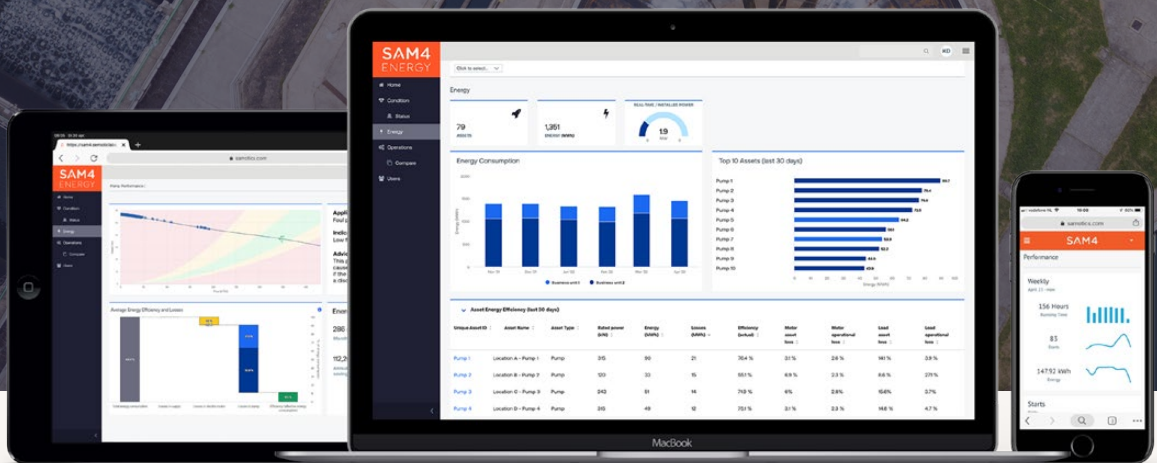


PRODUCT EXPLAINER

# SAM4 ENERGY

The path to Net Zero:  
Improving energy efficiency  
in the water industry



How water companies can reduce energy costs and carbon footprint within drinking water systems and wastewater treatment plants by optimizing equipment performance with SAM4 Energy.

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# The challenge for water companies: reaching Net Zero

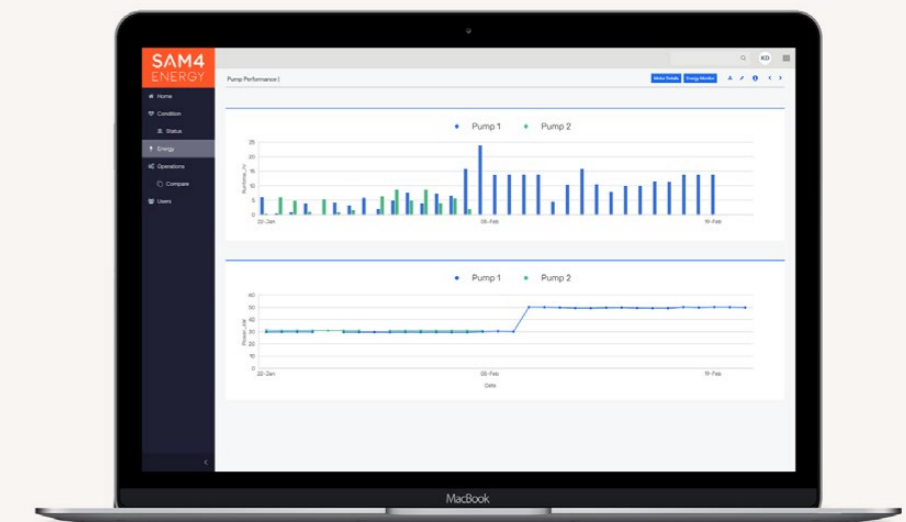
Water companies worldwide are under pressure to operate at net zero emissions. For example, the entire UK water industry is committed to reach this target by 2030<sup>1</sup>. At the same time companies are under pressure to treat larger and larger amounts of waste water and produce and distribute larger amounts of clean water as population and pollution grow. Up to two-thirds of emissions in the water industry are caused by electricity consumption in pumps, aerators and other equipment, making this the largest controllable emission source. With up to 40% of the electricity used by electric motor-driven systems being wasted due to operational inefficiencies, process-machine mismatches, and developing damage, the levels of these emissions become even more significant. At the same time, OPEX budgets are under pressure with rising electricity prices and limited ways to pass these costs on to end customers. There is a clear need for a solution that drives down electricity consumption.

