Schneider Electric

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Universal Automation

Opportunities for Industrial Water

A White Paper by Bluefield Research & Schneider Electric

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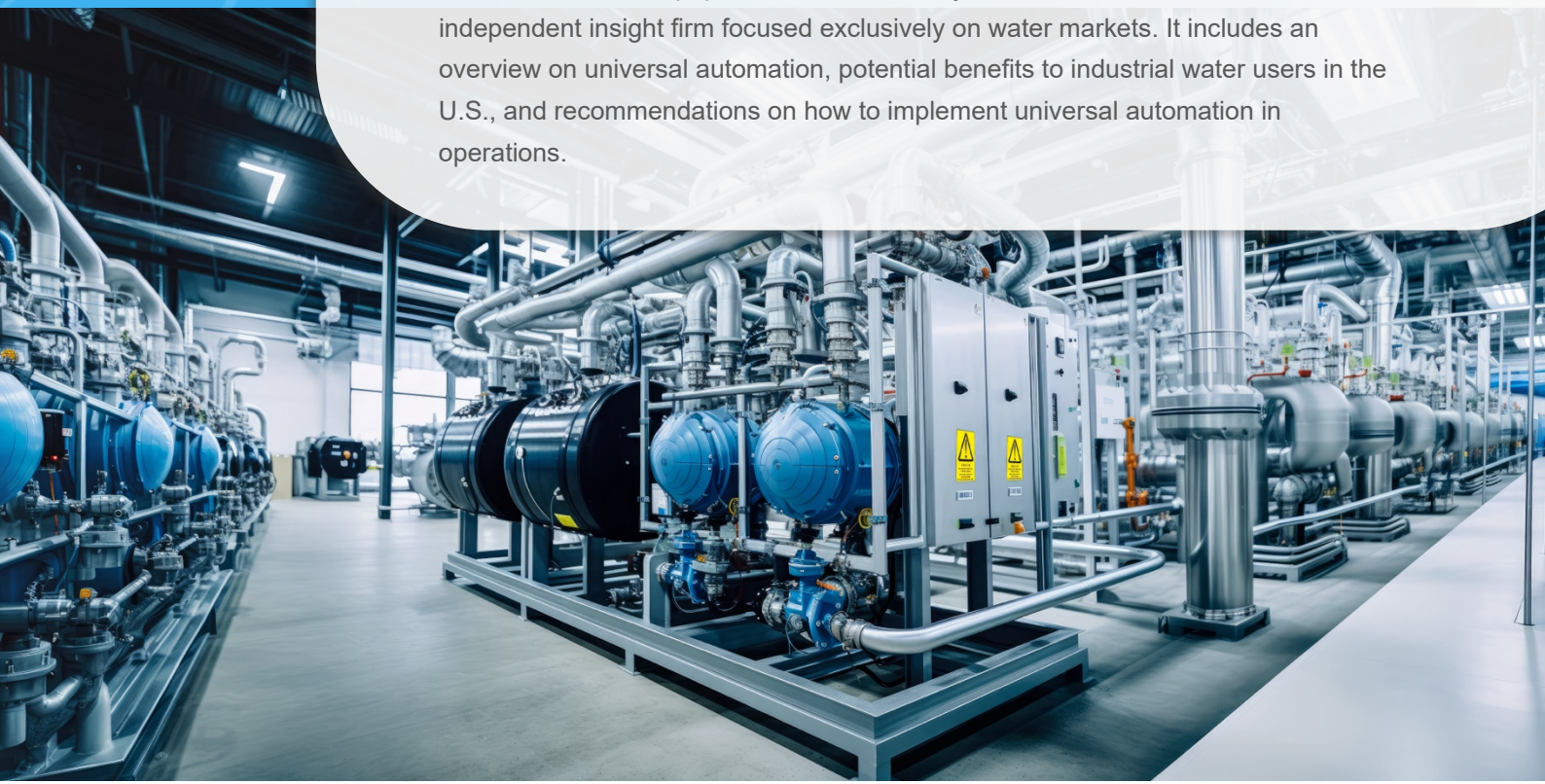
SECTION 1

ABSTRACT & INTRODUCTION

A host of digital technologies and services exist to simplify and optimize clean water and wastewater operations. Software can control industrial processes inside of plants and help reduce costs and optimize water management processes. For many water utilities, digital transformation efforts are well underway. Up to this point however, the benefits to their counterparts at industrial facilities have been less transparent.

In total, industrial water facilities in the U.S. are expected to spend over US$262 billion between 2024 and 2030 on operational expenses such as labor, chemicals, and energy. They are also expected to use over 58 trillion gallons (220 billion cubic meters) of water per year. A new approach to automation can help these industries through water, energy, and chemical savings. Also important are for industrial facilities to apply the principles of universal automation, where open automation is defined by the software and not the hardware. Universal automation software helps extend the lifespan of hardware and limit future capital expenditures.

Schneider Electric can help industrial facilities of all sizes meet their water management goals using their EcoStruxure Automation Expert automation software. This white paper was written in conjunction with Bluefield Research, an independent insight firm focused exclusively on water markets. It includes an overview on universal automation, potential benefits to industrial water users in the U.S., and recommendations on how to implement universal automation in operations.



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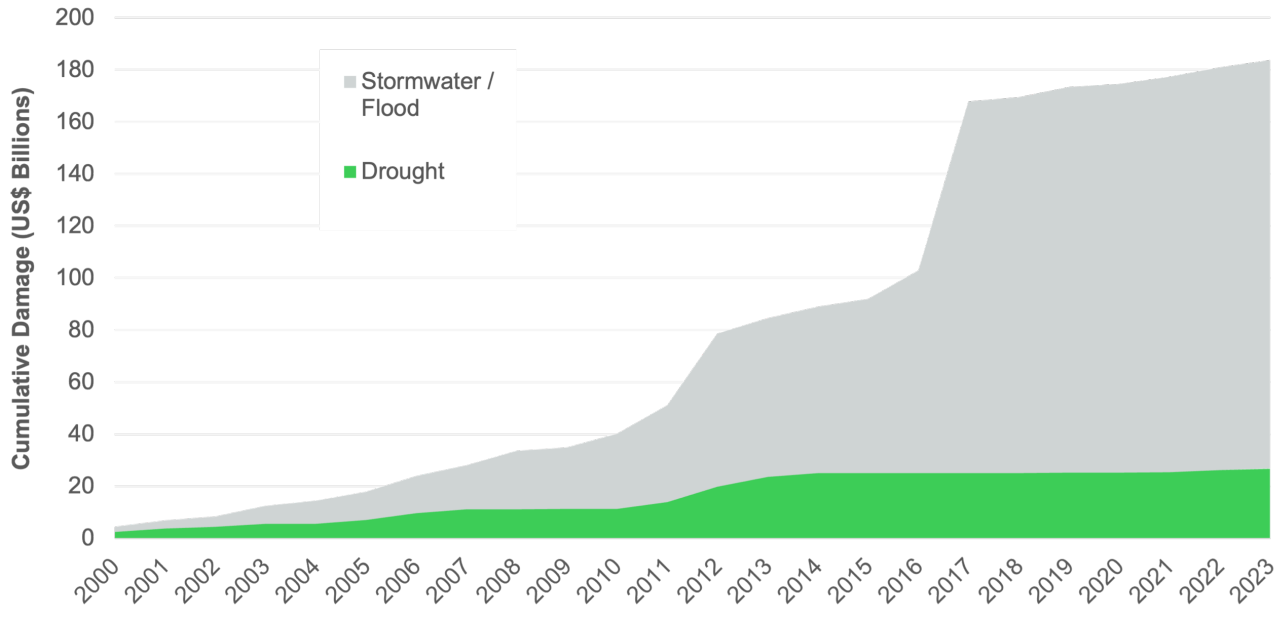
The Big Picture: Automation Due for Major Upgrade as Industries Adapt

