HOW NEW TECHNOLOGIES ARE TRANSFORMING WATER AND WASTEWATER TREATMENT INDUSTRY IN LATIN AMERICA AND THE CARIBBEAN

Digital economy

Water and Sanitation

NTT DATA   IDB | Invest

BACKGROUND

The Latin America and Caribbean (LAC) region is undergoing a digital revolution, and we are convinced that technological innovations have the potential to significantly accelerate and scale the region's development. These technologies are reshaping both traditional sectors and innovative industries. In this context, the main objective of this report is to address the disruptive technologies that are revolutionizing each of the industries in which IDB Invest operates in a structured manner. New emerging business models will be evaluated in the context of economic and social development, the foundation of the IDB Group. The selected models will prioritize inclusion, productivity, and innovation while addressing cross-cutting issues such as environmental sustainability, climate change, and gender equality.

Although new technologies have enormous potential to drive efficiency and open up new avenues of value creation, they also pose significant challenges in terms of governance, security, and equality. The rapid adoption of digital solutions has highlighted the importance of establishing a strong regulatory and investment framework that maximizes benefits while mitigating risks. As a result, the role of different economic agents and their ability to adapt and adopt these innovations becomes a critical aspect of catalyzing sustainable economic and social development.

As we examine the impact and potential of various key technologies in this report, it is important to understand that we are dealing with an interconnected ecosystem that is growing in complexity and scale. Advances in one area, such as Artificial Intelligence or Automation, are fed back and amplified in constructive collaboration with others, such as Big Data or the Internet of Things, resulting in a multiplier effect on value generation. This report aims to highlight how this technological interconnection is reshaping the economic and social context in LAC, providing an analysis that goes beyond the current situation to forecast how new technologies will continue to shape the region over the next decade.

CONTEXT

Water and sanitation are vital to improving societies' living conditions and development. Latin America and the Caribbean have almost a third of the world's water resources, essential for developing other sectors such as agriculture, industry, or power, as well as countries´ sustainable and equitable development.

Water is also one of the main ways to reduce the region´s poverty. By providing access to safe drinking water, mortality and starvation can be reduced, and the standard of living can be improved. In line with the above, better sanitation implies fewer diseases or infections, which improves health and expands life expectancy, especially for children.

Due to such industry's relevance, one of the main challenges governments face is water security, that is, the availability and access to water in terms of quantity and quality that ensures the survival of people and the performance of production activities. In light of this, specific communities in the region still have problems with scarcity, contamination, and lack of infrastructure (or an obsolete one) for the due supply of water and basic sanitation.

This challenge is reflected by the fact that only 75% of the LAC population had access to safely managed drinking water in 2020, meaning that over 160 million people still lack full access to water (JMP, 2022). The sanitation situation is even worse. Access to safe sanitation requires water and sanitation facilities not shared with other households and water waste treatment that avoids endangering health. In 2020, this access was only 34% in LAC, leaving over 430 million people without access to this service.

On the other hand, there are significant disparities in access to water in terms of rural areas versus urban, socioeconomic groups, and indigenous and Afro-descendant peoples.

Furthermore, the lack of access to regular services leads to a higher expenditure of households, which disproportionately impacts women and children. It is estimated that, worldwide, women and children account for 72% of the collection of water for household use (SFD, 2021). In addition to all this are other challenges, such as access to a sewer system, wastewater collection and treatment, service quality, worker productivity, the reality of high losses (non-revenue water), and the ensuing financial sustainability of companies.

Investment needs of the water and sanitation industry in the region combine these challenges. In this regard, the World Bank estimated that for LAC, the cost of capital required to meet targets 6.1 ("by 2030, to achieve universal and equitable access to safe drinking water at an affordable price for all") and 6.2 ("by 2030, to achieve access to appropriate and equitable sanitation and hygiene services for all, and to end open defecation, with special attention to the needs of women and girls and people in vulnerable situations") of SDGs would account for 0.23% of the Gross Regional Product (USD 12,208 million annually for urban areas and USD 1,841 million annually for rural areas) (World Bank, 2016) and (WHO, 2017).

One possible response to fill the investment gap in the sector is to draw private investors willing to participate in the design, construction, financing, operation, and maintenance of infrastructure in the water and sanitation industry. Alongside this, the private sector complements the public sector's effort by supporting it in improving the quality of public water and sanitation services

provided to users at a reasonable cost. All this is emphasized by including digital and innovative tools to improve efficiency, effectiveness, and quality in the management and provision of the service.

These new technologies are enabling solutions that favor the transformation of the water industry. Some examples are the Internet of Things (IoT) and sensors that help capture data in real-time to make more efficient use of resources. Other cases, such as Big Data and Artificial Intelligence, facilitate the development of models that allow predictive analyses of consumption or efficiency, predict maintenance or fault repair efforts, and estimate the probability of water contamination.

INDUSTRY'S IMPORTANCE IN THE REGION AND IDB INVEST'S OUTLOOK

Unfortunately, many people still lack access to clean water and sanitation. Three out of ten people worldwide lack access to safe drinking water services, and six out of ten lack access to safely managed sanitation facilities.

For this reason and regarding all the progress that remains to be made, Water and Sanitation itself is one of the Sustainable Development Goals, setting the main goal for 2030 to achieve universal and equitable access to drinking water at an affordable price for all.

Undoubtedly, water has an indispensable relevance both to the human populations and the full performance of countries, having a decisive impact on the progress and development of different economic sectors. Some of them are highlighted below:

- **Agriculture:** Water is a critical input for agricultural production and is vital to food security. Irrigated agriculture accounts for 20% of the total crop area and contributes 40% of total food production worldwide.

As a result of population growth and climate change that will imply an intensification of water demand, many companies in the agricultural industry are maximizing their efficiency by using soil moisture measurement sensors, big data and implementing solutions such as precision irrigation. Solutions such as eco-efficient crop monitoring and monitoring platforms deserve recognition, as they help optimize irrigation, review performance indicators, obtain data, and decide on efforts needed in real-time.

IDB Lab approved a new operation for Kilimo to meet this challenge. This startup is leading the transformation in the field of irrigation management and water efficiency in agriculture in the region. Based in Argentina and founded in 2015, Kilimo provides simple, user-friendly, and personalized irrigation recommendations to farmers through its AI-based solution that automatically collects and analyzes weather and satellite data without the use of hardware, thus removing the need for setup or upfront fees, and drastically reducing the price paid by farmers.

- **Power:** Power generation requires vast amounts of water, such as nuclear plants and those powered by gas and coal. Additionally, hydroelectric power (generated by transforming the force of water into electricity) is one of the primary sources of electricity generation in countries such as Brazil, Colombia, Ecuador, and Peru.

