About this Report

# **Energy Optimization for Water Utilities:** A Digital Playbook for Cost and Carbon Reduction

Report at-a-glance

- Energy Management Background & Trends
- Energy Optimization Solutions
- Utility Case Studies
- Company Profiles
- Appendix and Glossary

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# Summary

## BACKGROUND

Energy costs rank among the top three operating expenses for water utilities, offering significant opportunities for cost savings. Energy use in the water sector accounts for 11% to as much as 40% in operational expenditure (OPEX). This substantial portion and range underscores the potential for optimizing energy costs across the water cycle. Investing in digital solutions that facilitate energy monitoring and management is key to reducing energy expenses.

Effectively managing volatile energy prices is essential, especially in energy-importing markets, as it reduces operational risks and costs. Additionally, concerns about climate change and energy consumption have intensified the focus on energy efficiency within the utility sector.

Several initiatives from national governments and municipalities provide regulatory support for energy efficiency in the water. Europe is leading the way by implementing mandatory energy audits and setting targets for energy neutrality.

The growing availability and reliability of new, data-driven technology solutions—capable of demand forecasting, real-time hydraulic system monitoring, and energy demand management—equip utilities with a modern suite of tools.

Utility energy expenses—made up of electricity and natural gas—is becoming a sharper pressure point for water and wastewater system operators. Influenced by geopolitics and scaling demand for power, electricity prices range from roughly $0.10 per kWh in North America to more than $0.20 per kWh in parts of Europe.

## report SCOPE

This report explores strategic areas where digital energy optimization solutions can have the most significant impact, particularly in pumping, aeration, and load shifting, highlighting offerings from leading players in the industry. Detailed case studies and profiles of key players are included.

## report HIGHLIGHTS

- Drivers and inhibitors for energy management
- Mapping the water cycle and key energy-intensive processes
- Key players in pump and process optimization for treatment plants
- Digital water solution investments driving energy performance
- Global case studies

# Bluefield Insights

Global demand for electricity in the water sector is projected to increase significantly.

By 2040, electricity usage in this sector could account for 4% to 8% of total global electricity consumption. Municipal water supply and wastewater treatment processes account for 75% of the energy consumed in the municipal water sector.

- **Digitalization offers visibility and control over energy consumption and provides an early return on investment (ROI).** Savings of 10% to 40% on energy spend can be achieved throughout the water cycle—ranging from water production to wastewater treatment—through a combination of operational and capital measures.
- **Solution providers have created specialized electrical control and automation solutions through targeted acquisitions and platform development.** This approach enables them to offer advanced asset management solutions that extend beyond mere automation to include operations and management (O&M) support, thus ensuring stable revenue streams (e.g., Suez, ABB, Riventa).
- **Improvements depend on a comprehensive ecosystem of digital water solutions.** Key components include pressure loggers, variable speed drives (VSDs), and Supervisory Control and Data Acquisition (SCADA) systems. Optimizing pump operations is particularly effective, often yielding some of the highest returns on investment with potential savings ranging from 20% to 40%. Furthermore, enhancing processes in aeration and load shifting can contribute to additional savings.
- **Recent advancements include real-time control, digital twins, and artificial intelligence (AI)-based solutions.** Vendors utilize advanced data processing capabilities to enhance high-energy processes and address the limitations of traditional SCADA systems (e.g., Autodesk, Grundfos, Xylem).
- **The field of advanced analytics and decision support is growing rapidly.** Solution providers are expanding their offerings to capture a larger market share, including asset management solutions designed specifically for local utilities (e.g., Suez, Schneider Electric, Siemens).

# Key Drivers and Inhibitors for Energy Management

Rising energy costs, early returns on investments, and regulatory pressures drive opportunities for solutions providers.

| Drivers | |
|---|---|
| **Rising energy costs and potential for energy production** | • Energy is the largest controllable OPEX and represents 10% to 40% of total costs in the sector. Some digital solutions offer an ROI in as little as two months.<br>• Opportunities for grid participation can create additional revenue streams in some cases. |
| **Regulatory pressure and decarbonization** | • Regulatory pressures (e.g., the U.K.) have driven demand for advanced tools.<br>• Energy crisis and decarbonization targets have made energy optimization and diversification for critical infrastructure a priority. |
| **Availability and maturity of advanced solutions** | • Commercial solutions are increasingly available and tested, reducing adoption risks.<br>• Offering of interoperable tools allows utilities to utilize existing hardware and software, simplifying implementation. |
| **Data overhaul** | • Deployment of data-gathering and analysis tools (e.g., sensors, smart meters, SCADA) allows for detailed data collection to optimize algorithms.<br>• As aging equipment is replaced, digital optimization is embedded into procurement requirements. |