2.1 Water Management Challenges Face Increasing Volatility

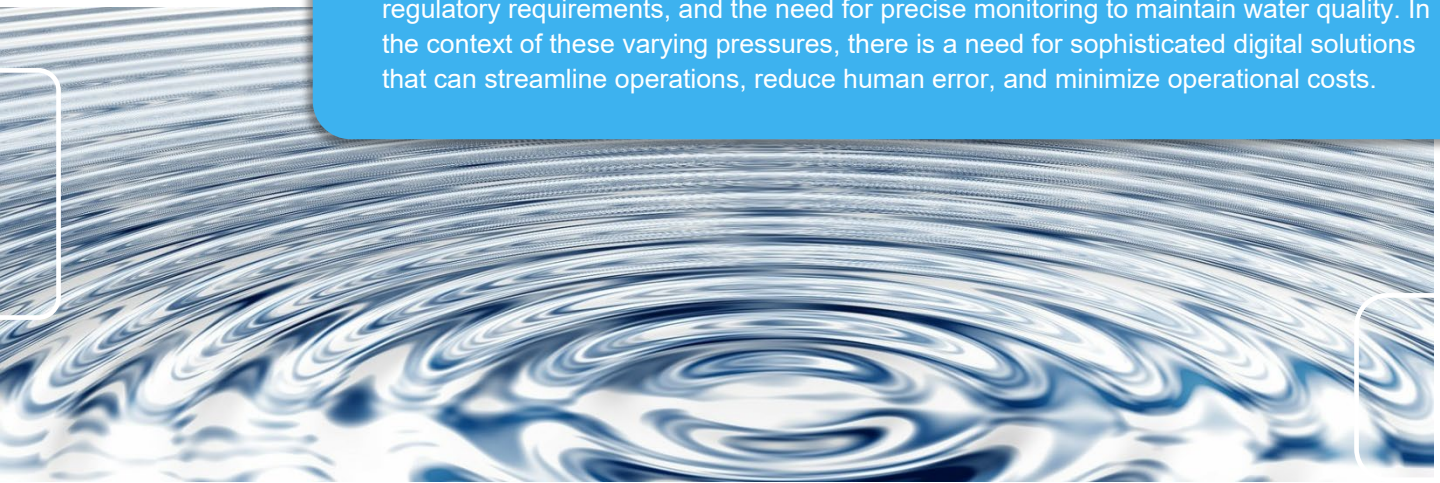
Water management challenges in the U.S. are growing increasingly complex. Since the turn of the 21st century, drought and flood events (excluding hurricanes, tsunamis, and tidal damage) have cumulatively cost over US$180 billion in damages in the U.S. In the most recent Clean Watersheds Needs Survey released in May 2024, the Environmental Protection Agency estimated that US$630.1 billion is needed to support water and wastewater systems over the next 20 years to support the Clean Water Act.

Figure 1: U.S. Water Related Climate Impacts, 2000–2023



Source: National Oceanic and Atmospheric Administration, Bluefield Research

The water industry faces multifaceted challenges, including aging infrastructure, stringent regulatory requirements, and the need for precise monitoring to maintain water quality. In the context of these varying pressures, there is a need for sophisticated digital solutions that can streamline operations, reduce human error, and minimize operational costs.

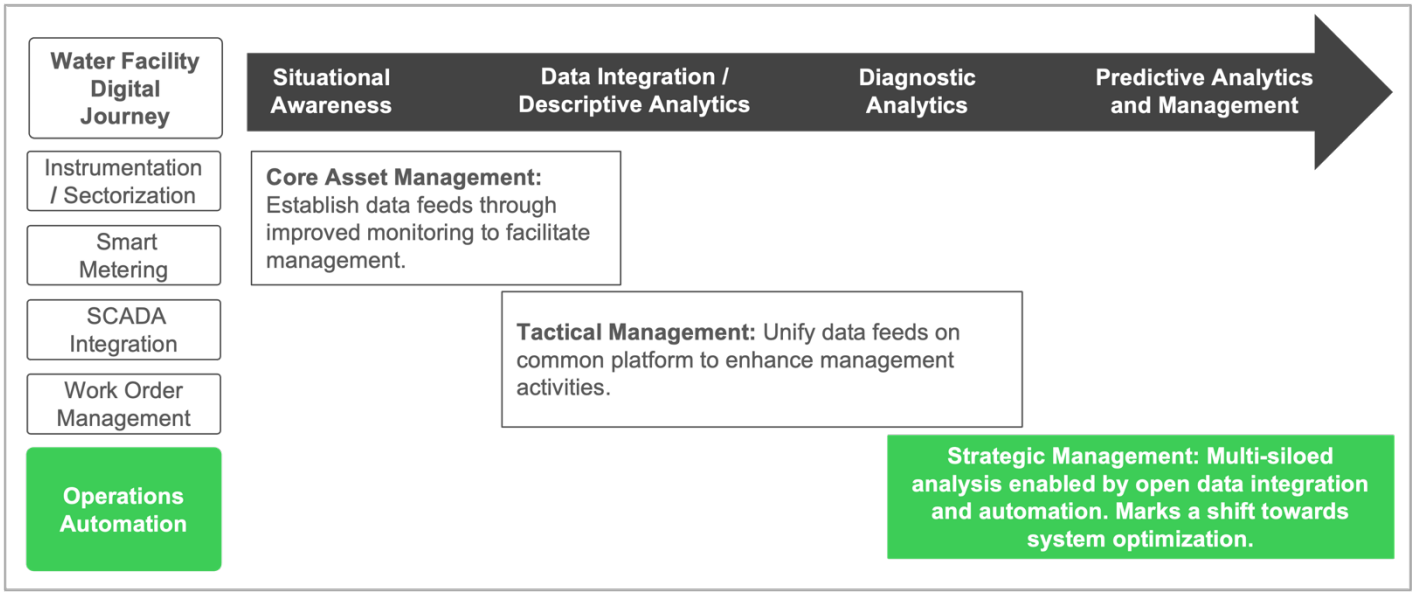


2.2 Complex Plant Requirements Call for a Multi-faceted Approach to Optimization

Water treatment plants require complex operational functions and strategic decisions from operators to run smoothly. Digital tools help connect a plant's various functions and optimize decision making. Automation in particular stands apart as one of the most advanced final steps a water treatment facility can undertake.

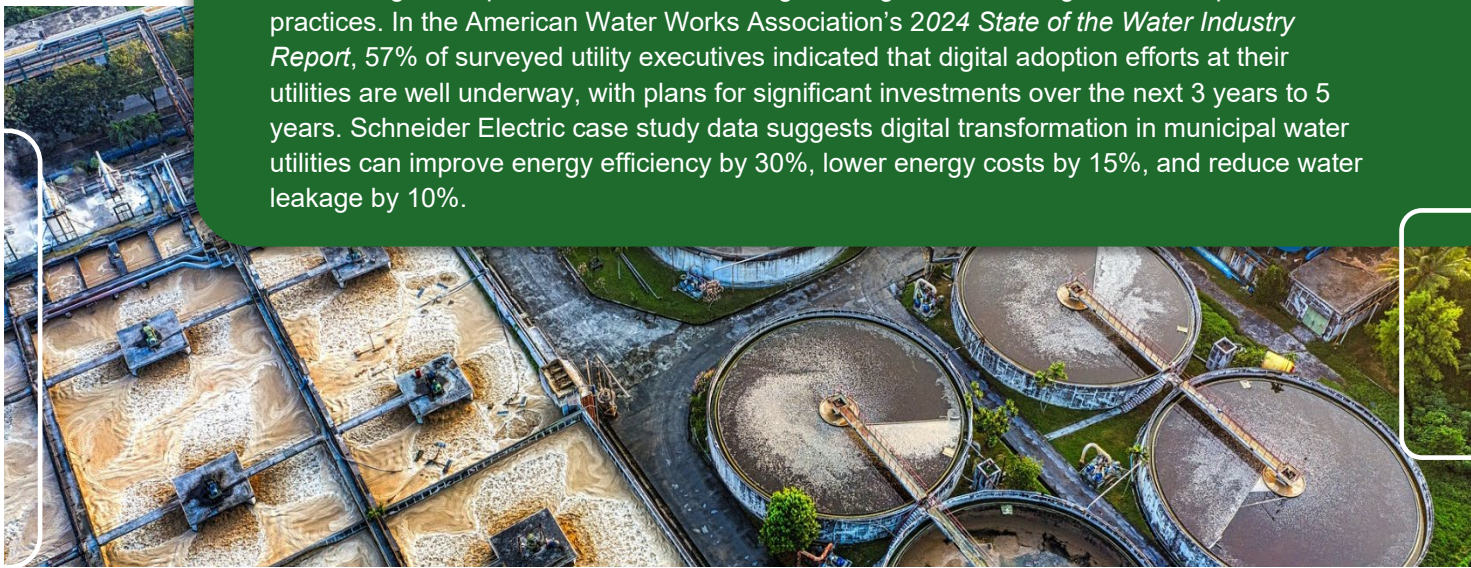
Automation has revolutionized various sectors, and the water industry is no exception. In the water industry, it encompasses a wide range of technologies, including Supervisory Control and Data Acquisition (SCADA) systems, programmable logic controllers (PLCs), remote monitoring systems, and data analytics. These systems work in conjunction to support operator decisions like chemical dosing, pump performance, and monitoring quality. Operations automation is a forward-looking step that is often preceded by instrumentation installation and the integration of other systems.