## The solution: SAM4 Energy

In the water sector, equipment typically needs to service a large range of flow demands so it is no simple task to optimize. As a global leader in analyzing electrical data, Samotics' SAM4 Energy solution provides the world's first automated tool to achieve continuous efficiency optimization.

SAM4 Energy analyzes the efficiency of the entire drive train, from losses in the electric motor to driven equipment such as pumps. Furthermore, the platform distinguishes the losses inherent in the equipment - like rated motor efficiency - and those caused by the way the equipment is operated - like pump efficiency losses from operating away from the best efficiency point. Armed with this information, SAM4's advanced algorithms go beyond individual asset performance, providing insight into the performance of e.g., entire pumping stations with multiple co-located pumps versus industry benchmarks.

This generates cost-effective recommendations that can be put into operational practice, often in a very short timeframe and without the need for costly capital investments. It helps our many customers to reduce their energy consumption and achieve yearly recurring electricity savings of 10–15% across their equipment and up to almost 40% on specific assets. This has a very positive impact on sustainability goals and carbon footprint.



SAM4 Energy provides a visually interactive reporting tool to continually monitor the status of equipment.

### About Samotics

Samotics is a leading provider of real-time actionable insights to optimize performance and energy efficiency of AC motors and rotating equipment. An expert team of data scientists, software developers and technical specialists has developed an AI-driven platform that supports global industrial companies in reducing energy waste and unplanned downtime. Our customer base includes sector-leading players such as Yorkshire Water, Anglian Water, Northumbrian Water and Pidpa.

# ENERGY SAVINGS POTENTIAL IN THE DRINKING WATER SECTOR

Pumps are the lifeblood of the water supply industry with pump systems on average accounting for more than 80% of the total energy consumption in drinking water treatment plants. Across a water supply network around 2/3 of energy consumption is accounted for in final water distribution. SAM4 Energy can unlock energy savings of 10–15% on average, with individual pumps in water supply showing savings potential up to almost 40% in specific cases. Finding where the performance and efficiency of critical pumps and other industrial equipment can be improved means having an in-depth understanding of energy use across the water sector and proven performance in solving associated efficiency issues.

SAM4 Energy is employed by many water utilities to understand where and when energy

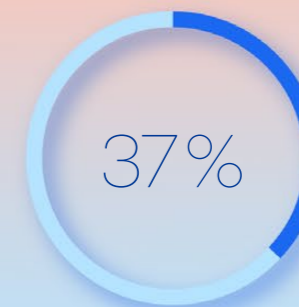
is wasted across their water supply network, thus helping them to improve efficiency and reduce associated costs and emissions. This has varied from SAM4 Energy advising to change flow threshold across co-located pumps (process change to function closer to best efficiency points across the pumps) to advising on component replacement and even whole pump replacement. Process changes recommended by SAM4 Energy provide a very cost-effective and quick means for water utilities to reduce costs and emissions as no capital investment is needed to solve such issues. The ability for SAM4 Energy to determine electrical inefficiencies that stem from developing damage to industrial assets and their components also assists our water industry customers in optimal maintenance strategy and planning, and further saving on industrial costs.

## ENERGY USE IN DRINKING WATER SYSTEMS

Pump systems account for 87% of the total energy consumption in drinking water systems; SAM4 Energy can unlock savings from 3% up to 37% for these systems.

For a typical system serving 200,000 people, that means a reduction of up to 1.5 GWh, or more than €325,000 per year, while avoiding ~660 tonnes CO<sub>2</sub> eq p.a.\*

\* Cost of 1kWh is €0.21, and 1MWh of CO<sub>2</sub> emissions equals to 0.429 tonne



of energy savings can be achieved with SAM4 Energy



of yearly electricity cost savings for a system serving 200,000 people

### WATER INTAKE

High energy savings can be made for surface water intake with assets such as split case, end-suction, inline and non-clog pumps.

### WELLS/BOREHOLES

Significant energy savings can be made with assets such as submersible borehole pumps.

### BOOSTER STATIONS

High energy savings can be made at booster stations with assets such as multi-stage centrifugal pumps.

### TREATMENT PLANT

Significant to high energy savings can be realized for intermediate water pumping within treatment plants with assets such as intermediate or high-pressure pumps.

### FINAL WATER DISTRIBUTION

With an industry average of 67% of energy used in final water distribution, significant energy savings can be realized for assets such as final water, multistage and centrifugal pumps.

### CALCULATING ENERGY SAVINGS POTENTIAL

Energy savings potential in the drinking water sector differs between assets based on their total energy consumption, specific operations and control settings. Factors such as diurnal and seasonal water demand patterns, as well as equipment set-up (age, presence of variable speed drives, etc.) will also impact the potential for energy savings.

