

Severn Trent Water

Digital twin to optimise energy and emissions at wastewater treatment plants

Severn Trent Water (STW), headquartered in Coventry, England, is one of the UK's largest water and wastewater utilities. STW serves over 4.6 million households and business customers in England and Wales and plays a vital role in delivering clean water and managing wastewater efficiently and sustainably.

As part of its commitment to innovation and sustainability, STW has developed the world's first Net Zero Hub for wastewater treatment at its Strongford site in Staffordshire. This pioneering initiative brings together cutting-edge technologies to reduce greenhouse gas emissions and serves as a blueprint for achieving net-zero operational emissions (Scopes 1 and 2) across the industry.

The utility's extensive infrastructure delivers almost two billion litres of water every day through 50,000km of pipes. A further 93,000km of sewer pipes take wastewater away to more than 1,000 sewage treatment works.

Challenge

STW has the ambitious plan of making its Strongford site the world's first waste treatment plant to achieve net-zero operational emissions (Scopes 1 and 2). This involves reducing process emissions, chemical usage, and energy consumption without compromising final effluent quality standards. One of the initiatives undertaken to fulfil these objectives is the development of a digital twin to visualise, simulate and optimise operational processes. This innovative approach is supported by the Ofwat Innovation Fund and developed as part of a collaborative project involving Xylem, AtkinsRéalis, Sand Technologies, and Siemens.

This multifaceted solution uses both mechanistic and data-driven modelling to simulate various environmental and load impacts on the treatment works. This provides real-time recommendations and decision-support tools to operational staff through a user-friendly interface.

Solution

An integrated project team, comprising Xylem, Sand Technologies and Siemens, has established an end-to-end model that covers both wastewater and sludge treatment at Strongford. One of the modelling components is Xylem Vue's Real-Time What-If Scenarios application



Program highlights:

- Visualisation of WWTP performance in near-real time thanks to a digital twin
- Operational decision-making support to achieve carbon-neutral performance
- Compliance with final effluent limits, reduction of nitrous oxide emissions and decrease in energy consumption

"The ambition was to develop three layers of the digital twin. The first is a visualisation layer that provides our operational teams with a single view of the entire site (...). The next objective was a simulation layer (...) so we can be more proactive and less reactive. The final layer is an optimisation layer (...) that takes into account energy demand, costs, and weather conditions..."



Jess Alce,
Strategic Innovation Lead at STW

(formerly known as TSO – Treatment System Optimisation) which has been implemented across the Activated Sludge Process (ASP) lanes within the treatment works. The objective of this solution is to minimise the production of nitrous oxide and reduce energy consumption, while ensuring that the effluent from this process meets the required standards.

The application provides operational recommendations generated by algorithms that use machine-learning and optimisation techniques. The solution also incorporates real-time nitrous oxide level predictions. In addition, it includes an emission risk measure provided by Cobalt Water, which is fed back into the [Xylem Vue](#) data model to ensure final validation against all performance objectives. The Xylem Vue solution was configured to check and approve all recommendations against the multi-objective optimisation criteria. It makes any necessary adjustments before forwarding them to the digital-twin interface where they can be evaluated and implemented by site operators within the overall digital-twin optimisation strategy.

Outcomes

The implementation of a digital twin at the Strongford treatment works, partially powered by Xylem's data-driven models, has enabled Severn Trent Water to visualise plant performance in near-real time. The solution is expected to support operational decision-making to achieve carbon-neutral performance over the course of implementation by combining observed data with simulation and optimisation algorithms.

Although the project is still in its early stages, the digital twin has already provided the tools to generate operational recommendations. These are expected to drive improvements in emissions, energy use, and compliance over the course of implementation, as the platform is adopted within site operations. Although field testing is still being planned and definitive results are not yet available, the foundations have been laid to deliver measurable impact in the coming months.

Key anticipated benefits include proactive plant management through real-time setpoint recommendations, improved operational stability and adaptability to respond to incoming loads, and enhanced compliance with final effluent limits. The solution is also designed to reduce nitrous oxide emissions and energy consumption, contributing to long-term environmental sustainability.

“As we move forward on our net zero and AI strategies, we are focused on building the capabilities needed to move from reactive operation to more predictive and optimised performance. At Strongford, that means bringing together data, simulation and advanced analytics to better understand and improve how the site runs. Over time, we will evolve these capabilities so they can be applied more widely to optimise energy, emissions and operational performance across our wastewater systems.”



Victoria Newall,
AI Architect at STW