On the other hand, the hydrogen market is experiencing accelerated growth, being regarded on the energy transition roadmap of various governments. The water industry is emerging as a crucial player in this scenario since water technologies are vital at different stages of the hydrogen production process.

- **Manufacturing:** Water is one of the most crucial components of any company involved in the production process and is especially important in the manufacturing industry due to the high volume needed.

Developing water treatment infrastructures before discharge into a production process with digital solutions enables these companies to manage the water resource, reducing its waste and treating it correctly to avoid contamination effectively and efficiently, for example, in marine biodiversity. Moreover, the more significant concern for responsible consumption is causing organizations to implement solutions to measure product water footprint throughout the supply chain.

- **Transport:** Water is critical to trade via river and sea routes. Droughts can cause bottlenecks, creating the need to seek alternative routes by land or air for shipping or receiving goods. On the other hand, high levels of rainfall can cause extensive and expensive damage and disable overland roads.

An example of the impact on transport is the drought of the Paraná River, which crosses Paraguay and flows into the Río de la Plata in Argentina and constitutes one of the main routes for grain transport. This situation is forcing many exporters to consider using land routes.

IDB INVEST'S OUTLOOK

The IDB Group is the industry leader in Latin America and the Caribbean, with over 1 billion dollars in yearly disbursements. IDB Invest mobilizes private capital, relies on mixed financing, and provides technical assistance to improve efficiency in service provision, climate change, corporate governance, and gender issues.

The primary investment guidelines are:

- Projects aimed at sustainable Water and Sanitation infrastructures, which spur increased coverage, quality, and efficiency of services.

- Development, performance, and exploitation of Public-Private Partnerships (PPPs).

INDUSTRY CHALLENGES & OPPORTUNITIES

For the progress and development of the water industry, companies and governments should consider the challenges and opportunities encountered by the sector and the benefits offered by the advances of new technologies. The main ones include:

Increasing water demand: Population growth, urbanization, and the intensification of industry and agriculture to supply growing societies will increase pressure on water demand. This increase in demand without a proportional increase in supply or efficiency of services usually implies

higher prices. It can cause water conflicts where the most vulnerable or lower-income people are generally most affected.

Investment in desalination plants is an example of how infrastructure can be streamlined, including digital solutions that improve plant efficiency and operation, increasing drinking water production with human or industrial consumption uses. In Peru, the government is promoting the construction of six desalination plants in various parts of the country to supply drinking water to more citizens. In the past few years, Chile has forwarded the installation of these plants, especially in the mining industry and for electricity generation, due to the country's strategic interest in developing green hydrogen.

Climate Change: Due to climate change, droughts and floods are becoming more frequent and intense, characterized as extreme events that compromise water supply and make it more unpredictable, disrupting the value chain and the necessary water distribution.

Using new technologies can help predict these events with greater probability, providing governments and companies with the necessary tools for suitable control of the risks stemming from climate change.

Water Quality and Contamination: Treating the world's wastewater before it is discarded into the ocean or other bodies of water is another risk to consider. The absence of water can lead to disease or degradation of natural ecosystems, endangering the availability of freshwater supplies.

By using sensors and IoT devices in the water, data on water quality and properties can be generated. This information is analyzed through systems, which can identify problems such as the cause of contamination of waterways and thus establish remediation strategies.

Infrastructure Streamlining: Part of the infrastructure built for water distribution was developed decades ago. This fact mainly impacts the network's water losses, a cost consumers ultimately pay.

In Brazil, about 40% of drinking and treated water is estimated to be lost in distribution networks without reaching citizens' homes. Meanwhile, losses due to network leaks are estimated to range between 20% and 60% in Mexico, depending on the state.

Most leaks are caused by irregular network connections (fraud), inaccurate readings (outdated water meters), and pipeline breaks (outdated infrastructure). This involuntary waste harms society and the environment. It can be minimized by applying digital solutions, such as using robots in repairs or satellite technologies to locate moisture subsoil stains.

The challenge is most blatant in some communities within the region where insufficient infrastructure exists. This represents an opportunity for governments and organizations such as IDB Invest to finance infrastructure renovation designs, focusing on small and disadvantaged communities, aimed at adopting the innovations and new technologies available, which help make water and sanitation universal, affordable, and accessible and therefore improving people's lives and encouraging sustainable economic growth, as addressed by SDG 6.

Digitalization as a Tool to Address Industry Challenges

As we have seen, implementing technology-enabled solutions can help overcome or mitigate the risks encountered by water and sanitation. However, the main obstacles to the industry's digital transformation should be considered:

- **Systems Integration and Interoperability:** Most water and sanitation companies have legacy systems that record information about their operations. Progress must be made in the integration and streamlining of systems to minimize the risk of having different data silos.

- **Absence of Digital Talent:** Adopting new technologies and digital transformation plans requires talent to transfer to the organization's operating model. Consequently, it is necessary to change the mindset of companies to move towards a digital culture and attract resources with knowledge in the application of new technologies.

- **Financing Digital Transformation Projects:** Any digitalization effort requires capital to be put into operation. Governments usually have limited budgets to carry out infrastructure projects in treatment plants, dams, or networks, so it is essential to involve the private sector through concessions, tenders, or PPPs targeting the management and