In this infographic significant (medium) and high savings potential have been listed for commonly used types of equipment, based on industry expertise.

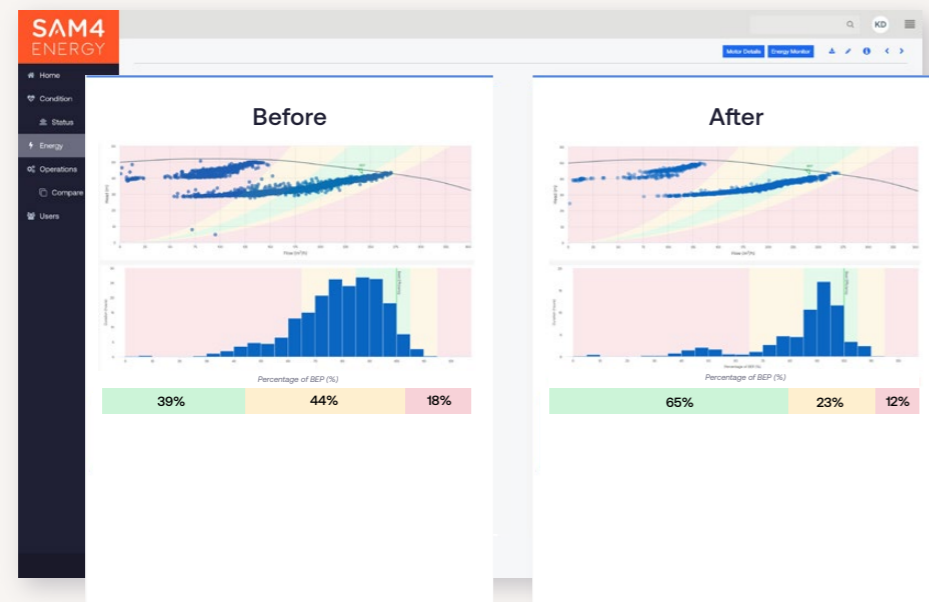
# SAM4 Energy in action: case from clean water pumping

## SOLVING INEFFICIENT PUMP OPERATIONS TO REDUCE ENERGY CONSUMPTION

Three pumps that form the core of a clean water pumping station were being analyzed by the SAM4 Energy platform. These pumps are critical to the supply of water to customers during both peak and non-peak times. The three clean water distribution pumps include two larger 55kW pumps and a smaller 11kW pump.

The SAM4 platform informed the water company that the two larger pumps were often used inefficiently to supply flow rates that could be independently covered far more efficiently by the smaller pump. SAM4 Energy further determined that a significant part of the energy losses were due to the mode of operation, with operational efficiency losses in the pump and associated electric motor accounting for about 10% of total efficiency losses.

Using the recommendations generated by SAM4 Energy, the customer implemented two simple setting changes to achieve more efficient pumping during low flow periods. Firstly, the flow threshold at which the 11kW pump delivered flow was increased, as the 11kW pump could deliver the low flow independently and more efficiently than the two larger pumps. Secondly, the speed of the 11kW pump was increased (by increasing the supply frequency of the VFD) to further widen the useful operating range of the smaller pump to deliver increased flow at the required pressure, with the larger pumps only being switched on when truly necessary. The customer was able to implement these changes in a matter of hours and this involved no additional capital expenditure.



Following implementation of the recommended actions, each pump was operating under more efficient conditions (green zones) in comparison to inefficient operation (red zones). Here is the situation of one of the larger 55kW pumps before (left) and after (right) the process changes were implemented.

Once these simple process changes were implemented the before and after situation could immediately be compared via the SAM4 Energy platform and the improvement calculated. All three pumps were operating closer to their best efficiency point. The total pump station efficiency improved by 7.1%, taking into account the distribution of running time, pressure and flow in the old and new situations. This translates to yearly electricity savings of €2,500 across the three pumps and an associated reduction of 9.2 tonnes of CO<sub>2</sub> based on energy reduction alone. Translating such savings across a whole water supply network offers very significant savings.

