardous, and more. All these categories play an essential role in the waste management system.

The vacuum waste collection systems currently in use need to be adapted further to carry more waste fractions in the future. Currently, only residual and paper waste are sorted using automatic waste collection systems supported by Envac.

However, food waste is the new addition to Trondheim's automated waste collection system.

Starting from May 2020, all new waste collection systems are to handle 3 fractions; residual & plastic, paper & cardboard, and last but not least – food waste. Biodegradable green plastic bags will be used for food waste.

TRONDHEIM'S AUTOMATIC WASTE COLLECTION

The vacuum underground system has been chosen to promote the idea of having more residential units in a specified space instead of expanding the city limits due to rapid urbanisation. Rather than developing a brand new infrastructure, the city aims to use and improve the existing one. Therefore, there is a need to think differently and develop an effective waste collection plan for sustainable urban development.

Almost 15 years ago, the city began developing area plans that define the waste system based on the size of the development.

For residential areas with 50-300 apartment units, the Mobile Vacuum System (MVS) was a must-have, and for those with over 300 apartment units, the Stationary Vacuum System (SVS) must be included in the development plan.

Furthermore, the plan has been revised, and residential areas with 250 units or more will have SVS as it is more future-oriented and much more efficient for waste collection.

Ladebyhagen apartments connected to Envac terminal in the area that eliminates heavy garbage truck movement.

Illustration of Campus Nardo, student housing new project in Trondheim city using the Envac automatic waste collection solution.

Although the Stationary Vacuum System (SVS) is important in better planning the urban environment, the plan has to balance the city's decisions based on effectiveness, safety, and space. The primary objective is to prevent large trucks from getting too close to residential units, which not only takes up valuable space but also threatens safety and the environment. Moreover, other factors like smell, hygiene, and pollution are considered when implementing an automatic waste collection system.

"In Norway; the least preferred solution is the disposal of waste at landfills. The most favorable option is to prevent waste generation and reuse and repair products. If waste is still generated, the key target is to recycle the materials."
- Brage Hertzenberg-Nafstad, Trondheim Municipality

A STATIONARY PNEUMATIC WASTE COLLECTION SYSTEM ELIMINATES THE NEED FOR WASTE TO BE COLLECTED BY TRUCK. INSTEAD, IT IS TRANSPORTED THROUGH UNDERGROUND PIPES BY AIR AND THEN COMPACTED IN SEALED CONTAINERS. THIS SOLUTION MINIMISES THE NEED FOR ROAD TRANSPORT AND ELIMINATES THE PROBLEM OF UNPLEASANT ODOURS. UNLIKE TRADITIONAL WASTE MANAGEMENT, NOBODY NEEDS TO COME INTO CONTACT WITH WASTE BAGS OR CONTAINERS.

AMBITIOUS WASTE MANAGEMENT AND COMMITMENT TOWARDS SUSTAINABLE DEVELOPMENT

- All residual waste is collected and sent to an incineration plant in Trondheim. This plant generates energy for the central heating system and has been in operation since 1986.
- Paper and plastic waste are sorted at an automated plant. A significant proportion of paper is recycled within the region.
- Producers are responsible for the treatment of plastic and glass packaging waste.
- Food waste is sent to a biogas plant that produces biofuel, liquid and dry fertilisers. The biogas is utilised as biofuel in garbage trucks and public transport.

The illustration explaining how the Envac stationary vacuum waste collection system works.

- In the city, all residual household waste is incinerated, which amounts to 29,000 tonnes collected from households in 2023. Residual waste constitutes 48% of total household waste in 2023 vs 53% in 2022. Despite rapid urbanisation, the total amount of waste generated has decreased annually, indicating growing awareness among end-users. Each person produced 287kg of waste in 2023 in the city of Trondheim, decreased from 296kg in 2022.

- Approximately 26% of the total waste in Trondheim is collected through underground waste collection systems. The Stationary Vacuum System contributes to around 2,5%, the Mobile Vacuum System contributes to approximately 5.5%, and 18% is collected through underground containers and other means.

ENVAC SUPPORTS BOTH STATIONARY VACUUM SYSTEMS AND MOBILE VACUUM SYSTEMS, CONTRIBUTING TO 8% OF TRONDHEIM'S OVERALL WASTE COLLECTION SOLUTIONS.