| Inhibitors | |
|---|---|
| **Risk adversity** | • Concerns about cybersecurity in real-time remote access and cloud-based optimization.<br>• Unclear regulations and dynamic tariffs diminish interest in load shifting and demand response strategies, prioritizing stability. |
| **Aging workforce and legacy systems** | • Transforming asset knowledge and operational experience into digital platforms requires change management and upskilling.<br>• Legacy technologies, while achieving operational goals, hinder optimization and integration into advanced solutions. |
| **Multi-departmental stakeholders (siloed data)** | • Energy management processes bridge various departments, with decision-making differing by utility. Operations and information technology (IT) departments are also key stakeholders.<br>• Traditional asset management planning is often static and occurs at intervals of 2, 5, or 10 years. |
| **Data distress** | • Utilities feel increased pressure to leverage data, leading to concerns about the quality of both historical and real-time data. This uncertainty makes them reluctant to adopt data-driven decision-making practices.<br>• Proprietary systems and the absence of open data standards impede the integration of third-party AI solutions or energy management systems. |

Source: Bluefield Research

# Key Questions Addressed

- Where are utilities overspending on energy—and how fast can costs be reduced?
- Which energy optimization strategies deliver the strongest ROI today?
- How much savings can be achieved without major CAPEX?
- How can utilities hedge against energy price volatility through digitization?
- Which technologies are moving energy optimization from theory to execution?
- What do proven utility deployments tell us about risk, payback, and scalability?
- How should utilities prioritize energy optimization investments across assets and departments to maximize near-term financial impact?

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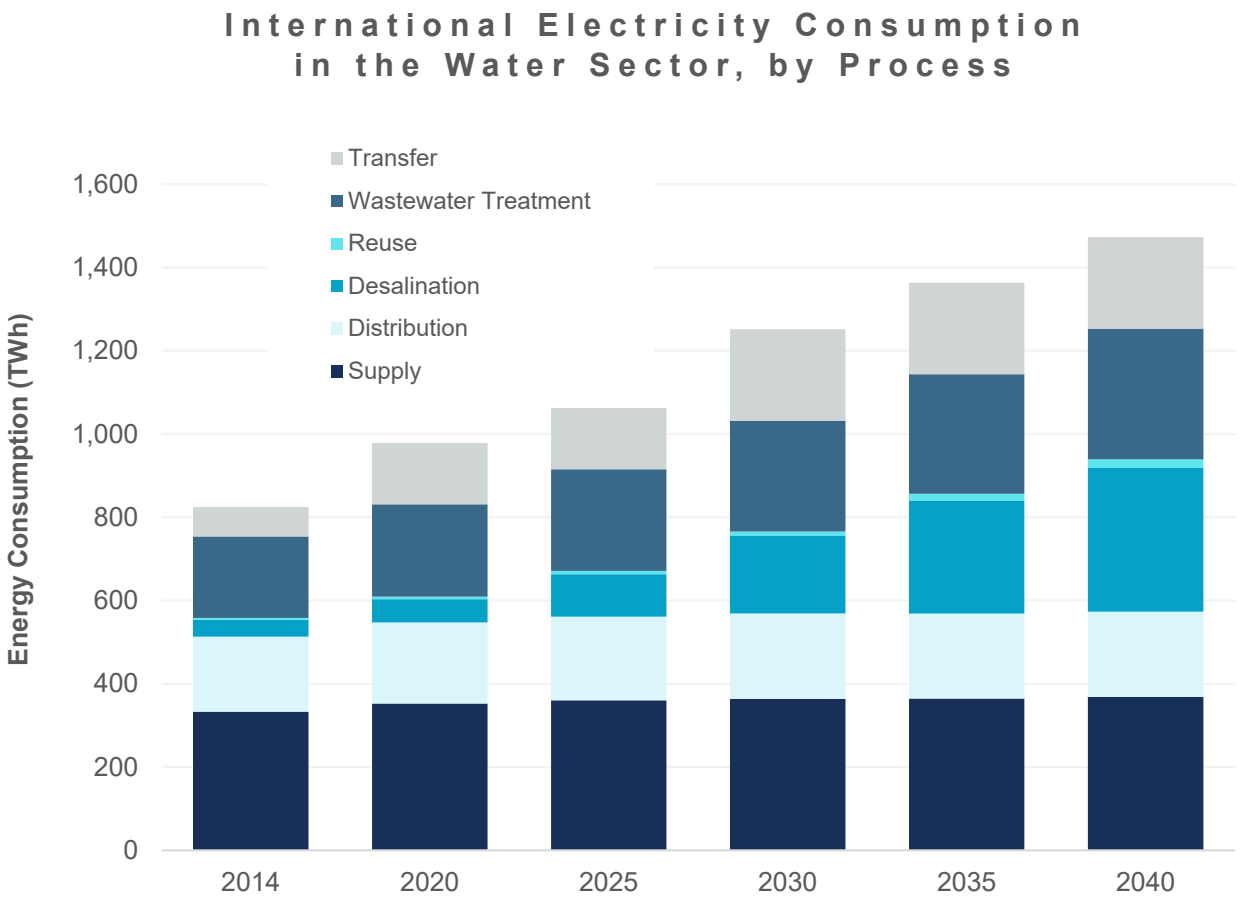
# Energy Consumption in the Water Sector