exploitation of water that further the implementation of digital solutions that generate value and long-term efficiencies.
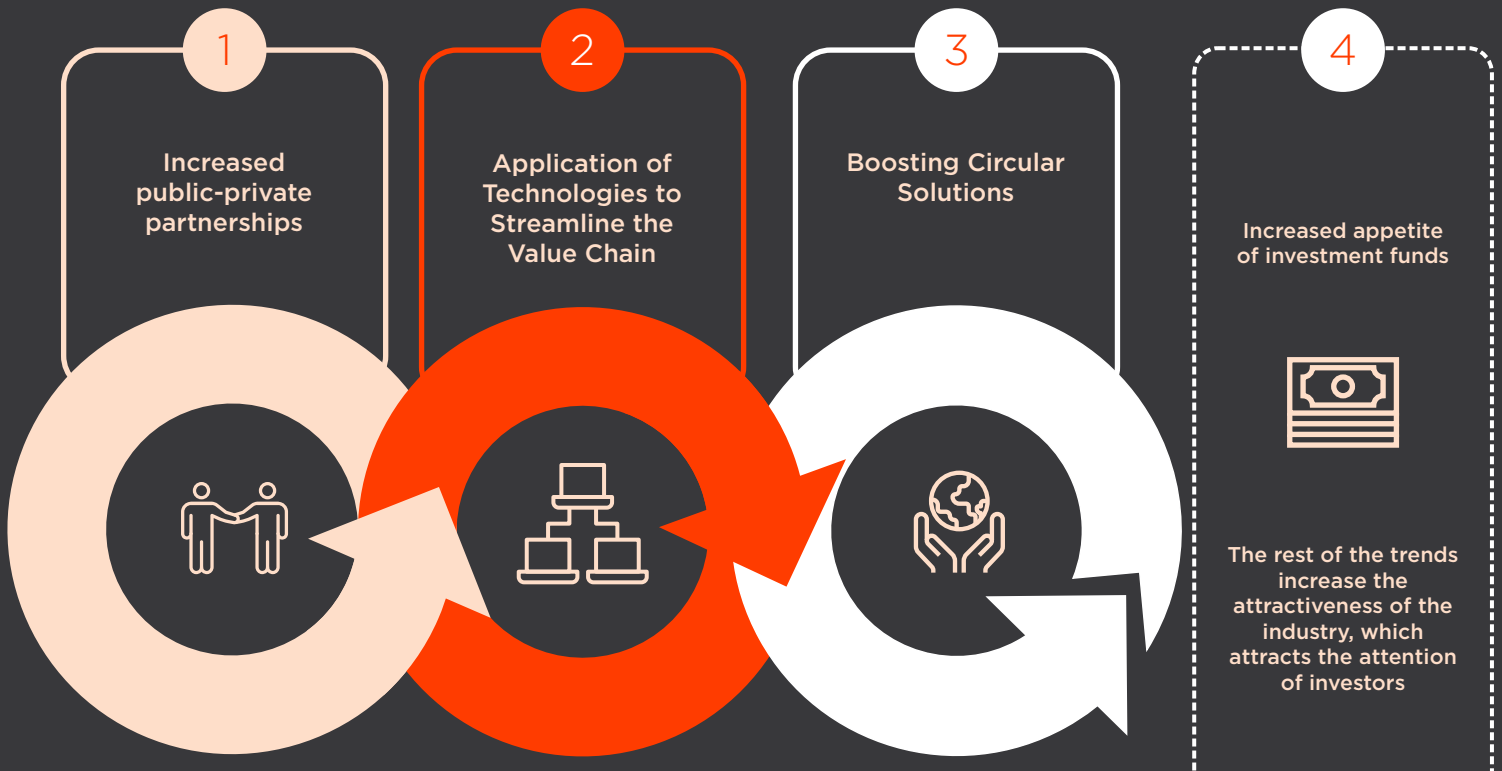
- **Cybersecurity:** As the volume of data generated and managed by companies increases, it becomes essential for them to have cybersecurity policies, processes, and standards to safeguard critical information on water resources.

KEY TRENDS

Digitalization and new technologies drive transformation in the water and sanitation industry. In this sense, they serve as a link and enhancer of the different trends that will be expanded upon. Public-private partnerships facilitate the inclusion of new technologies and innovations due to the participation of the private sector. The increased adoption of new technological solutions helps streamline and digitalize the value chain. Consecutively, this digitalization allows new circular solutions to be widespread.

All these aspects make the water industry increasingly appealing, attracting the attention of many investors. What is the reason behind it? There are three factors: the digital transformation of the industry, the increase in demand, and its gradual depletion as a finite resource. This increase in the industry´s investment generates a virtuous circle that allows more innovation and multiplies the effects on the rest of the trends, forming a more efficient and profitable sector that increases its long-term investment appeal.

1

Increased public-private partnerships

2

Application of Technologies to Streamline the Value Chain

3

Boosting Circular Solutions

4

Increased appetite of investment funds

The rest of the trends increase the attractiveness of the industry, which attracts the attention of investors

INDUSTRY DIGITALIZATION

IIncreased public-private partnerships: PPPs are long-term contracts between the public and private sectors to provide a public utility or infrastructure. To guarantee quality, performance and productivity indicators are established.

Through the contract, the public sector transfers the risks and benefits of the project to the private sector, which is responsible for its management. To maintain the long-term feasibility of the service, private companies receive payments from service users and governments (depending on the agreement).

As mentioned above, the water industry is critical for society and strategic for governments. It is a heavily regulated sector to ensure supply and avoid market concentrations (oligopolies) with power over prices. As shown in the publication prepared jointly by IDB and IDB Invest, supporting these agreements brings significant benefits for water and sanitation since the private sector covers the potential gaps that the public sector does not reach due to budget constraints, such as i) improving management and efficiency, ii) improving the coverage and quality of services, and iii) increasing capillarity, reaching more areas without the need to pass on costs to society by inefficient management.

From the standpoint of governments, these benefits may merely scratch the surface. Yet, there is a deeper aspect to these partnerships as it concerns the question: how does the private sector help digitalize the water industry?

On the one hand, the private sector uses new technologies to provide greater efficiency in management through the use of IoT devices in data capture, drones to monitor water levels or vegetation recognition, as well as Artificial Intelligence and Big Data models that allow analytics to improve managers' decision-making and spot risks in a preventive manner.

Moreover, to use new tools and techniques, they are well-informed on trends and new innovative solutions in the sector (for instance, using BIM methodologies for developing end-to-end infrastructure projects). Another critical example is using geographic information technologies (GIS) to manage networks, water catchments, or discharge points.

To progress in these collaborations, countries must have a favorable regulatory framework. Different levels within the region can be found. Although countries such as Ecuador and Bolivia restrict private participation in the industry, a privatization process has been carried out in Chile since the 1990s.

The case of Chile has been studied for the outcomes of its measures. Although it was initially criticized due to the increased price of water, this was offset by a reduction in demand, making it clear how removing subsidies can result in more efficient markets.

Raising water prices encouraged companies to invest in new infrastructure, which improved the country's water coverage and sanitation services.
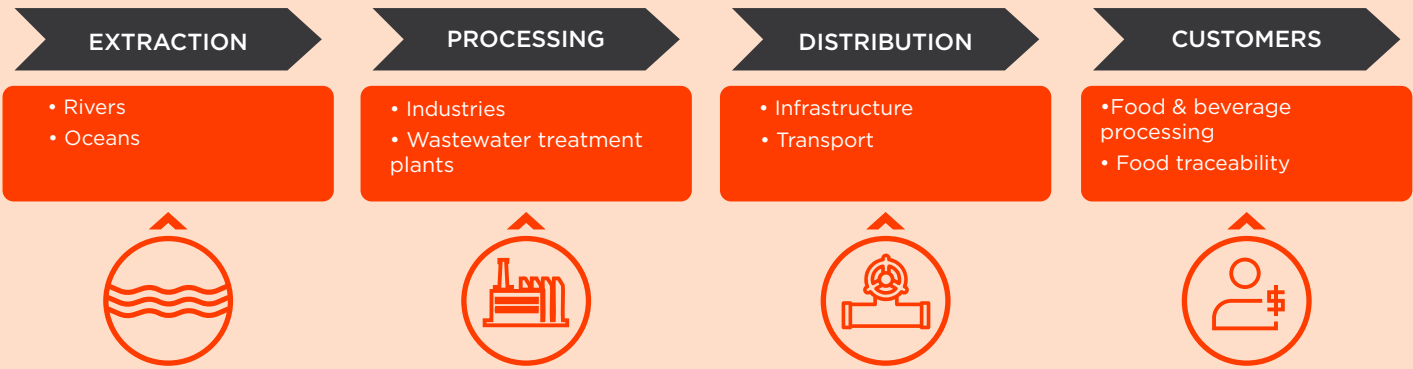
The success in the profitability of these companies led to the interest of international operators that introduced improvements in technology and specific talent. Additionally, all benefits were taxed, increasing the state treasury that could reinvest these monies in social spending policies.