Figure 2: Water Treatment Facility Digital Transformation Journey



Source: Bluefield Research

Several utilities have found that there is an unprecedented opportunity to leverage data-driven insights for proactive decision making, leading to more intelligent and adaptive practices. In the American Water Works Association's *2024 State of the Water Industry Report*, 57% of surveyed utility executives indicated that digital adoption efforts at their utilities are well underway, with plans for significant investments over the next 3 years to 5 years. Schneider Electric case study data suggests digital transformation in municipal water utilities can improve energy efficiency by 30%, lower energy costs by 15%, and reduce water leakage by 10%.



2.3 Current Automation Tools Require Major Upgrade

Aging plant infrastructure is a challenge for both municipal utilities and industrial facilities. Despite increased capital investment and facility growth, the average age of manufacturing assets and equipment in the U.S. is rising, with both facility and equipment ages all ticking higher in recent years. Older, legacy assets can hamper manufacturing productivity and result in higher operations and maintenance (O&M) costs.

Figure 3: Average Age of U.S. Industry Assets Increases Despite New Builds and Investment

+8.1%

Average increase in asset age in U.S. manufacturing facilities between 2017–2022

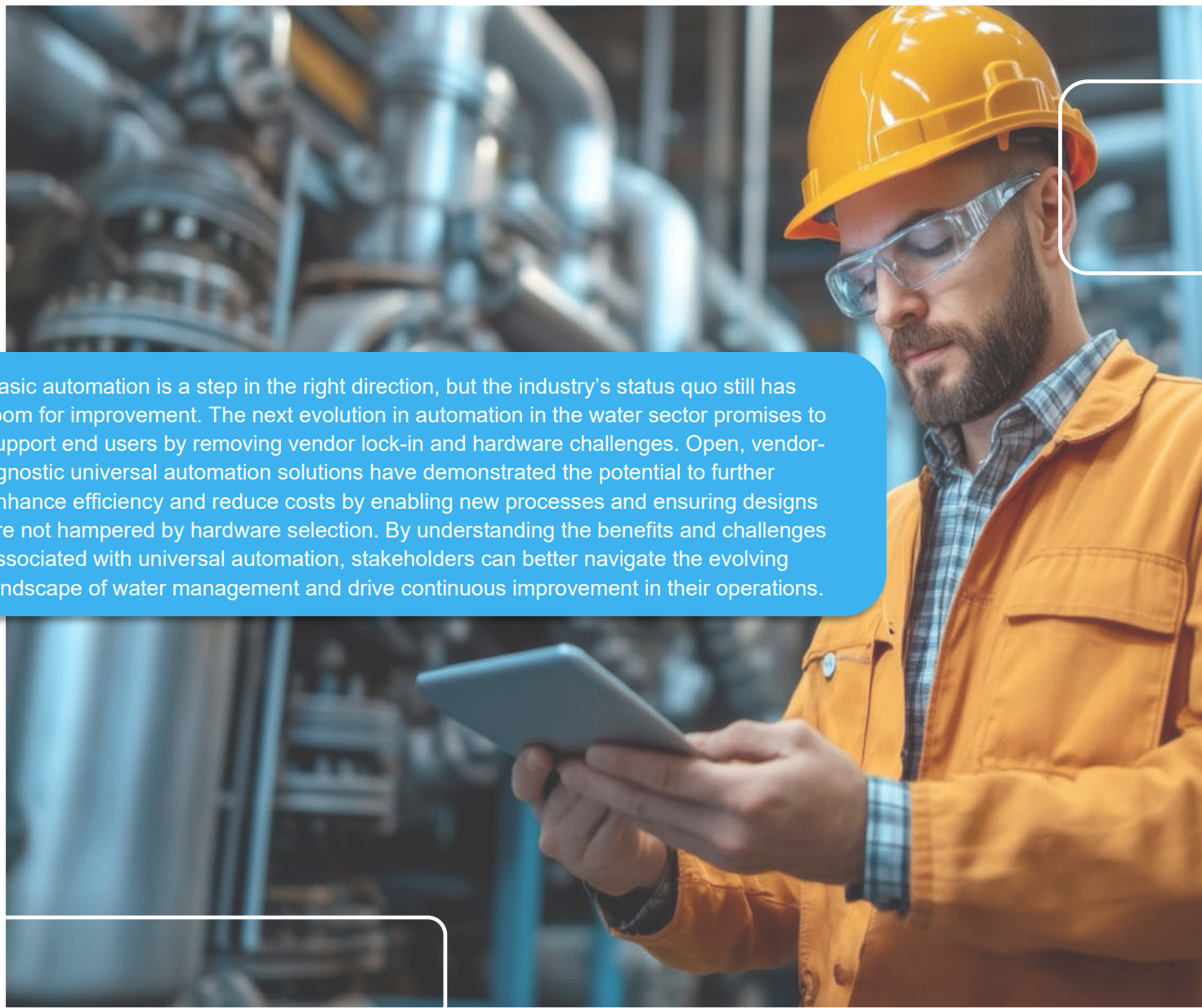
US$236.9B

Investment in industrial assets ((i.e., structures, equipment) in 2022, a 28.6% increase since 2017

+48,608

Number of new U.S. industrial facilities added between 2017–2022

Source: U.S. Bureau of Labor Statistics, U.S. Bureau of Economic Analysis, Bluefield Research



Basic automation is a step in the right direction, but the industry's status quo still has room for improvement. The next evolution in automation in the water sector promises to support end users by removing vendor lock-in and hardware challenges. Open, vendor-agnostic universal automation solutions have demonstrated the potential to further enhance efficiency and reduce costs by enabling new processes and ensuring designs are not hampered by hardware selection. By understanding the benefits and challenges associated with universal automation, stakeholders can better navigate the evolving landscape of water management and drive continuous improvement in their operations.

SECTION 3

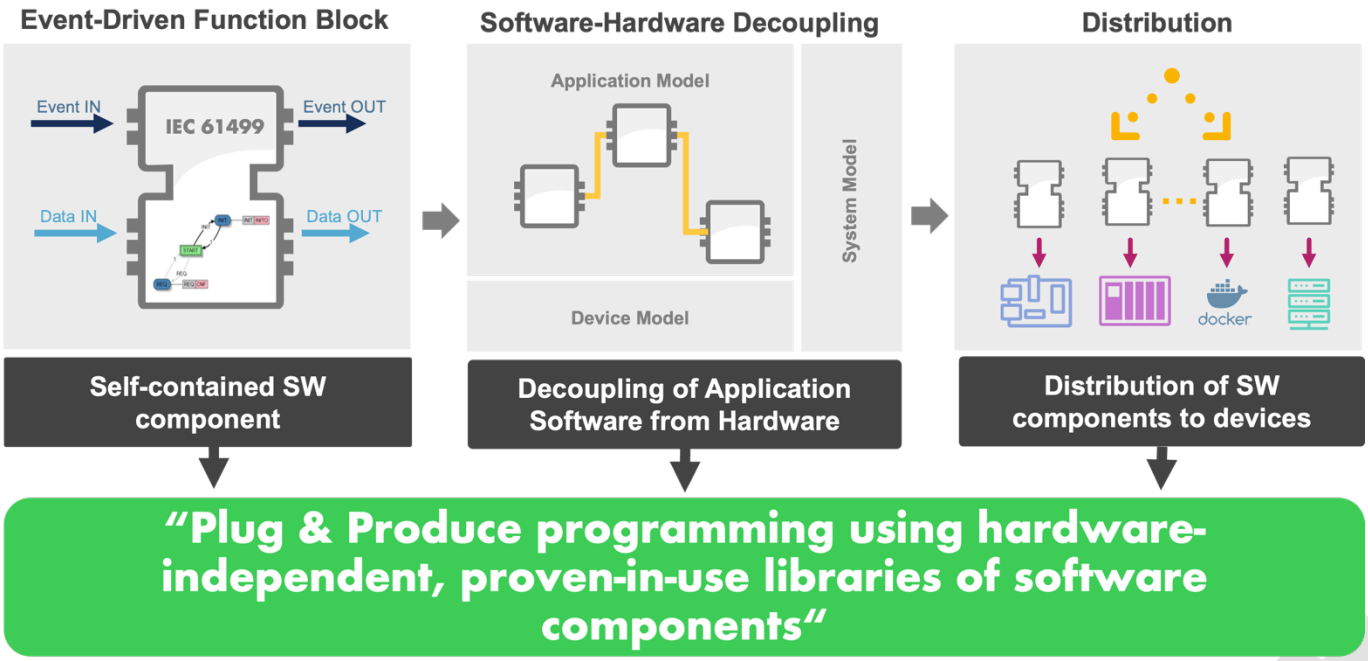
Mapping Points of Opportunity: Universal Automation Optimization