Savings type	Savings
Yearly electricity costs	€2,500
Carbon emissions reduction	9.2 tonnes



# ENERGY SAVINGS POTENTIAL IN THE WASTEWATER SECTOR

In the wastewater sector SAM4 Energy can realize significant savings across the whole network. Pumps and blowers account for up to 65% of energy consumption in wastewater treatment plants. SAM4 Energy can unlock 10-15% savings on average for these systems and up to almost 40%\* for specific assets. SAM4 Energy analyzes performance and energy waste across the inherently variable nature of the wastewater network, helping to improve efficiency and reduce associated costs and emissions. As with the water supply sector, this has varied from SAM4 Energy advising on process changes (i.e. changing the operational setup of co-located pumps to function closer to their best efficiency points) to advising on component replacement and even whole asset replacement (i.e. replace a worn impeller or

add a variable speed drive). Process changes recommended by SAM4 Energy provide a very cost-effective and quick means for water companies to reduce costs and emissions with no associated capital investment. Furthermore, SAM4 Energy's insights can also provide an indication of inefficient operations that are damaging to equipment or their components, allowing further savings on required maintenance costs when addressed.

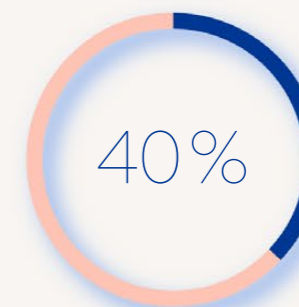
\* Global Water Research Coalition: Energy efficiency in the water industry: a compendium of best practices and case studies global report.

## ENERGY USE IN WASTEWATER TREATMENT PLANTS

Inside a wastewater plant, pumps and blowers take up to 65% of the total energy consumption; SAM4 Energy can unlock savings from 3% up to 40% for these systems.

For a typical system serving 200,000 people, that means a reduction of up to 1.7 GWh, or more than €360,000 per year, while avoiding ~740 tonnes CO<sub>2</sub> eq p.a.\*

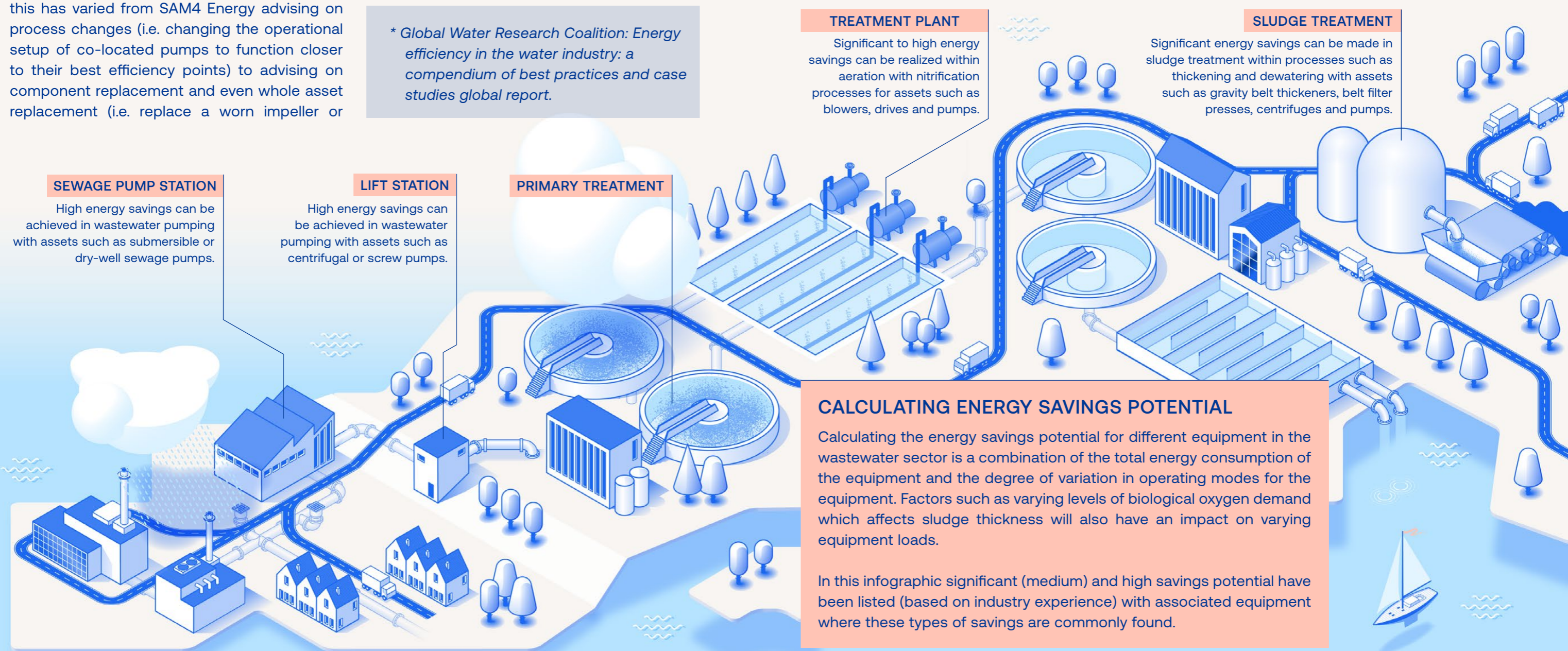
\* Cost of 1kWh is €0.21, and 1MWh of CO<sub>2</sub> emissions equals to 0.429 tonne