As seen in the case above, the support and advancement of PPPs in the water and sanitation industry represent an opportunity for IDB Invest to fund projects that improve efficiency, include new technologies in operation, and modernize systems and infrastructure in the different countries of the region, which ultimately benefits citizens who receive better sanitation services and access to water.

Application of Technologies to Improve Value Chain Efficiency: Along the entire value chain of the sector, from water collection through its treatment and distribution to the end consumer, new digital solutions are helping manage water use more efficiently and effectively. Taking a simplification of the water value chain as an example, the prominent use cases we found are the following:

Digitalization of value chain in water
Generation of digital ecosystem

EXTRACTION	PROCESSING	DISTRIBUTION	CUSTOMERS
• Rivers • Oceans	• Industries • Wastewater treatment plants	• Infrastructure • Transport	•Food & beverage processing • Food traceability

CASE STUDIES

•Drones for monitoring water levels •IoT to capture data on water properties and characteristics	• Big Data and Artificial Intelligence for resource management and predictive analytics • Measuring water quality	• IoT devices and sensors for infrastructure maintenance • Virtual reality for repairs • Digital twins to prevent errors	• Monitoring water quality • Tools for efficient use • Demand estimate • Decentralization solutions • Transparency in water management and quality

• Blockchain to ensure water traceability along the entire chain

As shown in the diagram, artificial intelligence, big data, sensors, drones, and other digital solutions provide innovative solutions to manage water along the entire chain. Likewise, advanced analytics solutions allow better decisions based on analyzing the data generated throughout the process.

Water Extraction/Catchment

In the first phase, the water is in its natural state both on the surface, such as in lakes or the sea, or in-depth, that is, in the different underground aquifers. There are currently various technological tools to ascertain the quantity and quality of this water. As a result of these tools, a large amount of data on water health can be accessed at different scales (community, region, or country). Devices such as drones help automate and streamline monitoring tasks over large areas, activities that previously had to be carried out manually. They can also help detect pollutant plumes and even environmental monitoring of rivers. Below are two examples of technologies applied in natural waterways:

- **Environmental Drones:** Intended to protect riverbeds and coastal areas by assessing the quantity and quality of water in real-time. It reduces reaction times during environmental events such as floods, which is very useful for improving agility in the case of environmental accidents or spills. Specifically, NTT DATA relies on a service called River View, in which drones, remote sensing, and sensors are used to characterize the ecological status of rivers, allowing a digital twin to predict the evolution of ecosystems, classification of plant species, as well as identification and characterization of hydro-morphological variables.

- **IoT sensors:** The deployment of IoT in the water world favors both the efficient monitoring and management of water supply and the early detection of natural disasters.

  IoT devices collect real-time data on water quality and levels in reservoirs, rivers, and wells, enabling water providers to make better decisions. In addition, IoT sensors monitor the quality of natural water in water bodies, spot changes in levels, and issue early warnings of potential floods, droughts, and other related disasters. This rapid and efficient response capability helps save lives and reduce the impact of natural disasters. Hence, several companies seek alliances between sensor production and IT companies to provide an optimized analysis of the data generated.

  An example of innovation in this regard is Swalert, an IoT platform and software for real-time monitoring and early warning of contamination or variations in water quality. Its system allows for taking precautions in incident management, reducing risks, and enhancing the analytical capabilities relative to the information collected. This technology can be used in natural waterways and drinking water distribution networks.

Processing
(Purification and Sanitation)

Within the treatment and processing of water for its subsequent trading or discharge to the riverbed, several technological solutions based on Artificial Intelligence and Big Data collect the maximum information to support an analysis that allows the automation of processes and the optimization of their operation and maintenance.

- **AI and Big Data for Resource Management:** These tools are applied to urban and industrial plants, improving operational efficiency, real-time monitoring, and decision-making. AI optimizes processes, identifies patterns and anomalies, predicts problems, and facilitates predictive maintenance. It helps reduce energy and chemical operating costs. In short, AI promotes efficiency and sustainability in water treatment, protecting the environment and providing clean water. In this sense, several projects have been developed in LAC to optimize treatment plants. It is worth mentioning the one carried out in Chile by the company Ainwater, in which power savings of up to 30% were achieved, as well as a reduction in the use of chemicals and maintenance hours.

- **Measurement of Water Quality by AI:** Advanced algorithms and data analysis are used to accurately and continuously assess critical parameters such as contaminants, microorganisms, turbidity, and pH, allowing the detection of deviations and anomalies in real-time and generating automatic alerts to implement corrective measures. Furthermore, it facilitates predictive maintenance by identifying possible problems in treatment processes. In summary, AI ensures constant monitoring, early detection, and rapid response to ensure that treated water meets the quality standards established by environmental regulations, providing a safe and reliable supply and discharge. As examples of projects developed in this regard, there is a tendency to implement digital twins that allow optimization and quality monitoring. In this line, Swalert is being designed (detailed in the previous section) to warn receivers of discharges based on the output of treatment plants.

Distribution (Supply and Wastewater Treatment Networks)

The use of new technologies in the distribution phase is essential. Mexico City alone estimates that

40% of drinking water in 2021 was lost in leaks

an increase of 71% over the previous year. With the application of new technologies, it can be detected earlier, generating alerts and subsequent root cause analysis to feed back the models and calculate the probability of failure, besides performing predictive maintenance. Additionally, with the aid of robots and devices, repair times are shortened, minimizing water losses in the network. Two of these efforts are detailed below to strengthen the management of urban supply and wastewater treatment networks:

- **Digital Twin for Network Management:** Digital twins are virtual replicas of water networks that integrate real-time data from sensors and monitoring systems. They allow for real-time monitoring, improved decision-making, and process optimization.

