# Turning Wastewater Into Energy

Water and wastewater facilities are typically high-energy consumers. Treatment processes alone can account for 25%–40% of a municipality's electricity bill—energy that could be saved and resources that could be redirected to other priorities. The key lies in recognizing that the technology and expertise already exist to make water management systems energy-neutral. At the Marselisborg Wastewater Treatment Plant, this potential was realized through an optimization process that evaluated all energy-consuming assets and maximized energy recovery from sludge. As a result, the plant redesigned its operations and treatment processes to become a state-of-the-art wastewater treatment facility.

Today, the facility produces 50% more electricity than it consumes and generates 2.9 GWh of heat for the district heating system without the need for external organic waste or additional carbon sources. This excess energy is sufficient to meet the energy needs of both drinking water supply and wastewater treatment services across the entire water cycle within the catchment area.

**REDUCE**

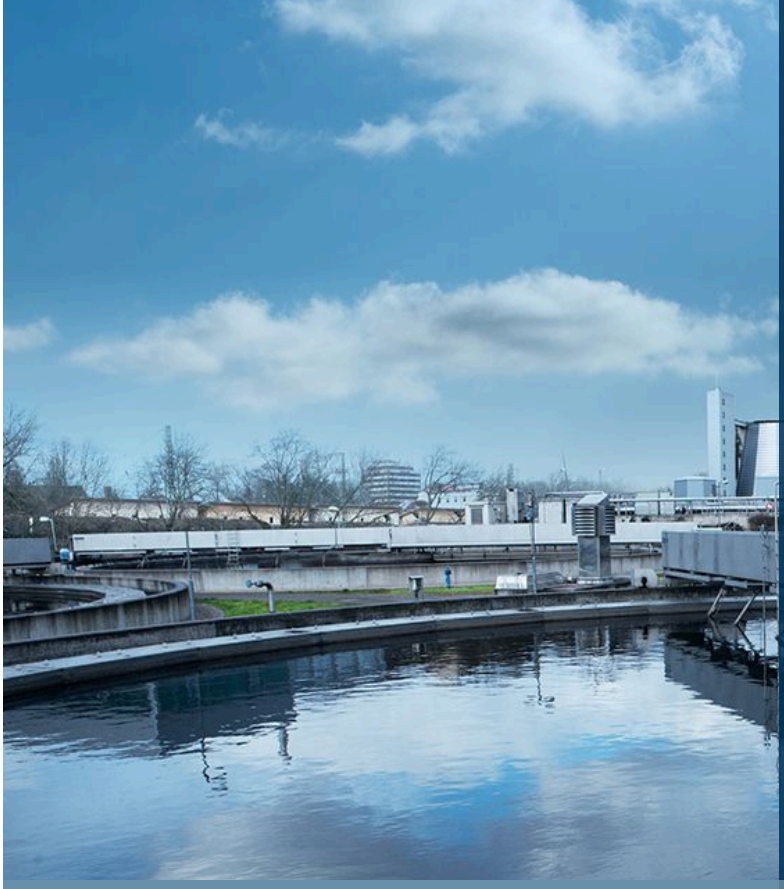
**RECOVER**

**AARHUS, DENMARK**

**WASTEWATER**

**INDUSTRIAL**

wef | CASE STUDY



## CHALLENGES FACED

Complexity arose from integrating heat recovery and transporting surplus heat to the district heating network, which required infrastructure adaptations and careful management of heat losses. Further optimization of chemical dosing and sludge dewatering was needed to reduce energy and chemical use without compromising efficiency. Key efforts focused on reducing energy consumption through optimization of aeration, mixing, and flow management and by introducing anaerobic ammonium oxidation.

## TECHNOLOGIES & SOLUTIONS USED

Marselisborg Wastewater Treatment Plant implemented several advanced technologies, including a dual-layer data management and supervisory control and data acquisition, a new turbo compressor, upgraded combined heat and power units, sludge liquor treatment based on the anaerobic ammonium oxidation process, and an optimized fine-bubble aeration system. These measures reduced electricity consumption by approximately 1 GWh per year, representing 25% total energy savings.

## IMPACT & INSIGHTS

Today the facility produces 50% more electricity than it needs and 2.9 GW of heat for the district heating system without adding external organic waste or carbon. This is more than the nearby catchment area's consumption for water and wastewater management, making it the first energy-neutral utility area in the world, uncoupling water and energy. Aarhus Vand has evolved through an ingenuity-driven development process. Guided by value-driven change management, employees adopted an innovative approach to improve the treatment facility's energy balance.

## LESSONS LEARNED

The utility aims to achieve climate neutrality by 2030. During the optimization and monitoring of energy production at the facility, greenhouse gas emissions, particularly nitrous oxide from biological processes and methane from energy recovery systems, were identified. Reducing these emissions is now a key priority. A new structural plan to centralize three major wastewater treatment plants into one facility is underway to support city growth, meet future demands, and advance climate neutrality. This transition will also shift the role of wastewater treatment plants toward resource recovery facilities.

> **As the initiative progressed, the initial ingenuity-driven approach evolved into a structured innovation process known as the Living Lab concept. These innovation environments provide opportunities to test and demonstrate solutions across three areas: the drinking water distribution network, the wastewater treatment plant, and climate adaptation projects.**

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