3.1. The Universal Automation IEC61499 Standard

Technology changes fast, especially digitally enabled technology. But for large facilities like utilities or industrial water treatment plants, it's not always practical or financially feasible to invest in each new iteration of digital systems and software. That presents a challenge because current automation systems are highly proprietary in nature and automation technology can become dated in just a short three-to-five-year window. That abbreviated lifespan is much shorter than the decadal timeframe that the water industry is accustomed to with pipes, pumps and other hardware.

As it stands, the closed automation systems that have been the standard in the water industry are inherently difficult to upgrade over time. Simply adapting or changing them is costly and often requires the need for outside engineering consultancy or specialized hardware integrator support. The solution lies in universal automation, which allows for a software first approach where solutions can be distributed across different vendor hardware. The IEC61499 standard, which is the industry standard for universal automation, allows for incremental changes to software and hardware. This allows for changes with smaller operational budgets, as individual components can be replaced without an entire automation system overhaul.

Figure 4: The IEC61499 Universal Automation Standard



Source: UniversalAutomation.org

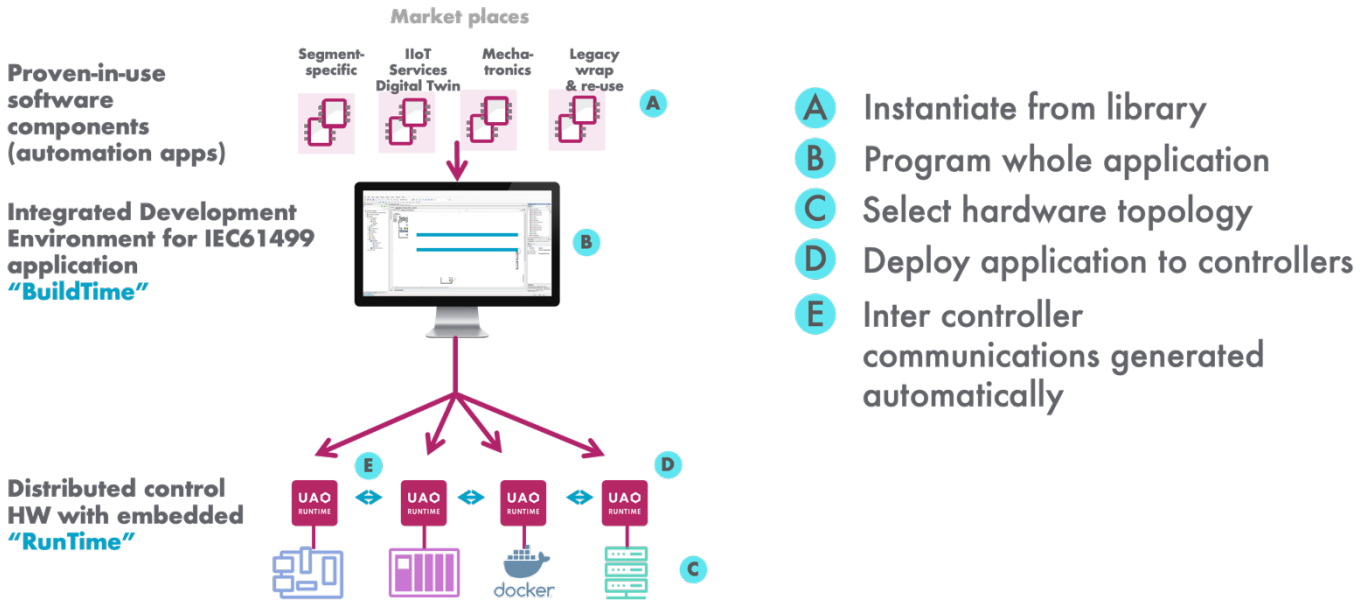
3.2. Universal Automation Benefits for Water Facilities

For treatment system operators, it also allows them to mix-and-match the best hardware and software for their applications. That lack of flexibility and diversity of offerings has been an industry pain point.

The universal automation concept already exists. Consider the consumer electronics industry, where the separation of hardware and software is necessary to run different software applications on any personal computer or smartphone. Thankfully, consumers do not have to purchase a new phone just because they opted for a new music streaming service.

Effectively, the industry is moving away from centralized systems towards a more distributed system where individual parts have intelligence, can communicate with each other, and function cohesively. In addition to Schneider Electric, other industrial firms with a focus on the water sector have also adopted universal automation standards including Yokogawa Electric, Analog Devices, Wilo, and Veolia.

Figure 5: Universal Automation Allows for a Distributed Control Environment

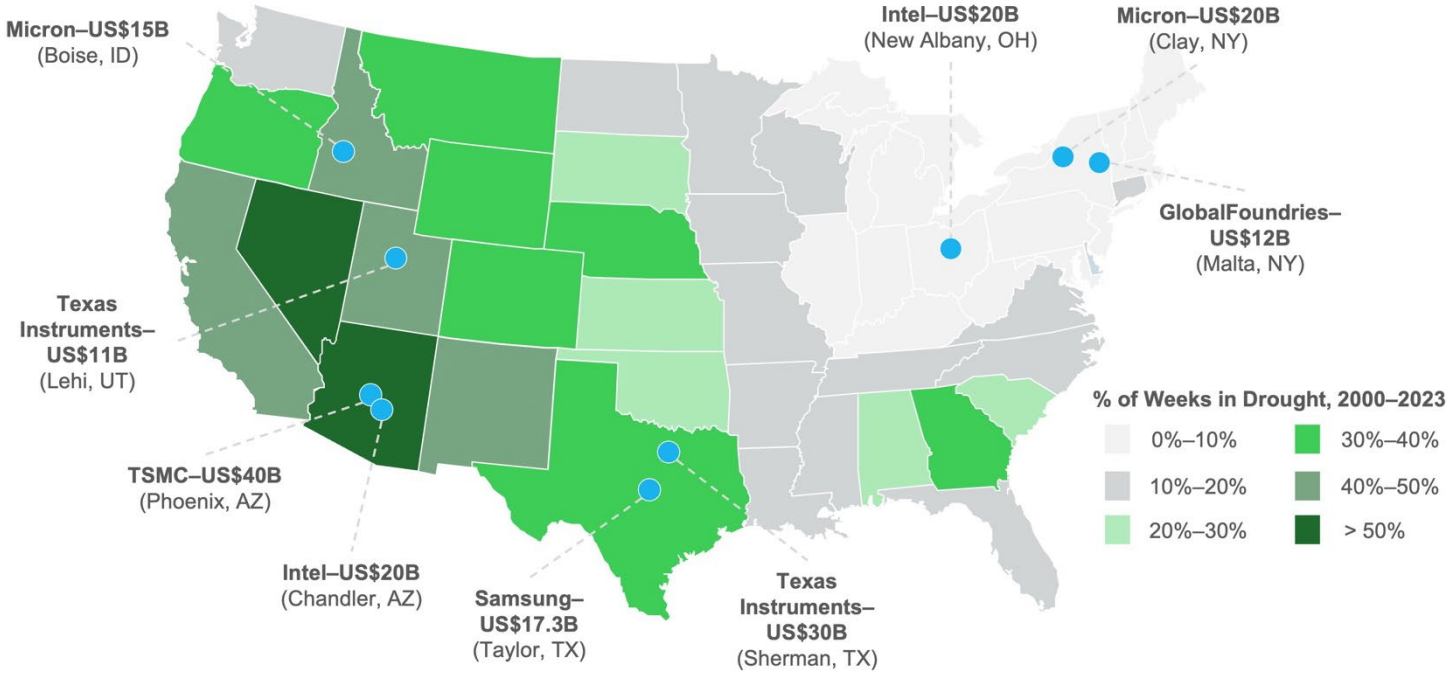


Source: UniversalAutomation.org

3.2. Universal Automation Benefits for Water Facilities, continued

As the need for improved water management grows, the integration of advanced automation technologies is essential for enhancing efficiency, ensuring sustainability, and optimizing resource utilization. The opportunity is especially pronounced in the U.S., where industrial facilities are balancing new market growth with water challenges. For the semiconductor industry alone, there are 15 new or major expansions planned to come online in the next 10 years in the U.S., many in drought-prone areas.