  AI is applied to analyze and process this data, identify patterns, spot anomalies, and predict future events. The combination of these two

tools allows continuous monitoring and management of the network, facilitating the early detection of leaks, faults, or water quality problems. Consequently, developing models to optimize network operation allows the automatic adjustment of distribution systems, predictive maintenance planning, and efficient management of water demand. Therefore, more innovative and more effective management of water networks is achieved by providing real-time information, early detection of problems, and helping in the decision to improve the efficiency, sustainability, and quality of water supply service.

Several companies are dedicated to managing networks through digital twins; in Europe, all the companies that manage wastewater are implementing these technologies in search of greater profitability. An example in this area is the company BuntPlant, which, among its numerous applications, applies AI for complete water cycle management, helping in decision-making, leak detection, and water meter management.

- **AI Leak Detection and Remote Sensing:** Several satellite-enabled leak detection solutions are emerging to locate and analyze moisture, provide accurate locations of potential leaks, and detect non-visible ones. To do this, they leverage Artificial Intelligence and Machine Learning algorithms trained to recognize water leaks from different sources, speeding up the detection and repair process.

In this sense, satellite images and georeferenced databases are being tested for detecting water leaks on a large scale. For example, one of the companies that markets this type of solution is Asterra.

Clients (Managers and Users)

Digitalization also ultimately benefits consumers. In this manner, citizens have more data on their use of water and its properties. An example is smart water meters that allow remote reading of meters. In addition, pulse counters enable households to be more aware of water consumption, encouraging sustainable use and bill savings.

- **Transparency in Management and Quality:** Using sensors, real-time monitoring devices, and geographic information systems (GIS), data on key water quality parameters can be collected and visualized. This gives authorities, institutions, and citizens access to accurate and up-to-date information, encouraging improved decision-making.

  In addition, technological tools allow the creation of online platforms where information on water quality is shared, and parameter monitoring reports and actions are carried out, which furthers citizen participation and collaboration between different actors for sustainable water management. In this setting, some of the water management companies and public administrations in Europe are beginning to implement platforms for direct communication with citizens and not only for the global presentation of data, as has been carried out in recent years.

- **Chatbots in the Water Industry:** They allow interactive and efficient user communication. Their application includes providing real-time support, answering frequently asked questions about billing, payments, and services, and providing information about water conservation and tips for more efficient use. Chatbots enable automated customer support, reducing wait time and providing quick responses to common queries, improving the user experience and freeing up resources.

  On the other hand, chatbots can collect data and feedback from users, which provides valuable information for decision-making and continuous improvement in water management. This tool is being implemented in many industries, not just the water industry.

One example of how new technologies benefit citizens is IoTrace, a cloud-based solution that allows the incorporation of key performance indicators on power, water, and other supplies used in the production process.

By providing data and solutions in real-time, it allows each participant with permission to search information based on their role in the value chain to be updated minute-by-minute. This solution is currently being applied in the supply chain of the fishing industry and is expected to be applied to other sectors, including water.

Another more widespread case is the applications earmarked for raising awareness about responsible water use, such as We Eat Water, which allows the acknowledgment of food´s water footprint.

The increase in digitalization along the value chain generates a greater volume of data, which can then be analyzed more accurately (more information is equivalent to more robust models) to make better strategic decisions on water and sanitation.

Promotion of Circular Solutions: The circular economy aims to maximize the resources available for reuse throughout production. As we know, water is a finite good. For this reason, many companies are looking for innovative solutions that allow a second use of water following a production-consumption-recovery chain that allows its long-term sustainability.

The use of circularity in the water and sanitation industry is very relevant in Latin America and the Caribbean, as many wastewater plants are obsolete and have little operational capacity. This issue is aggravated in rural areas. Discarding wastewater in lakes and rivers without precise treatment puts the population at risk of drinking water with high contamination levels.

It is possible to redefine the meaning of wastewater by developing new solutions, going from waste of resources to having a value (reusable). Among the leading cases are the reuse of water from wastewater treatment plants and the generation of power or biogas. Other potential applications are water reuse for garden irrigation and cleaning sidewalks, promenades, pedestrian areas, and city driveways.

Providing a second life to water brings benefits in different areas. Economically, the treated water or the power produced can be sold. At the environmental level, the correct treatment of wastewater once discharged avoids degrading water quality and harming marine ecosystems. Lastly, at the social level, it reduces diseases caused by contaminated water, improving public health.

Greater Participation of Investment Funds: An increase in global water demand is expected in the coming years due to population growth, economic development, and changes in consumption patterns. All this will be compounded in some global regions by poor water availability (more than two billion people live in countries suffering from water stress) and declining water quality due to contamination.

Given this scenario, investment in water has been one of the approaches that asset managers have incorporated over time into their product catalog, receiving large amounts of capital. This increased investment appetite is supported by two ideas: solving the challenges of resource scarcity and social concern for the environment (which encourages investments in companies that pursue sustainable goals). In this regard, many companies are dedicated to water, from those with a technological approach to finding solutions that solve shortages to others focused on supply and distribution.

Among the most relevant managers to offer these thematic funds is Allianz, with the Allianz Global Water fund having over 900 million euros of assets and having been revalued by 43% in the last three years.

Its investment strategy aims to identify companies whose supply addresses water scarcity and quality issues and helps improve the sustainability of global water resources.

Fidelity, another of the largest management companies in the world, offers the Sustainable Water & Waste fund, which has an approximate size of 1.9 billion dollars and invests in global companies involved in the design, manufacture, or sale of goods and services pertaining to the water and waste management sectors.

The fund can invest across the water and waste value chain, including companies developing new technologies to meet ever-increasing demand.

For its part, the IDB, through AquaFund, finances solutions in the water and wastewater treatment industry in Latin America and the Caribbean, focusing its investment strategy on four axes: i) access to water and sanitation in areas of low population density; ii) water security and climate change; iii) water governance and wastewater treatment service providers; and iv) urban sewerage and flood control.

Since its beginning, **AquaFund** has supported more than 124 efforts, introducing over USD 4.1 billion into water and sanitation. It has also helped governments in the region provide universal access to high-quality water supply and wastewater treatment services.

NEW BUSINESS MODELS

Governments, companies, and universities are exploring the applications of new technologies in the water and wastewater treatment industry, aiming to find solutions to solve this resource shortage in the future. Below are three of the new business models that have emerged due to technological advances:

Decentralization of Networks

Infrastructure systems for water storage, treatment, and distribution were centrally designed to benefit from economies of scale and concentrate specialized technicians in operating these systems. Although the marginal cost of these systems is lower, they require high initial costs to ensure their maintenance and operation.