"Our top priority is to provide a sustainable solution for Trondheim that improves the quality of life for the current residents and future generations. The innovative Envac system makes waste collection smarter, greener, safer, and more hygienic. We take pride in being the pioneers of a forward-thinking waste collection system that can support the city in achieving its goals."

- Roy Sandersen, District Manger Trondheim, Envac Norway

GOOD TO KNOW

TOTAL POPULATION: 214,000 residents
(January 1st, 2024)

WASTE TYPES: 3 fractions in MVS (plastic, food & residual waste) and 4 fractions (plastic, paper, food & residual waste) in SVS

PIPE DIAMETER: minimum 400 mm for waste collection

NUMBER OF TERMINALS: 9 existing terminals (including 1 for the hospital) and 15 upcoming terminals

NUMBER OF APARTMENTS CONNECTED: 11,000 approx. apartments are connected to 9 existing terminals, and future terminals will be connected to over 24,000 apartments

TOTAL WASTE COLLECTED BY ENVAC: approximately 30% of total underground waste, almost 2 300 tonnes of residual waste and 175 tonnes of paper.

> *TRONDHEIM WILL BECOME CLIMATE NEUTRAL BY 2030 BY CUTTING THE DIRECT GREENHOUSE GAS EMISSIONS BY AT LEAST 80% COMPARED TO 2009.*
> *THE GOAL IS THAT THE CITY WILL BECOME CLIMATE POSITIVE BY 2050.*
>
> *- TRONDHEIM MUNICIPALITY*

2 300
tonnes of residual waste

Collected by the system through the underground pipe network.

21,000
habitants

The system will serve over 50,000 habitants in the future with new terminals.

26%

of total waste

in Trondheim is collected through various underground systems.

24/7
availability

The system has been in operation for around half a million hours so far with round the clock availability thus proving its roubustness

ST. OLAV HOSPITAL, TRONDHEIM

St. Olavs Hospital in Trondheim covers a surface area of 206,600 square meters with more than 8,600 employees. Founded in 1901, the hospital had only seven buildings initially, but it has undergone significant upgrades and transformations over the last three decades. Today, St. Olavs Hospital is a university hospital with a vision to provide excellent treatment to the population of Central Norway.

The hospital underwent a significant reconstruction project, which resulted in the construction of new buildings and facilities over a large area. The new hospital has over 900 beds and has implemented several innovative measures to ensure efficient and effective waste collection.

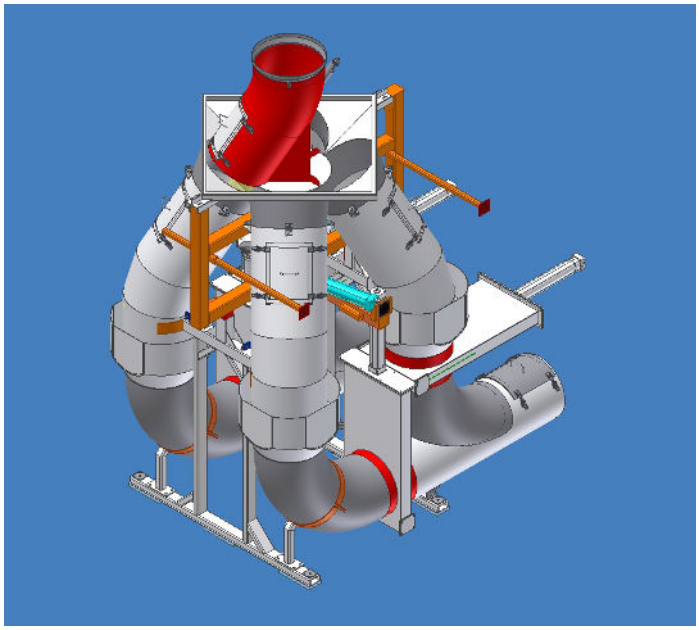
AUTOMATIC WASTE COLLECTION AT THE HOSPITAL

One of the most notable measures adopted by the hospital is the installation of Envac's automatic waste collection system. **The system is designed to collect four different waste streams: paper, confidential paper, residual, and plastic. It requires only one disposal inlet for all four fractions, which is connected to an underground pipe network and automatically sorts the waste into separate containers.** The system is also known as Sort-More and provides a high level of service while meeting the hospital's strict requirements for hygiene, occupational health, and safety.