Figure 6: Planned U.S. Semiconductor Manufacturing Facilities and Water Scarcity



Source: U.S. Drought Monitor, Bluefield Research

SECTION 4

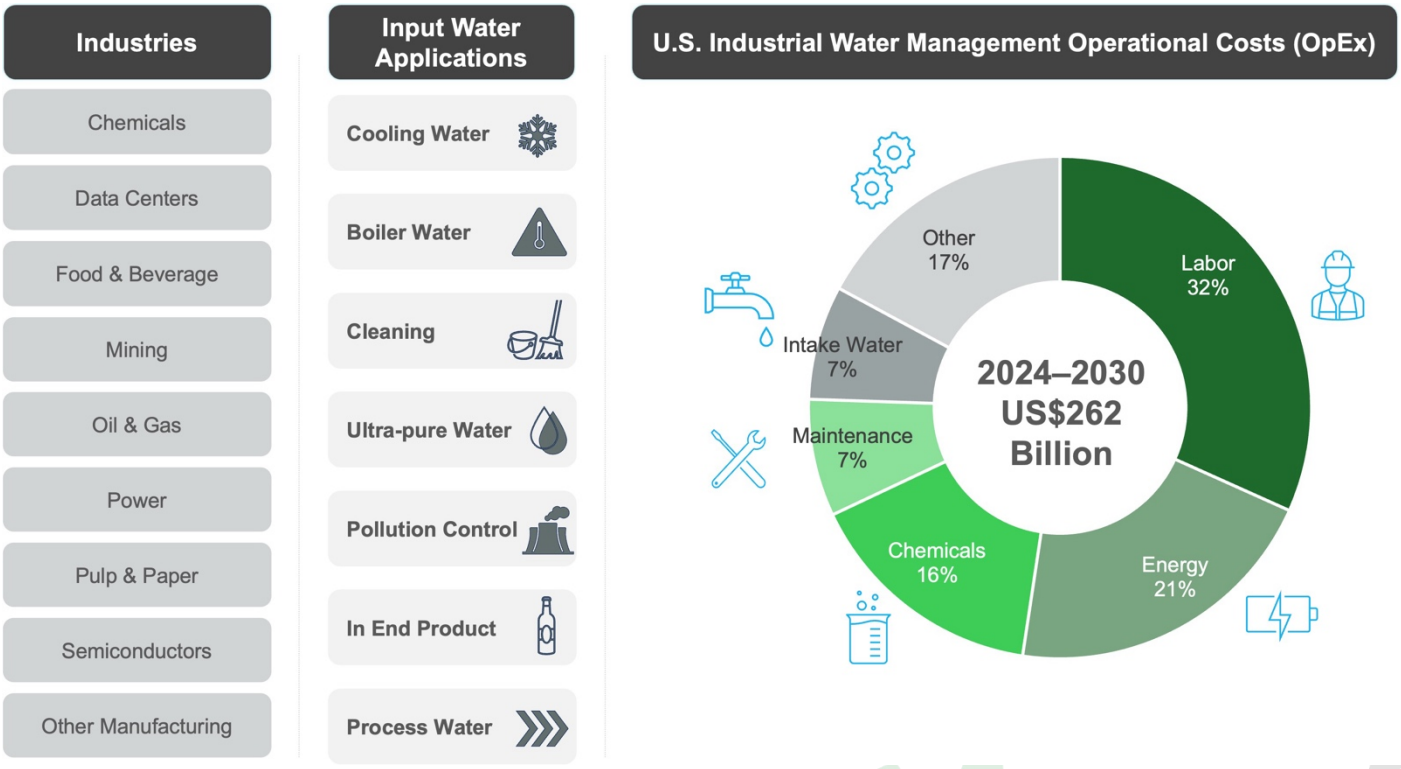
Key U.S. Industries Challenged for Greater Water Efficiency

4.1. Industrial Water Footprint Overview

Industry cannot operate without water. Similar to how fundamental water is for human life; it is an essential requirement for industry processes. Water is used as cooling water, for cleaning, in steam for power generation, as a process input, and more. Like municipal water facilities, industrial facilities must also have treatment steps to ensure intake water meets standards (e.g., ultrapure water for semiconductors) and their wastewater discharges meet local regulations.

These water management needs can be quite costly. In total, industrial water facilities are expected to spend over US$262 billion between 2024 and 2030, with key operational expenses in labor, chemicals, energy. In aggregate, the opportunity for operational cost savings across industries through digital technologies is immense. Reducing energy costs by 15% via universal automation efforts in industrial water facilities could save over US$8 billion through the end of the decade.

Figure 7: Industrial Water Applications and Operational Costs



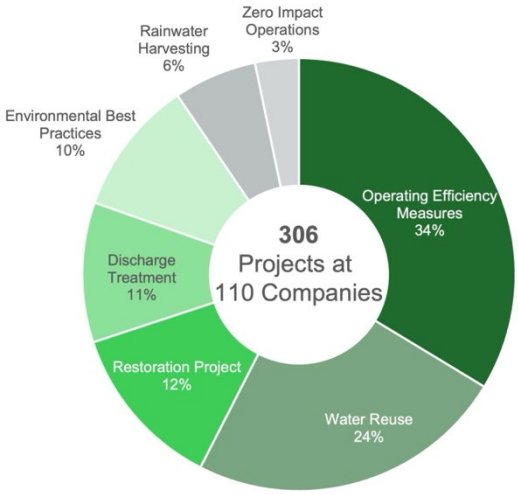
Source: Bluefield Research

4.1. Industrial Water Footprint Overview continued

Reducing water usage, especially in areas of water scarcity, is another growing focus for industry. Of the 11 industries evaluated by Bluefield Research, seven industries achieved 100% water use reporting, with the total percentage of leading industrial companies reporting water use rising to 93% in 2022, up from 30% in 2020. Corporate water disclosures shed light on the potential risks to businesses and their stakeholders. As industry addresses water scarcity as an operational risk, new investments in operational efficiency (e.g., universal automation) will become foundational. A 10% reduction in water usage would result in nearly 6 billion gallons of water saved per year.