As in other sectors, such as power, innovative solutions are also emerging in the water industry, allowing network decentralization with lower operating costs and quicker implementation than centralized systems. This economic efficiency leads to a faster return on investment (ROI) than centralized systems.

Among the prominent use cases, we can find companies that operate wastewater treatment and reuse systems in the facilities (on-site) of urban buildings or tourist complexes. These systems are installed in the new urban complexes and run automatically, can be monitored remotely, and perform wastewater treatment with an excellent quality-price ratio. Some suppliers offer to deploy their water treatment operations in sites upon demand, for example, for military operations, plant failures, or in areas where a natural disaster has occurred.

This shift from traditional infrastructures to decentralized systems must be leveraged by technologies to provide real-time data on, for example, the quantity or quality of water used, favoring the interoperability of the entire ecosystem (governments, companies, and consumers).

EXAMPLE: DECENTRALIZATION OF NETWORKS

IslaUrbana

"Rainwater harvesting"

Project intended to contribute to sustainability in Mexico, through rain harvesting

VALUE PROPOSITION

Its mission is to promote sustainable development in the water industry based on rainwater harvesting. They are dedicated to designing and installing catchment systems in Mexico, especially where people lack water. Among the main benefits are power costs savings, the independence of water for households, and the recovery of aquifers.

RESULTS

+33.000
total systems installed

+600.000
beneficiaries

+200.000
waterpipes
saved annually

TECHNOLOGY

A rain harvesting and purification system is used, which carries out the biological, physical, and chemical disinfection processes.

On the other hand, each installed system is monitored to check that it is being properly used and maintained.

OTHER PLAYERS

Soluciones Hidropluviales

GRUPO PISARI®

ALLIANCES

Extensive network of collaborators, including: OXFAM UNDP

IMPACT

Conduct environmental education workshops.

Put their efforts in various areas of the country to improve access to clean water where its scarcity has the worst of impacts.

KEY CAPABILITIES AND RESOURCES

· Expansion to other markets within the LAC region.
· Investment in marketing to disseminate the solution.
· Penetration in the corporate segment, with potential for schools, hospitals, and industry.

CUSTOMER SEGMENTS

Mexican families with little access to the water supply network or who live in areas where there is a shortage of this resource.

MAIN REVENUE STREAMS

Direct sale of products: components for water collection and purifiers.

Sale of services: installation, maintenance, technical advice, and project consulting.

Urban Distribution Network Management Solutions

As discussed throughout the report, the sector's infrastructure is obsolete and suffers from losses in the network, which means an increase in the price of water by transferring these costs to final consumers.

Investing in new technologies within water infrastructure management improves the efficiency and effectiveness of network repairs, reducing long-term maintenance costs and avoiding waste that has a high social and environmental impact.
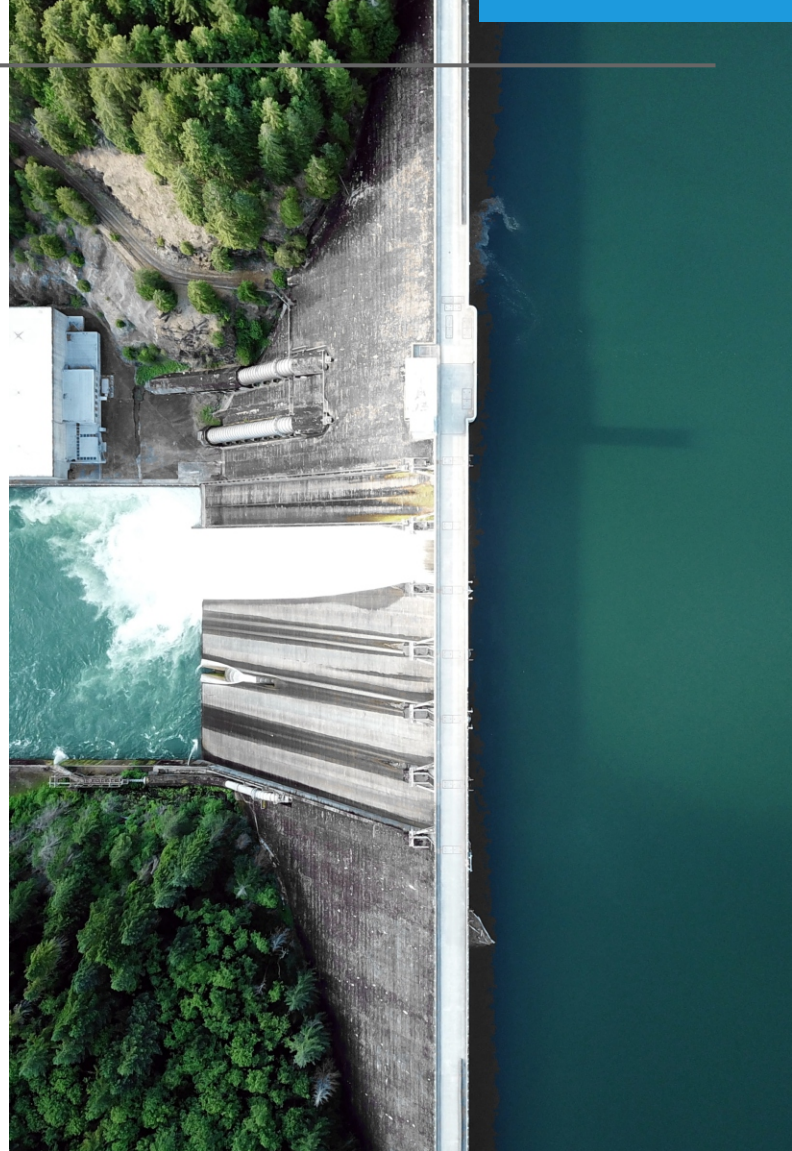
Among the prominent use cases is the use of satellite images for the early detection of leaks. As the devices are connected to the management systems, alerts can be established to allow better monitoring. The same goes for wastewater monitoring, where IoT devices detect and predict water conditions and characteristics. Besides, AI is used to optimize treatment plants to increase power efficiency and reduce product consumption.

Augmented Reality and Virtual Reality (immersive realities) are also used for the preventive maintenance of the facilities. Little by little, companies are beginning to adopt Digital Twins. These virtual models reflect the physical world and allow data analysis to guarantee the quality of networks through simulations and tests.

To enhance the capabilities in infrastructure management, Artificial Intelligence and Big Data applications can be included to integrate all critical data into the analyses to make

more accurate predictive management of assets, extending the infrastructure's useful life and reducing unit costs.

Among the companies that use these technologies to innovate in this type of solution is Asterra, which uses Artificial Intelligence to analyze the data collected by satellites and improve the monitoring of infrastructures. For its part, Ainwater seeks to optimize treatment plants, applying Artificial Intelligence models to obtain recommendations and using Digital Twins to improve plant efficiency.