There are inlets with a screen on every floor level that have four different buttons. These buttons help to control the type of waste that goes into the corresponding container at the end of the pipe network. Whenever a user presses the button for the selected type of waste, the system uses air pressure to transport the waste to the collection terminal. After that, it is diverted into the proper waste containers. **The system also connects to Øya Helsehus, a 20,000 square metre care home for special needs and elderly.**

ABOUT SORT-MORE

Sort-More is a mechanism developed by Envac for handling up to four different waste fractions in one single chute. Sort-More is installed at the bottom of a vertical waste chute and acts as a multi-diverter and an intermediate storage.

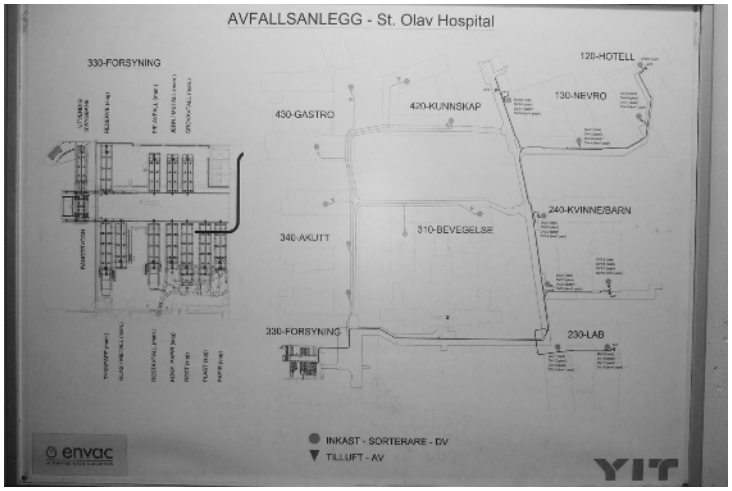


Main components:

- The waste management system has inlet doors with buttons mounted on a panel above them. These controls enable the user to select the type of waste material to be disposed of.
- There are four discharge valves, one for each type of waste material: paper, confidential paper, residual, and plastic.
- A pneumatic mechanism is activated by the controls situated on top of the inlet door.
- The system also comprises storage sections, which are emptied using air pressure once they are full. The activation of the system is sensor-based.

THIS IS HOW IT WORKS:

- Before disposing of the waste the user indicates the waste fraction on the control panel.
- An integrated control module operating the valves is connected to the control system in the waste collection station.
- The shut-off valves installed in each fraction sequentially open only a few seconds during the collection cycle, allowing the evacuation of waste stored in the corresponding chutes.



PICTURED ABOVE IS ONE OF THE ORIGINAL ENVAC DRAWINGS FOR THE HOSPITAL.

THE DESIGN SAVES SPACE IN THE BUILDING WITHOUT LOSING STORAGE CAPACITY.

FACTS:

TOTAL AREA: 206,600 square meters

TOTAL BEDS: 900

WASTE TYPES: 4 fractions (paper, confidential paper, residual, and plastic

PIPE DIAMETER: 500 mm for waste collection

PIPE NETWORK: 3,000 meters

NUMBER OF SYSTEMS: 20 Sort-More

NUMBER OF INLETS: 120

AMOUNT OF WASTE COLLECTED: 1800 tonnes per year

SYSTEM AVAILABILITY: 99% (24/7)