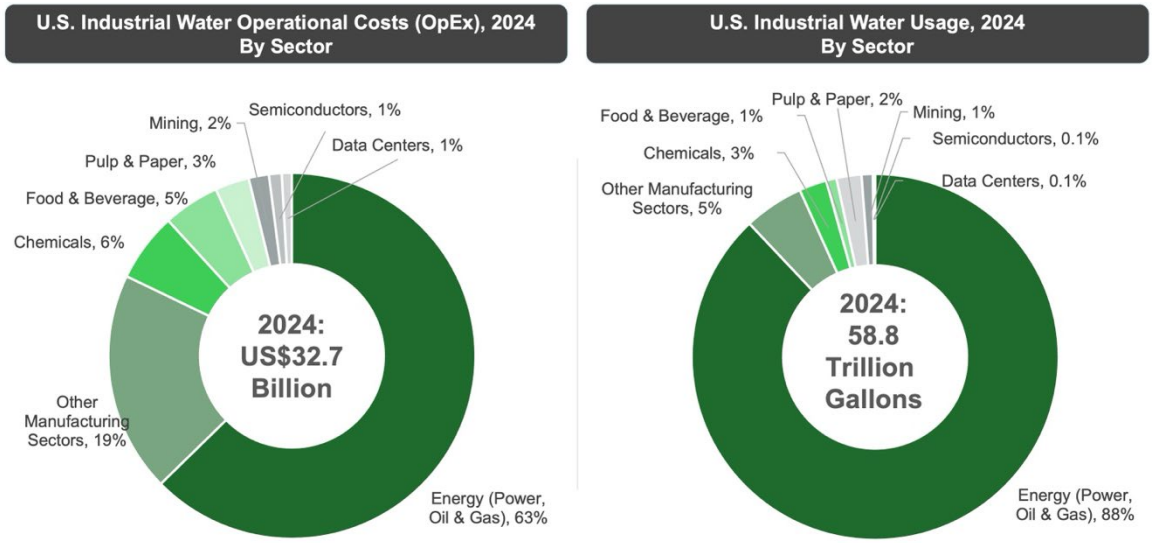
These costs and water management challenges are especially pronounced for the energy, semiconductor, and mining sectors, which each have unique market drivers and water quality needs. The energy sector stands out for the vast quantity of water it uses, the semiconductor industry is unique in its rapid facility growth in water-scarce areas, and mining differentiates itself due to its stringent wastewater regulations, water intensity, and remote operations.

Figure 8: Water Sustainability Projects Disclosed by Leading Industrial Companies



Source: Companies, Bluefield Research

Figure 9: Industrial Water Usage and Cost Overview by Industry Sector

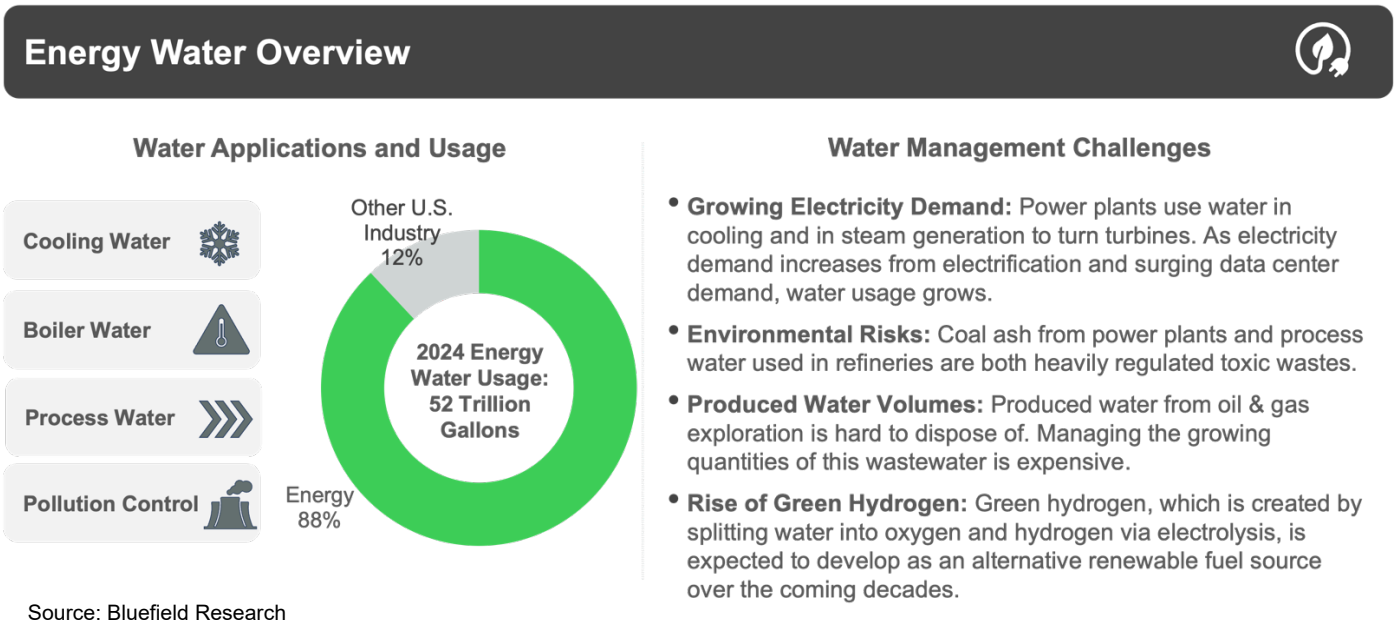


Source: Bluefield Research

4.2. Segment Overview: Energy

The energy sector accounts for the majority of U.S. industrial water usage (88%) due to the significant amount of water withdrawn for cooling and boiler water in electricity generation and in oil & gas refining. The sector is adapting to a changing energy landscape, where new technologies like green hydrogen, biogas, and renewables displace traditional energy forms like coal, oil, and natural gas and alter water management strategies.