of energy savings can be achieved with SAM4 Energy



of yearly electricity cost savings for a system serving 200,000 people



### SEWAGE PUMP STATION

High energy savings can be achieved in wastewater pumping with assets such as submersible or dry-well sewage pumps.

### LIFT STATION

High energy savings can be achieved in wastewater pumping with assets such as centrifugal or screw pumps.

### PRIMARY TREATMENT

### TREATMENT PLANT

Significant to high energy savings can be realized within aeration with nitrification processes for assets such as blowers, drives and pumps.

### SLUDGE TREATMENT

Significant energy savings can be made in sludge treatment within processes such as thickening and dewatering with assets such as gravity belt thickeners, belt filter presses, centrifuges and pumps.

### CALCULATING ENERGY SAVINGS POTENTIAL

Calculating the energy savings potential for different equipment in the wastewater sector is a combination of the total energy consumption of the equipment and the degree of variation in operating modes for the equipment. Factors such as varying levels of biological oxygen demand which affects sludge thickness will also have an impact on varying equipment loads.

In this infographic significant (medium) and high savings potential have been listed (based on industry experience) with associated equipment where these types of savings are commonly found.

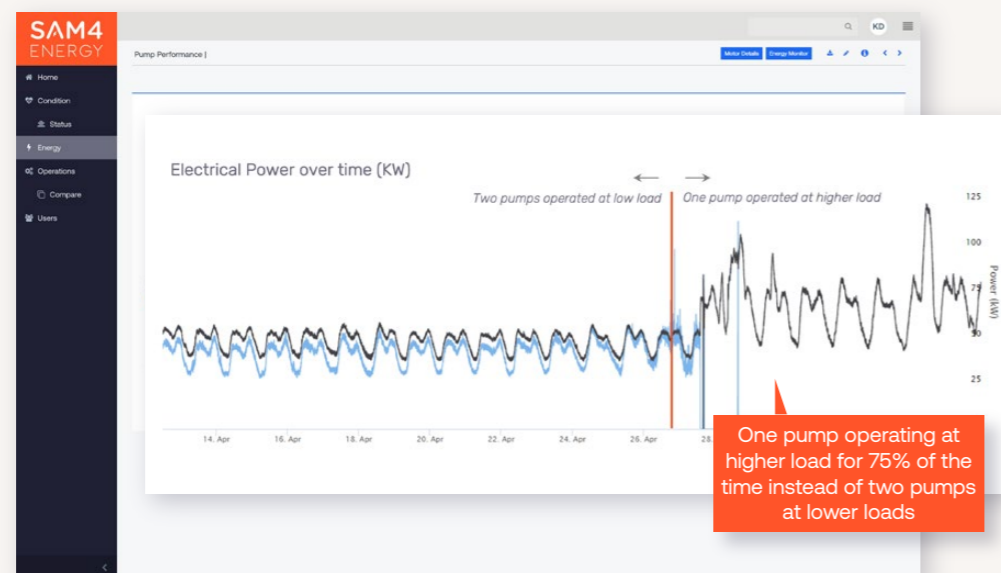
# SAM4 Energy in action: case from the wastewater sector

## REDUCING ENERGY CONSUMPTION BY OPTIMIZING SCREW PUMP OPERATIONS

At a wastewater treatment inlet station two 185kW screw pumps are frequently operated in parallel to meet the required flow levels. These pumps, monitored by SAM4 Energy, are critical in the wastewater treatment process as they provide a steady supply of wastewater to the plant. Moreover, any failure might mean that wastewater backs up into the collection network with potential sewage overflows as a result.

The SAM4 platform determined that the two screw pumps were used inefficiently (at low loads), because the two were operated simultaneously at low loads for approximately 75% of the time. This behavior is useful under wet weather flow conditions (associated with storms), but for the majority of the time (associated with dry weather periods) a single pump could adequately meet required demand/flow rates. This allowed the one operating pump to function closer to its peak efficiency point in dry periods to optimize energy efficiency across the two pumps.