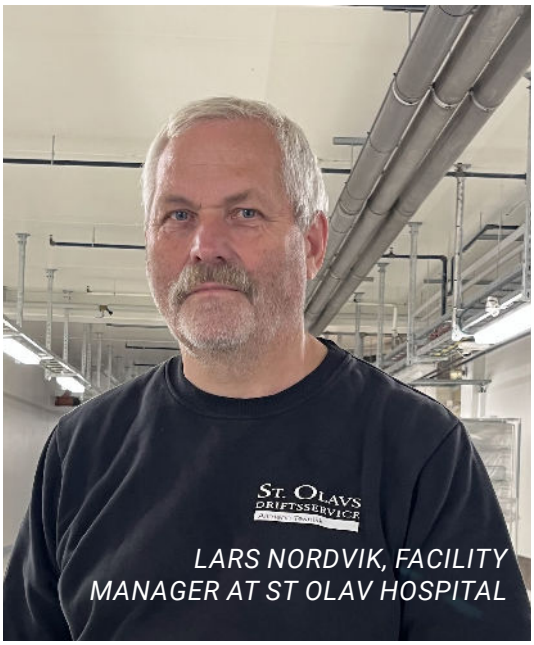
FIRST SYSTEM OPERATION: 2005

The drawing of the network of Envac system at the St Olav Hopital, Trondheim, Norway.

The new psychiatric centre will have the latest Sort-More system connected to the existing waste collection terminal.

The innovative system efficiently reduces the need for road transport and also eliminates the problem of unpleasant odours and the need for manual handling of waste bags or containers. The visionary system offers additional benefits for healthcare facilities, including:

- Collection of refuse and recyclables at the point of origin.
- Automated transport of waste and recyclables underground from the deposit point to the collection station.
- Reduction of manual handling.
- Reducing negative environmental effects, such as energy consumption, gas emissions and littering.
- Encouragement of recycling, resulting in a decrease in waste volumes.
- Uses closed pipe networks to transport waste, reducing physical contact, transmission of infections, and accidents, creating a safer and more hygienic environment.
- Reduces the traffic in hospital hallways related to waste collection.



LARS NORDVIK, FACILITY MANAGER AT ST OLAV HOSPITAL

"THE HOSPITAL IS EASIER TO MAINTAIN, CLEAN AND TIDY. THE WASTE MANAGEMENT SYSTEM IS DESIGNED TO EXPOSE NO BACTERIA ASSOCIATED WITH THE WASTE THROUGHOUT THE FACILITY, RESULTING IN NO UNPLEASANT ODOUR IN THE HOSPITAL WARDS, CORRIDORS, OR COLLECTION STATIONS. THE SYSTEM CAN HANDLE LARGE VOLUMES OF WASTE, REQUIRING LESS WORKFORCE FOR WASTE MANAGEMENT.
- LARS NORDVIK, FACILITY MANAGER AT ST OLAV HOSPITAL

The hospital's system is an integral part of its infrastructure, enabling seamless operations and smooth delivery of services to the patients. The system's reliability and robustness ensure its availability for the users, allowing them to access and utilise it without any hassles. The system has been operational since 2005, and over the years, it has stood the test of time thanks to its high-quality components that have contributed to its longevity.

MODERNISATION ROADMAP FOR THE FUTURE DRIVEN HOSPITAL

The hospital system has a long way to go in its lifecycle, but in an ever-evolving and dynamic environment, Envac suggests modernisation with the following improvements:

1. Energy efficiency: Envac Automation Platform (EAP 4.0 or latest) can reduce electricity consumption by approximately 15%. This platform can configure the system requirements through machine learning and big data, which further reduces the cost of equipment maintenance and peak shavings. It also extends the equipment's useful life and filter service life by approximately 20%.

2. System improvement: Prepare the mechanical infrastructure to face future challenges and improve cost-efficiency. According to the current parameters, incorporating Artificial Intelligence will enable maximum efficiency in the collection process. Gathering and analysing data on waste will allow us to offer hospitals comprehensive information about the services they can receive.

3. Adding a new fraction: Food waste is a significant concern today. The hospital can significantly contribute to reducing food waste by adding an unknown fraction of food waste to its existing waste collection system. This will be a game changer, as it will improve waste collection and support the municipality's goals of reducing food waste while making waste-to-energy conversion more efficient.

Moreover, Envac's automated waste collection system is paving the way for data-driven waste management in the future. Unlike traditional waste collection methods, this system does not rely on human input to determine its operation and identify areas for improvement.

The illustration explaining the automatic waste collection process at the hospital using the Envac system

"Trondheim municipality excels in waste management and recycling with data-driven solutions and transparent regulations. Envac is proud to contribute to the municipality's efficient waste collection and sustainability goals."

- Knut Johansen, Sales Manager, Envac Norway

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ST OLAV HOSPITAL, TRONDHEIM

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