Figure 10: Energy Water Management Overview

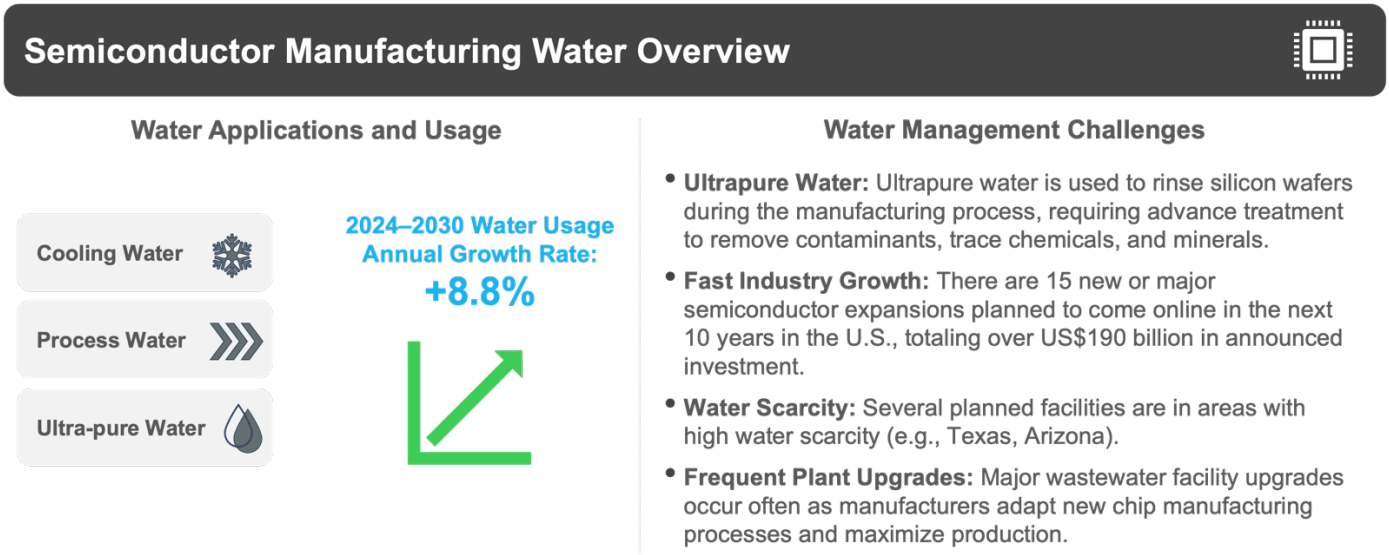


Source: Bluefield Research

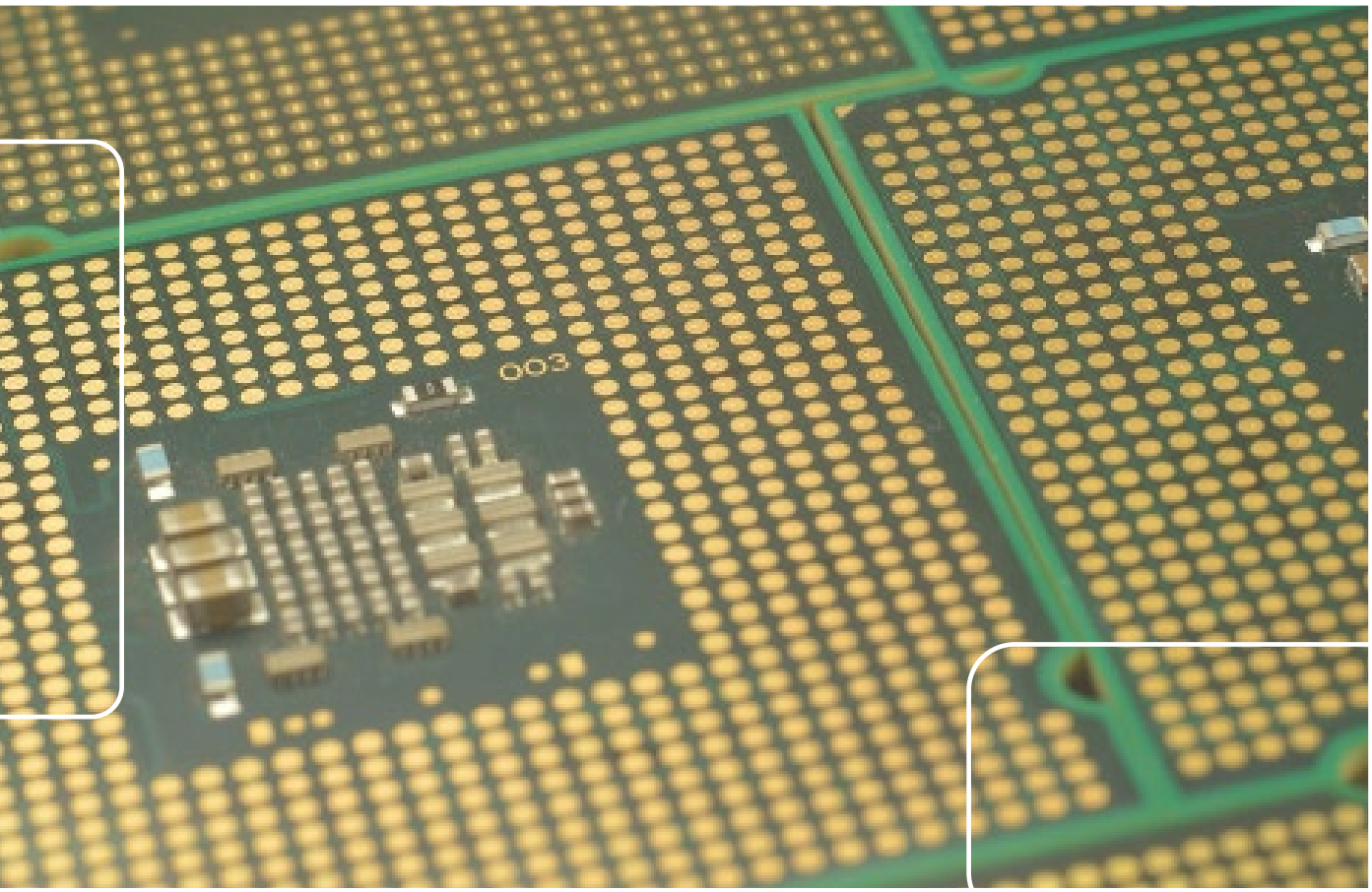
4.3. Segment Overview: Semiconductors

The semiconductor industry has one of the most intensive water treatment processes, as facilities require ultrapure water to rinse semiconductor wafers during production steps. The industry also stands out for its rapid growth, with the industry benefitting from the rollout of the U.S. CHIPS Act's over US$30 billion in manufacturing incentives. A slate of new greenfield manufacturing facilities is planned, with several in areas of high-water scarcity and frequent drought (e.g., Phoenix, Arizona; Lehi, Utah).