Using the recommendations generated by SAM4 Energy, the customer implemented a simple setting change. This achieved more efficient pumping during low and regular flow periods by changing the flow threshold of when one pump was used independently and when two pumps came into operation.



Implementation of a simple process change led to having only one pump operating for 75% of the time and closer to its peak efficiency point. This improved the energy efficiency across the two pumps by 10–25%.

Once this simple process change was implemented an immediate improvement could be seen in the situation via the SAM4 Energy platform. The new mode of operation significantly increased efficiency, leading to a 25% energy reduction across the two pumps. This equated to savings of up to €41K p.a. in electricity costs and an associated reduction of ~75 metric tonnes of CO<sub>2</sub>eq p.a. based on energy reduction alone. This offers very significant savings when translating these savings across a whole wastewater network which can incorporate hundreds of lift stations.

In addition to the immediate savings that were generated, having industrial equipment operating closer to its best efficiency point prolongs the life of the equipment. This has additional financial and sustainability benefits with respect to capital expenditure, depreciation and industrial and environmental costs of capital production.

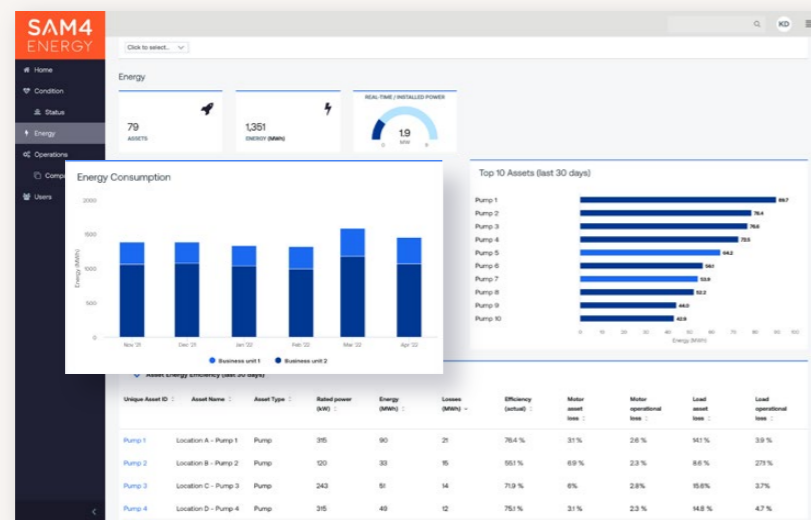
Savings type	Savings
Yearly electricity costs	€ 41,000
Carbon emissions reduction	75 tonnes



# How SAM4 Energy platform works in the water industry

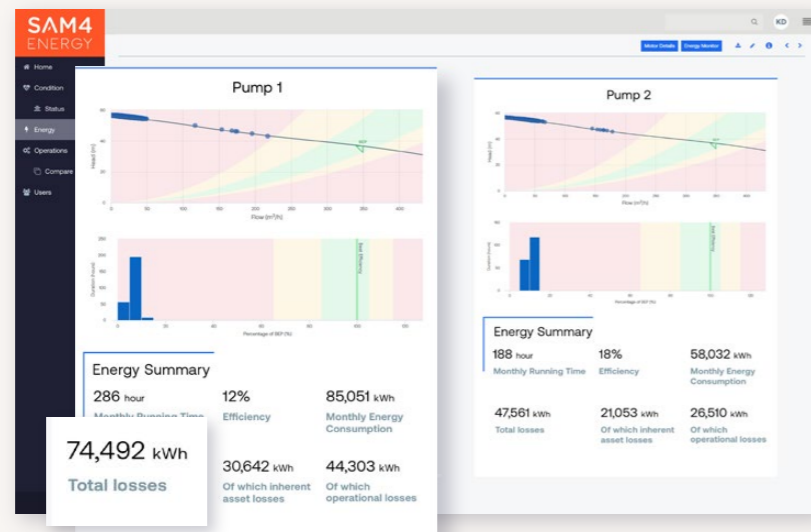
## 1. MONITOR ENERGY EFFICIENCY OF EQUIPMENT 24/7

SAM4 Energy performs continuous monitoring of your pumping systems and other industrial assets through either integration with your existing data sources or gathering data from IoT sensors within your motor control cabinet. This provides an in-depth picture of each asset's energy use and efficiency over time to enable effective energy reporting.