EXAMPLE: INFRASTRUCTURE MANAGEMENT SOLUTIONS

aganova

"Technology and innovation at the service of water"

Leak detection specialists in water transport networks.

VALUE PROPOSITION

Its mission is to provide cost-effective, efficient, and effective technologies with a recurring use model that helps minimize Non-Registered Water (NRA), and that can offer its customers valuable information for decision-making.

They develop and offer solutions worldwide for the reduction of water losses in transport networks.

RESULTS

Investments by funds: Cimbria and Emerald

3 international projects

TECHNOLOGY

Through Nautilus, a sphere of small dimensions that is inserted into the network of large-diameter water pipes, it collects information that allows determining, through the conjunction of big data and ultrasound, the exact location of leaks in the network. Its data management platform (Nemo) allows analysis with algorithms and their classification.

OTHER PLAYERS

FIDO

SewerAI

ATMOS INTERNATIONAL

ALLIANCES

Alliances with institutions and public organizations (CEDETI, EU...) for the development of R&D projects.

IMPACT

Reduces and minimizes water waste.

Facilitates decision-making derived from digitalization.

KEY CAPABILITIES AND RESOURCES

· Overall Growth International Expansion: Acquiring new customers in North American markets.

· Improvement in the technology platform.

· Increase business team.

CUSTOMER SEGMENTS

Private or public sector companies that are dedicated to managing water infrastructure.

MAIN REVENUE STREAMS

Sale of Nautilus: Device for the assessment, detection, and prevention of water leaks in large diameter pipes

Sale of the Nemo Platform: Digital platform earmarked for planning, monitoring, and interpreting of results obtained with Nautilus

Smart Devices for Consumers

Relationships between customers and businesses are becoming increasingly digital. Although the speed of adoption of new technologies has been higher in other industries (for example, in mobility or financial services), companies in the water industry are beginning to provide digital solutions to consumers.

The change in customers' new consumption habits and a more significant concern for sustainability have driven the growth in the use of these devices. Using these intelligent solutions has as its main benefit the efficiency in water use, avoiding useless waste. On the other hand, it helps consumers save by reducing spending while encouraging sustainable housing construction.

Among the most relevant cases, we find the use of sensors to detect leaks, such as in washing machines or pipes. They are also applied in the taps to activate the water flow for the necessary time. Another case is using devices in the showers, which allows the temperature to be programmed.
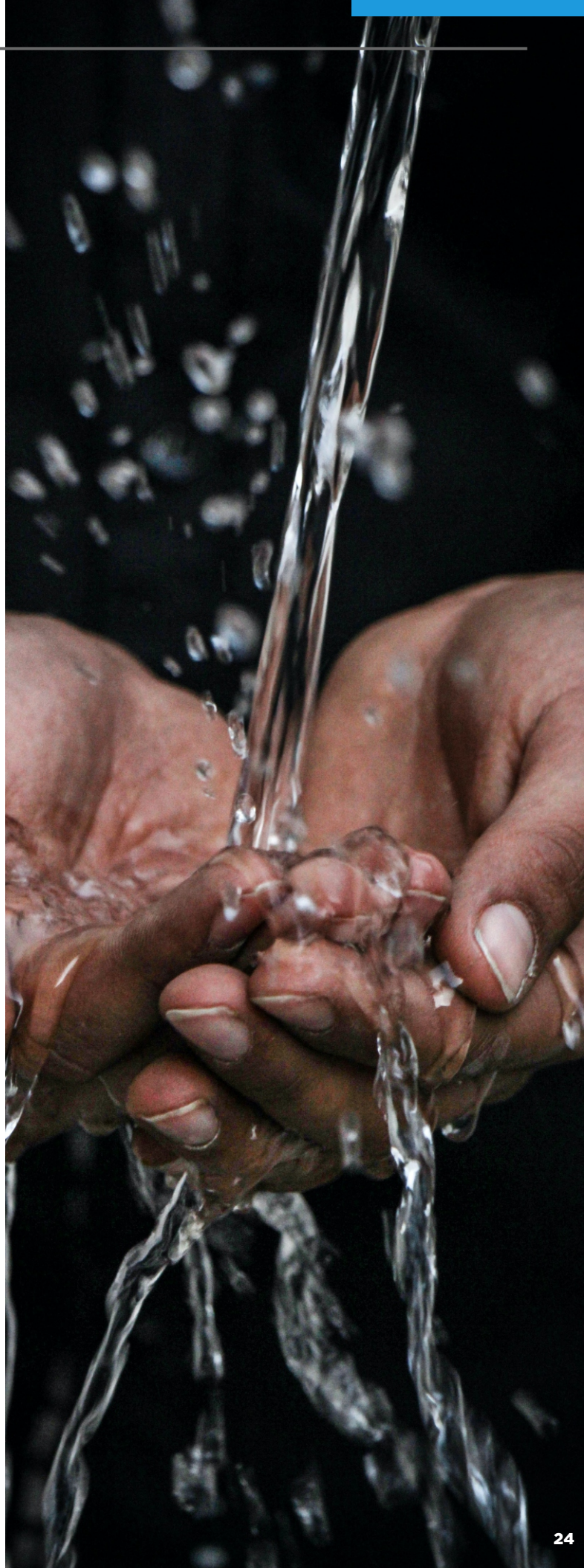
All of these solutions leverage technology to help customers reduce water waste. Smart devices generate real-time data using this resource, which is processed with advanced analytics to establish recommendations. Users can finally see these insights about their behavior patterns through apps.

For example, BuntPlanet, among its various solutions, offers software that applies Big Data analysis and Artificial Intelligence to analyze the end uses of water by breaking down its consumption into essential components: washing machine, dishwasher, tap, toilet, irrigation, leaks, among others. In this way, users can take specific actions to make better use of water and have a positive impact on the environment.

EXAMPLE: SMART DEVICES

AquaReturn®

"The satisfaction of saving while still enjoying"

Device that prevents water waste waiting for it to come out hot

VALUE PROPOSITION

AquaReturn is a small and easy-to-place appliance that prevents water loss while waiting for it to come out hot.

AquaReturn is designed for use in installations with a heater, water heater or individual boiler, and in homes with hot water from solar panels.

RESULTS

Waterwise Award
House of Lords - London

UN Water Finalist
New York

TECHNOLOGY

When the hot water tap is turned on, the AquaReturn smart device detects the temperature that the water reaches through the hot water pipe. If it is below 35°C, the equipment drives it through the cold water pipe back to the boiler. When it reaches the consumption temperature, its warning switch warns you.