The use of electricity in the water sector is set to increase globally, reaching between 4% and 8% of total global electricity consumption by 2040.




Note: Supply includes ground and surface water treatment
Source: International Energy Agency, Bluefield Research

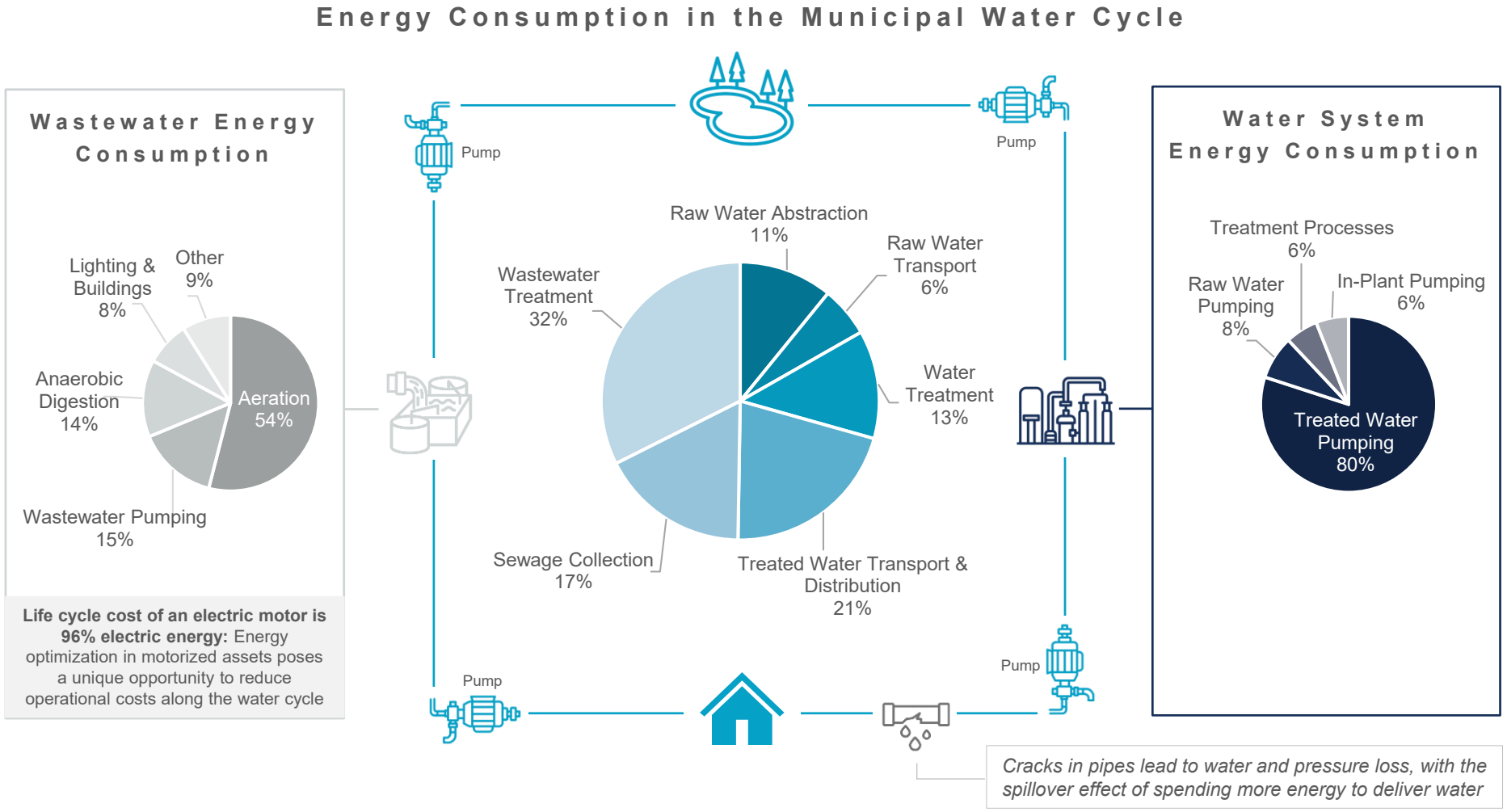
## Analysis

**Water supply and wastewater treatment account for 75% of the energy consumed by the municipal water sector in Europe.**

- Water treatment, both for drinking and wastewater, constitutes a significant share of municipal energy bills, ranging from 30% to 50%. In the U.S., this figure is closer to 30% to 40%.
- To provide 245 liters of water per day per person, approximately 35,000 gigawatt hours is required, which represents about 1.13% of the electricity produced in the EU. This amounts to about 70 kilowatt-hours per person per year (European Commission).
- Energy extraction and production in the EU also consume large quantities of water, around 21 billion cubic meters. Reducing energy consumption can improve profitability in the water sector and, in turn, lower water consumption for energy production.
- In Europe, the combined energy requirements for water supply and distribution, desalination, and wastewater treatment range from 70 terawatt-hours to 80 terawatt-hours—approximately equivalent to the gross electricity generation of Belgium. Worldwide, the water sector uses about 120 million tonnes of oil equivalent per year, over half of which is in the form of electricity. This totals around 850 terawatt-hours, constituting around 4% of global energy consumption.
- In the wastewater sector, large treatment plants (serving over 50,000 population equivalents [PE]) tend to be more energy efficient than smaller plants. Although they represent only about 10% of the total number of wastewater treatment plants (WWTPs), they process about 70% of the PE and consume 58% of the total electricity used in the sector.
- The rise of large desalination projects in the Middle East and North Africa, as well as increased treatment of brackish water in countries like the Netherlands, further contributes to energy consumption in the water sector.