## 2. IDENTIFY ENERGY WASTE AND PRIORITIZE OPPORTUNITIES

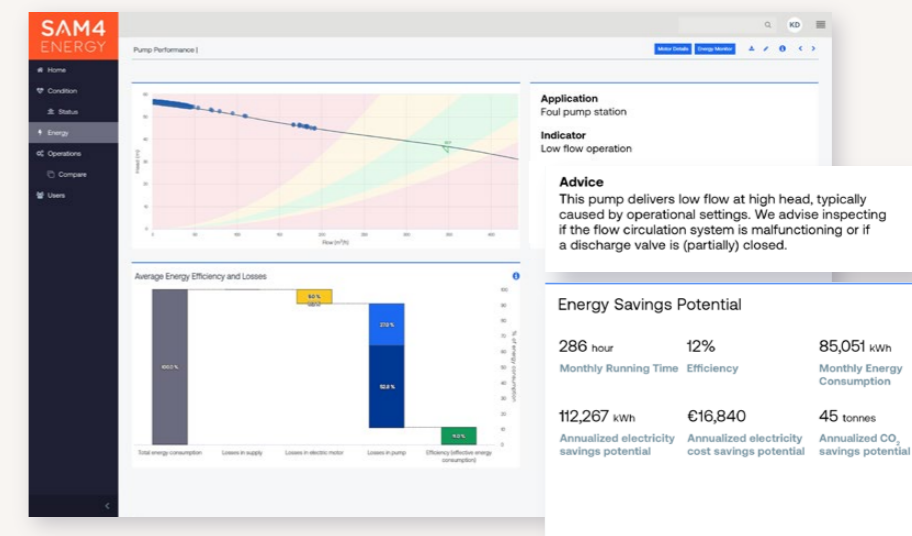
Your data is continuously processed on our analytics platform. This quantifies the energy waste across your industrial equipment, showing in absolute terms where energy consumption, cost and efficiency losses are largest.



SAM4 Energy generates concrete advice you can put into action to help reduce energy waste, costs and carbon footprint for your water company. It is accomplished with the step-by-step approach outlined on these pages.

## 3. RECEIVE EXPLICIT RECOMMENDATIONS TO IMPLEMENT

SAM4 Energy diagnoses the cause of your energy waste and generates recommendations you can implement. This can vary from changing processes such as flow thresholds at a pumping station to replacing components or even whole assets. To help you prioritize, SAM4 Energy ranks recommendations by savings impact, so you can focus where it matters most to achieve 10–15% reduction in annual electricity costs and associated carbon emissions.



## 4. VALIDATE THE RESULTS, BENEFIT FROM THE SAVINGS

Once you implement the recommendations received to your inefficiency issues, SAM4 Energy further measures, tracks and validates any improvements. This shows you in clear terms the energy savings and carbon offset you are achieving for your pumps and other industrial assets.





# Technical deep-dive

## SAM4 ENERGY PROVIDES REAL-TIME MACHINE ENERGY EFFICIENCY AUDIT

SAM4 Energy audits your machines' energy efficiency in real-time using electrical signature analysis (ESA). Unlike many energy monitoring services that only take into account your equipment's rated efficiency, SAM4 Energy's algorithms determine the efficiency of your machines, and the way you operate them, in three ways:

- **Electrical grid efficiency:** poor power quality (e.g., high voltage unbalance or harmonic voltage factor) delivered by your utility provider leads to decreased performance of electric motors.
- **Electric motor efficiency:** an electric motor only achieves its rated efficiency at its rated load and speed. Therefore, SAM4 Energy's algorithms analyze the impact of different settings on efficiency loss, power factor and output power.
- **Driven load efficiency:** like motors, driven loads (such as pumps, blowers or compressors) deliver optimal output at their design work point. For pumps, SAM4 Energy analyzes the operational efficiency, what share of ingoing mechanical power is actually transformed into hydraulic power (i.e., pump flow and head), automatically.



## MONITOR YOUR PUMPS' OPERATIONS IN REAL-TIME WITHOUT FLOW SENSORS

SAM4 Energy monitors electrical signals, but its insights are not limited to electrical motors. Using advanced algorithms, our analytics platform also provides insights into pump flow and head, by taking into account:

- **Pump curve:** every pump manufacturer designs their pumps for a certain flow and head, at a specific input power. Combining this information with real-time electrical signals allows SAM4 Energy's algorithms to reliably estimate the pump operation at every point in time. When such pump curves are not available, integrating with existing flow or pressure measurement data could be an alternative.
- **Pump RPM:** SAM4 Energy determines a pump's speed through analysis of supply frequency to the electric motor and adjusts the pump's head and flow accordingly.