OTHER PLAYERS

NESS

metrica6

ALLIANCES

Alliances to market the product:

· With **Bosch** for Brazil and England.
· With **Wilo** for Germany, France, and Mexico.
· With **Leroy Merlin** and ECI in Spain.

IMPACT

· Allows a family to save thousands of liters of water per year.
· Contributes to avoiding waste of resource, improving its efficiency.

KEY CAPABILITIES AND RESOURCES

· Growth in the number of customers

· Geographical expansion

· Capital Need for Complementary Product Development and Data Analytics Capabilities

CUSTOMER SEGMENTS

By the nature of their business, the main customers are people from the medium-high socioeconomic sector who have a concern for the environment and seek solutions that allow them to maximize efficiency in the use of resources.

MAIN REVENUE STREAMS

Product Sale:
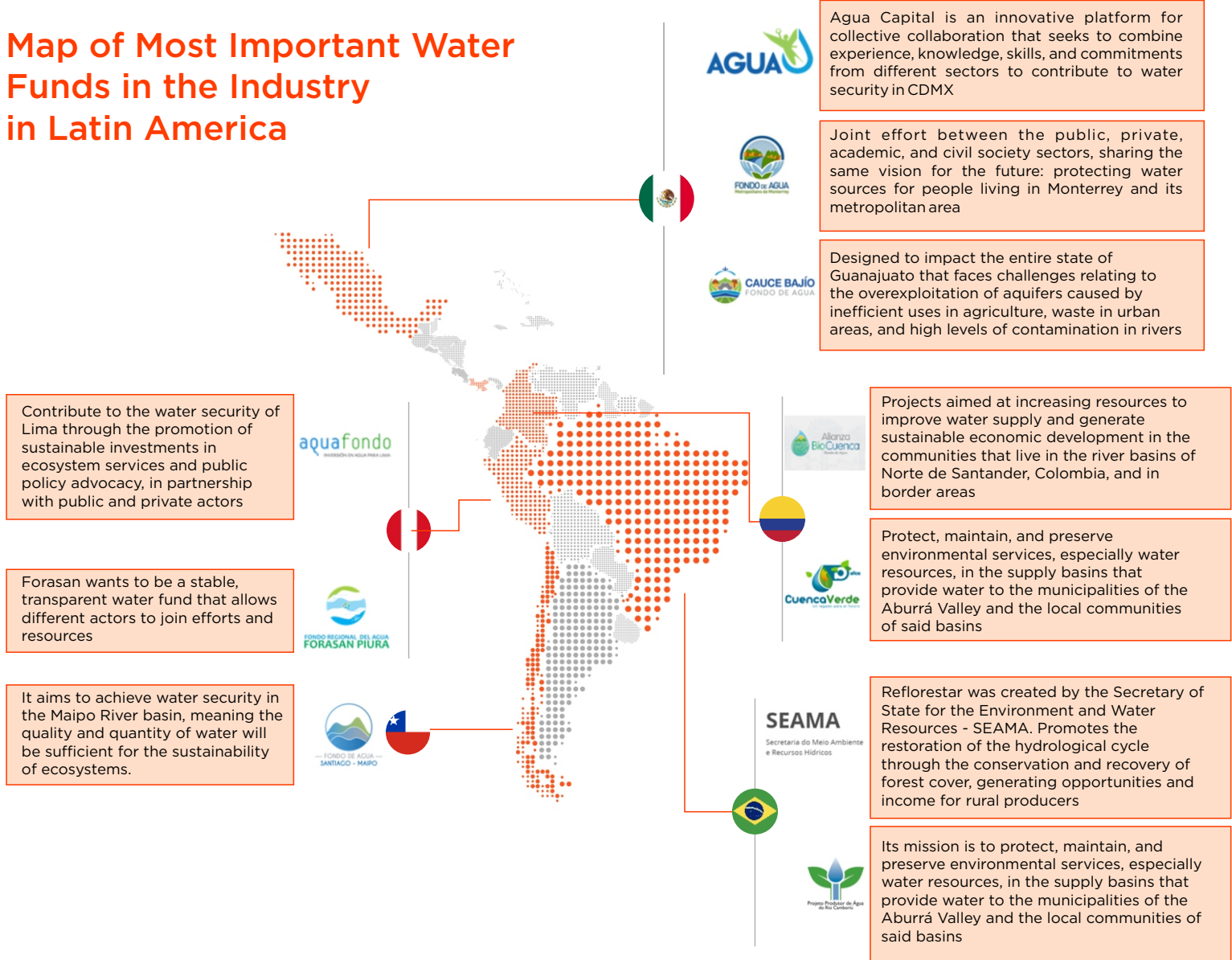
The price of the device is € 347

PLAYERS MAP

As seen throughout this analysis, new technologies are helping to respond to the industry's challenges, specifically the potential scarcity of this resource in many regions over the next few years.

To conclude, the following illustration presents the most crucial water funds in Latin America and the Caribbean, which seek to mobilize resources to achieve water

security, management, and dissemination of knowledge, as well as the development of capacities and technical support.

In 2011, the Latin American Alliance of Water Funds was created, with the participation of the Inter-American Development Bank (IDB), to contribute to water security in Latin America and the Caribbean through the creation and strengthening of Water Funds.

Map of Most Important Water Funds in the Industry in Latin America

Agua Capital is an innovative platform for collective collaboration that seeks to combine experience, knowledge, skills, and commitments from different sectors to contribute to water security in CDMX

Joint effort between the public, private, academic, and civil society sectors, sharing the same vision for the future: protecting water sources for people living in Monterrey and its metropolitan area

Designed to impact the entire state of Guanajuato that faces challenges relating to the overexploitation of aquifers caused by inefficient uses in agriculture, waste in urban areas, and high levels of contamination in rivers

Contribute to the water security of Lima through the promotion of sustainable investments in ecosystem services and public policy advocacy, in partnership with public and private actors

Forasan wants to be a stable, transparent water fund that allows different actors to join efforts and resources

It aims to achieve water security in the Maipo River basin, meaning the quality and quantity of water will be sufficient for the sustainability of ecosystems.

Projects aimed at increasing resources to improve water supply and generate sustainable economic development in the communities that live in the river basins of Norte de Santander, Colombia, and in border areas

Protect, maintain, and preserve environmental services, especially water resources, in the supply basins that provide water to the municipalities of the Aburrá Valley and the local communities of said basins

Reflorestar was created by the Secretary of State for the Environment and Water Resources - SEAMA. Promotes the restoration of the hydrological cycle through the conservation and recovery of forest cover, generating opportunities and income for rural producers

Its mission is to protect, maintain, and preserve environmental services, especially water resources, in the supply basins that provide water to the municipalities of the Aburrá Valley and the local communities of said basins

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