Figure 11: Semiconductor Manufacturing Water Management Overview



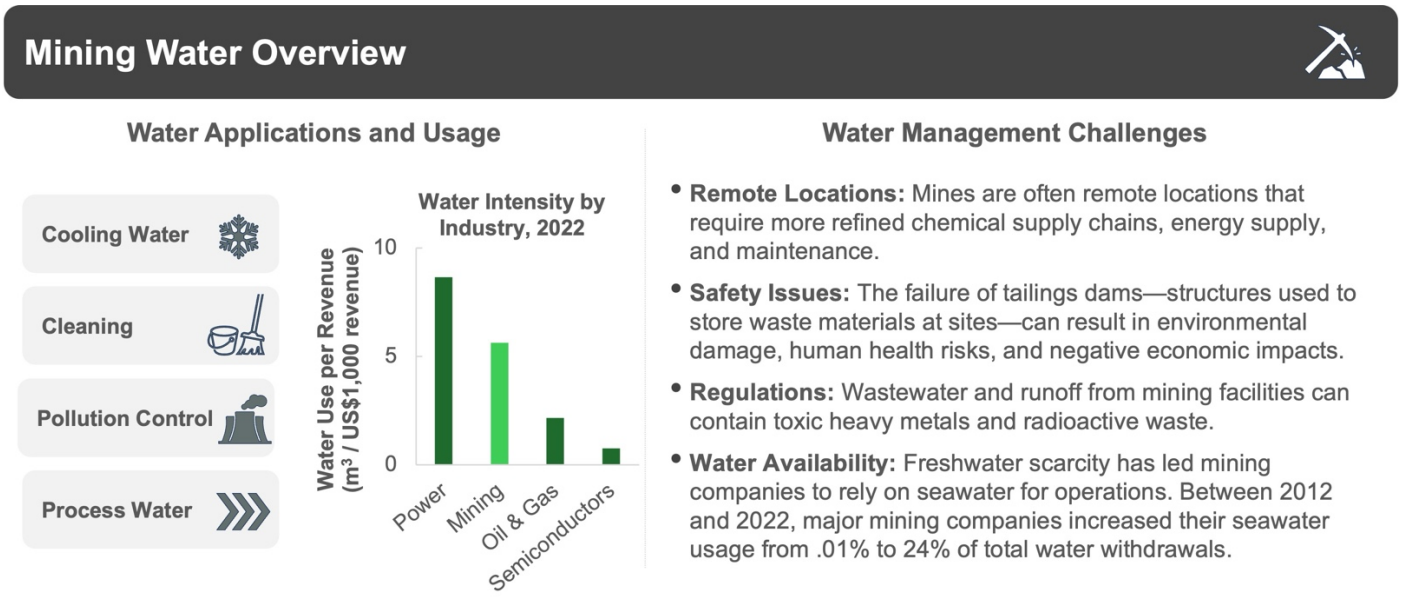
Source: Bluefield Research



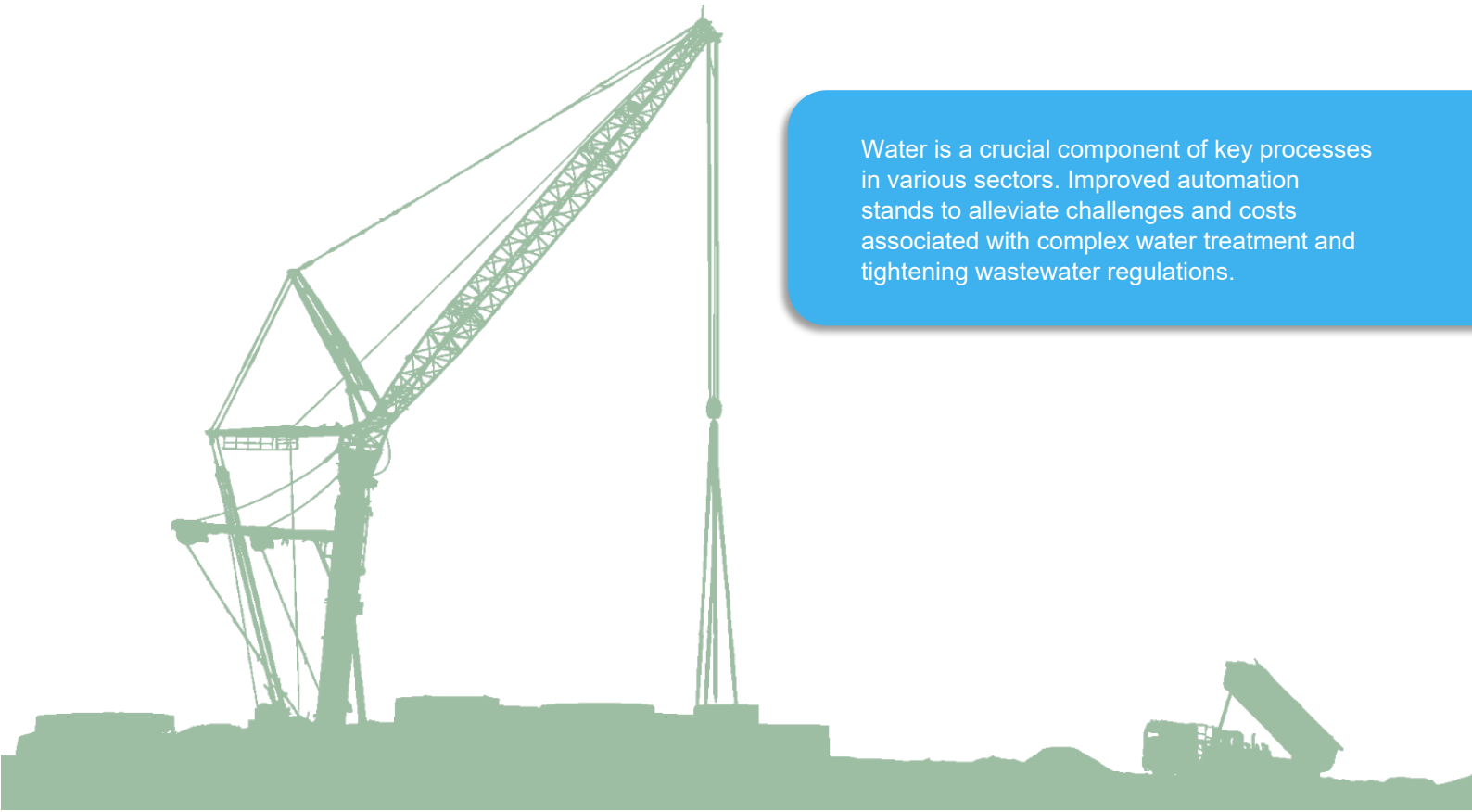
4.4. Segment Overview: Mining

The mining sector stands out due to the size and complexity of mining operations. Often in remote locations with harsh conditions, mines use water in key process operations for cleaning, sediment transport, and dust control. Due to evaporation in processes and water lost, mining companies have the highest water consumption (i.e., water withdrawn that is consumed and not discharged) of industries tracked by Bluefield. Wastewater is also a key concern, as storage and treatment of hazardous wastes is both an environmental and health risk. Specifically, the treatment of wastewater stored in tailings dams and toxic runoff with mining sites are key risks.

Figure 12: Mining Water Management Overview



Source: Bluefield Research



Water is a crucial component of key processes in various sectors. Improved automation stands to alleviate challenges and costs associated with complex water treatment and tightening wastewater regulations.

SECTION 5

Taking Next Steps Toward Universal Automation

5.1. Schneider Electric EcoStruxure Automation Expert overview

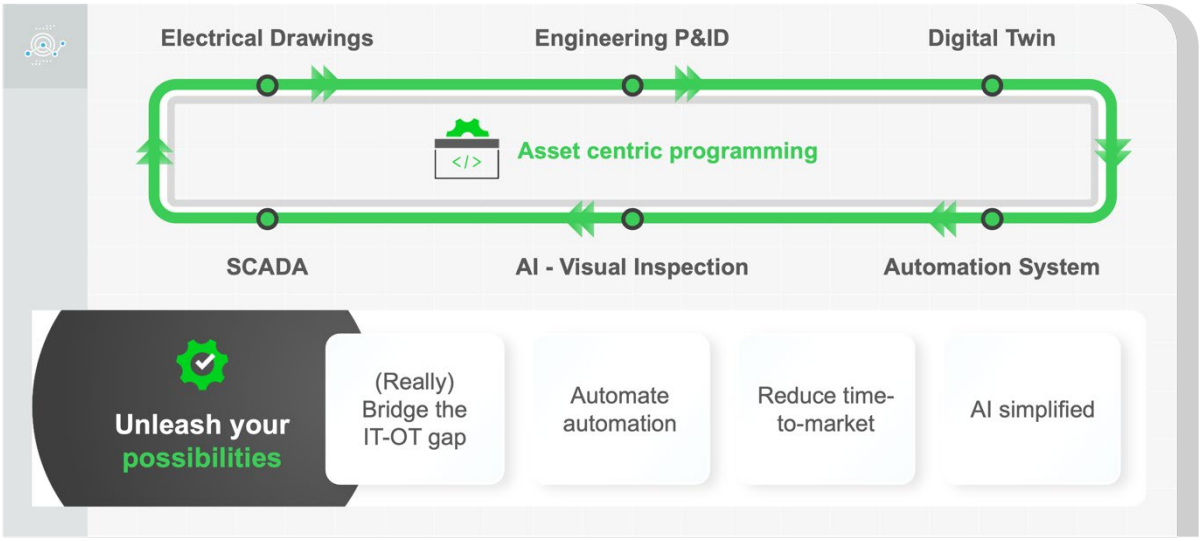
Schneider Electric's EcoStruxure Automation Expert (EAE) is a software-centric universal automation system aimed at future-proofing water and wastewater plant operations. By providing a user-friendly best in class implementation of universal automation, EcoStruxure Automation Expert allows facilities to have complete life-cycle management, seamless integration of IT/OT services, and improved system diagnostics for their automation systems. Digitized water and wastewater services and operations aid predictive analysis and decision-making to avoid disruptions, leakages, contamination, or scarcities.

Previous Schneider Electric case study data from municipal utilities suggests that basic digital automation efforts could improve energy efficiency by 30%, lower energy costs by 15%, and reduce water leakage by 10%. These past projects optimized water recycling systems, pump operations, and network monitoring and management within plants. As a market leader in conventional automation, Schneider Electric's existing footprint of systems and breadth of deployment positions Schneider to lead the way on designing systems for the future with universal open automation.

EcoStruxure Automation Expert allows for direct integration across a product lifecycle – from design to operation. It connects to Schneider Electric's digital twin ecosystem and AVEVA engineering software so new designs or changes to existing ones can be validated virtually prior to implementation, both reducing errors and saving time and money.

Schneider Electric's solutions cover the entire water cycle in water and wastewater treatment plants, industrial facilities, desalination plants, and supply and sanitation networks. Together with its partners, Schneider delivers digital solutions to support better decision making, resource conservation, and operational efficiency.

Figure 13: U.S. Water Treatment Plant Universal Automation Process Diagram



Source: Schneider Electric

5.2. Water Facility Universal Automation Adoption Strategies

There is an inherent lag in accepting and adopting new technology, in part due to a lack of awareness and education. For those seeking to upgrade existing systems, there is the fundamental challenge of re-engineering legacy technology and installing new hardware compatible with the universal automation standard.

Thankfully, universal automation is not an all-or-nothing option. Plants can future-proof their systems by migrating small segments at a time rather than replacing an entire controls system. Universal automation can also be integrated into existing PLC-based systems to add functionality and connectivity. For new greenfield constructions with the freedom to choose from all existing technologies, such as in new build semiconductor facilities, universal automation is a logical choice.

For both new systems and retrofits, a consultative approach is best at discerning the best option for municipal utilities and industrial facilities. The long-term payoffs will free up engineering time, make operations more cost and energy-efficient, and extend the lifespan of hardware. Faster troubleshooting reduces unplanned downtime, and systems are more easily passed from operator to operator.

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Universal automation in the water sector stands to usher in a host of energy, water, and cost savings. Find more information and support on how to implement universal automation in your water treatment facility at se.com.

ABOUT
BLUEFIELD RESEARCH

Global companies across the value chain are developing strategies to capitalize on greenfield opportunities in water—new build, new business models, and private investment. Bluefield Research supports a growing roster of companies across key technology segments and industry verticals addressing risks and opportunities in the new water landscape.

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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ABOUT
SCHNEIDER ELECTRIC

Schneider's purpose is to create impact by empowering all to make the most of our energy and resources, bridging progress and sustainability. At Schneider, we call this Life is On. Our Mission is to be the trusted partner in Sustainability and Efficiency.

We are a global industrial technology leader bringing world-leading expertise in electrification, automation and digitization to smart industries, resilient infrastructure, future-proof data centers, intelligent buildings, and intuitive homes. Anchored by our IoT solutions we connected products, automation, software and services, delivering digital twins to enable profitable growth for our customers.

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