# Mapping the Water Cycle and Key Energy-Intensive Processes

Pumping and aeration represent the lion's share of electrical consumption in the sector due to the energy costs of operating multiple electric motors simultaneously.




Source: CEDengineering.com, Utilities, Bluefield Research

# Defining the Market – Selected Energy Optimization Solutions

Pumping and aeration are the primary sources of energy consumption in utilities, making them important targets for optimization. Additionally, load shifting offers the quickest ROI with a minimal CAPEX footprint.

## Key Digital Water Solutions for Energy Optimization

| Energy Optimization Within Fluid Dynamics | | | |
|---|---|---|---|
| **Digital Solution** | **Energy Savings** | **Typical ROI** | **Notes** |
| **Pump Optimization Within the Network** *(e.g., AI, VFD, SCADA integration)* | 15%–30% | 2 months–5 months | Largest single source of electrical demand in water systems. Optimal pump scheduling, minimized throttling, and improved system curve matching drive energy optimization and cost reductions. |
| **Process Optimization** *Focused on fluid dynamics (e.g., blower, in-plant pump optimization)* | 15%–40% | 3 months–24 months | In wastewater treatment, aeration accounts for around 60% of total energy consumption. Process control algorithms can reduce over-aeration and help stabilize oxygen levels. |
| **Load Shifting / Demand Response** *(DR)* | 5%–15% | 1 month–3 months | Drives financial savings from shifting processes to off-peak hours, or to hours when key energy sources are accessible and cheaper. Highest ROI is achieved when paired with time-of-use tariffs or demand response (DR) markets. |

**Other Complementary Solutions**

- Leak detection and pressure management digital solutions in mains and distribution networks.
- Digitalized routine equipment maintenance that reduces overall energy consumption (e.g., reduced fleet deployments due to fewer on-site checks).
- Biological, chemical, and physical treatment process improvements via digitalization (e.g., membrane fouling control).
- Digitalized energy recovery processes that enable operators to reduce the purchase of external energy sources (e.g., heat recovery, biogas).
- Renewable energy integration and/or on-site production with digital forecasting tools.