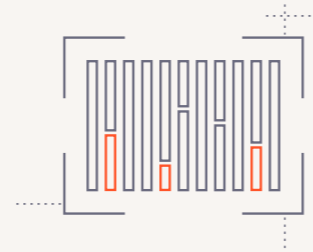
# Key benefits of SAM4 Energy to assist the water industry

Learn how you can benefit from SAM4 Energy's advanced analytics platform in achieving your sustainability and carbon reduction goals.

## ACCESS OUR WORLD-LEADING ANALYTICS PLATFORM

### Increase the value of your data

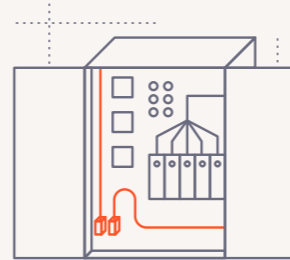
Your energy data is processed on our advanced analytics platform. The platform uses proprietary algorithms developed with industry expertise to add insight to your energy data. Through our advanced data transformation methods, we are able to generate recommendations you can put into action across your water network, to put you in control of reducing your industrial energy waste. This leverages our years of experience of AI-driven monitoring of industrial motor-driven equipment in the water industry. Samotics supplements this with human expertise in energy efficiency and within the water sector, should you require any additional support.



## QUICK AND EASY TO IMPLEMENT

### No major infrastructure changes, no major disruptions

Set-up of the SAM4 Energy system is fast and easy, through either integration with your existing data sources or by installing our energy sensors in one location, inside your motor control cabinet. This can be performed in stages to fit easily around your operational activities. Implementation involves no major infrastructure changes, and with minimal costs. Once installed, data collection and analysis are quickly underway. One major advantage of a system that is quick to implement is that you can also generate results quickly.



## EASY TO USE, ALL THE TIME

### See the efficiency of your pumps in real time

SAM4 Energy provides you with a visually interactive reporting tool to continually monitor the status of your pumps and other equipment. This allows you to perform a continuous energy audit, without having to go out in the field and install (flow) sensors. SAM4 Energy's metrics will provide you a permanent and real-time view of current energy usage and waste to help you prioritize energy savings opportunities that matter the most. Data can also be exported to support follow-up analysis or deep dives.



## SUPPORTING YOU THROUGH THE PROCESS

### Make your journey to results an easy one

Samotics supports you in all steps of your energy efficiency journey with SAM4 Energy. We provide you with help to identify the most appropriate pumps, blowers and other industrial equipment to focus on and offer clear guidance during implementation. We provide you with familiarization of the system and the metrics you can generate to optimize your customer experience. We further help in reviewing your results after an initial data build-up and analysis phase.



## INPUT FOR PUMP REPLACEMENTS

### Utilizing historical data

If a pump needs to be replaced at short notice due to failure, SAM4 Energy can provide the historical overview of delivered flow, duty points and power, allowing for better selection of a replacement pump.



## ADAPTING WITH YOUR WATER COMPANY

### The scalability and flexibility of SAM4 Energy

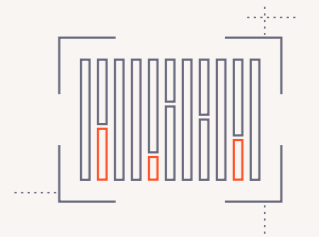
The ease of installation and implementation provides water companies with a great deal of flexibility when scaling up from an initial trial of the technology. With little disruption you can implement SAM4 Energy at a single treatment plant or across a complete water network. As your assets are replaced over time, SAM4 Energy continues to operate without any inconvenience to you. It can also easily adapt as your company grows or experiences any major infrastructure changes to its asset base.



## ENJOY HIGH RETURN ON INVESTMENT

### The real value our customers enjoy

Samotics' water industry customers realize a high ROI from using SAM4 Energy. The solution typically pays back for itself after 3–6 months. Receiving recommendations based on their cost-effectiveness enables SAM4 Energy customers to prioritize, to first target where the greatest energy savings can be achieved. By targeting inefficient processes for example, companies can often reduce energy waste and costs with little or no additional investment. This allows for the cheapest way to realize energy and CO<sub>2</sub> reductions in the shortest time. Choosing this approach enables for a quick time to value. In addition, when compared to other strategies and systems, SAM4 Energy provides a very inexpensive solution to meet and surpass the financial and sustainability goals of water companies.



# Interested?

Would you like to know more about how SAM4 Energy works and whether it could be of value to your operations? Do not hesitate to reach out.

## Contact

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