Source: Bluefield Research

# Global Case Studies Overview


Source: Operators, Vendors, Bluefield Research

# Sample Case Study

MM Spa upgraded its pump strategy to comply with updated ISO requirements and lower energy costs in its operations.

## Utility & Vendor Information

| | |
|---|---|
| **Area Served** | Milan, Lombardy, Italy |
| **Population Served** | 2,000,000 |
| **Key Assets** | 2110 km water pipes<br>28 pump stations<br>584 wells |
| **Vendor(s)** | Suez, Siemens |

## Location


## Utility Challenge(s)

- Metropolitana Milanese (MM) manages the water operations in the city of Milan. The network included 28 active pump stations equipped with an energy management system since 2011, following an EU-funded pilot implemented in partnership with Siemens.
- In 2019, MM conducted an overhaul of the energy management system to meet updated ISO requirements for management and decrease energy costs, which had increased by 11% year-over-year (YoY) since 2018 due to rising energy tariffs and the expansion of the treatment network.

## Solution(s) Applied

- MM implemented Suez's AQUADVANCED Water Supply system to manage real-time data acquisition and validation. This system predicts water consumption demand and calculates optimized pumping strategies, which are then communicated to the pumps and valves via SCADA.
- Before implementing the energy optimization system, new power meters, flow meters, and pressure meters were installed at each pump station.

## Results

- In 2020, the first year after implementation, the energy required to produce and distribute each cubic meter of water was reduced by 8% to 0.034 kWh/$m^3$. This change led to a savings of 6,400 MWh, equivalent to US$483,000, and a reduction of 2,600 metric tons of $CO_2$ emissions.
- From 2021 to 2024, during a period of high energy prices due to the pandemic and the war in Ukraine, MM saved an estimated US$904,000 in annual energy costs by implementing various energy-saving technologies.

Note: Currency conversion used: €1 = US$1.18
Source: Utility, Bluefield Research

# Purchase Options

This Insight Report is available for purchase and immediate file download.

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**02 February 2026, Barcelona, Spain** – Energy is among the top three operating expenses for water and wastewater utilities globally, accounting for roughly between 11% to 40% of total operating expenditures (OPEX) depending on region and system characteristics. This large and increasingly volatile cost burden is accelerating utilities' investment in digital optimization tools that can generate measurable savings in a matter of months.

According to a new Insight Report, Energy Optimization for Water Utilities: A Digital Playbook for Cost and Carbon Reduction, Bluefield Research forecasts US$135.5 billion in cumulative spending on digital water solutions enabling energy optimization from 2025 to 2030—more than 60% of total digital investment in the sector—as utilities prioritize near-term operating cost reductions, including energy and carbon emissions.

Utility energy expenses—made up of electricity and natural gas—is becoming a sharper pressure point for water and wastewater system operators. Influenced by geopolitics and scaling demand for power, electricity prices range from roughly $0.10 per kWh in North America to more than $0.20 per kWh in parts of Europe. In this environment, data-driven optimization solutions become more viable and represent one of the fastest pathways to reduce OPEX.

"This is fundamentally an OPEX-driven market," explains Maria Cardenal, a senior analyst at Bluefield Research. "Digital tools cut energy costs, improve reliability and asset performance, support predictive maintenance, and position utilities for future carbon reduction requirements."

According to Bluefield's analysis, digital solutions deliver the greatest energy savings in three areas:

- Pump optimization within the network: 15% to 30% reductions; pumps are the largest energy users in distribution networks and treatment plants, representing 70% to 80% of electricity use in water production and distribution.
- In-plant process optimization (e.g., aeration in wastewater treatment): 15% to 40% savings. Aeration alone consumes 50% to 70% of energy consumption at wastewater treatment plants.
- Load shifting and demand response: 5% to 15% savings by scheduling energy-intensive operations during off-peak hours when electricity rates are lower.

"If utilities want fast, defensible savings, pump operations are the first place to look," says Cardenal. "Pumps represent the largest share of electricity demand across most systems, and optimization can deliver meaningful reductions without a major infrastructure overhaul—especially when Supervisory Control and Data Acquisition (SCADA) systems and variable speed drives are already in place."

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Companies are turning to Bluefield for in-depth, actionable intelligence into the water sector and the sector's impacts on key industries. The insights draw on primary research from the water, energy, power, mining, agriculture, financial sectors and their respective supply chains.

Bluefield works with key decision-makers at utilities, project development companies, independent water and power providers, EPC companies, technology suppliers, manufacturers, and investment firms, giving them tools to define and execute strategies.

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