

Innovation in Water, Sanitation, and Solid Waste

Assessment, perspectives, and
opportunities for Latin America and the
Caribbean

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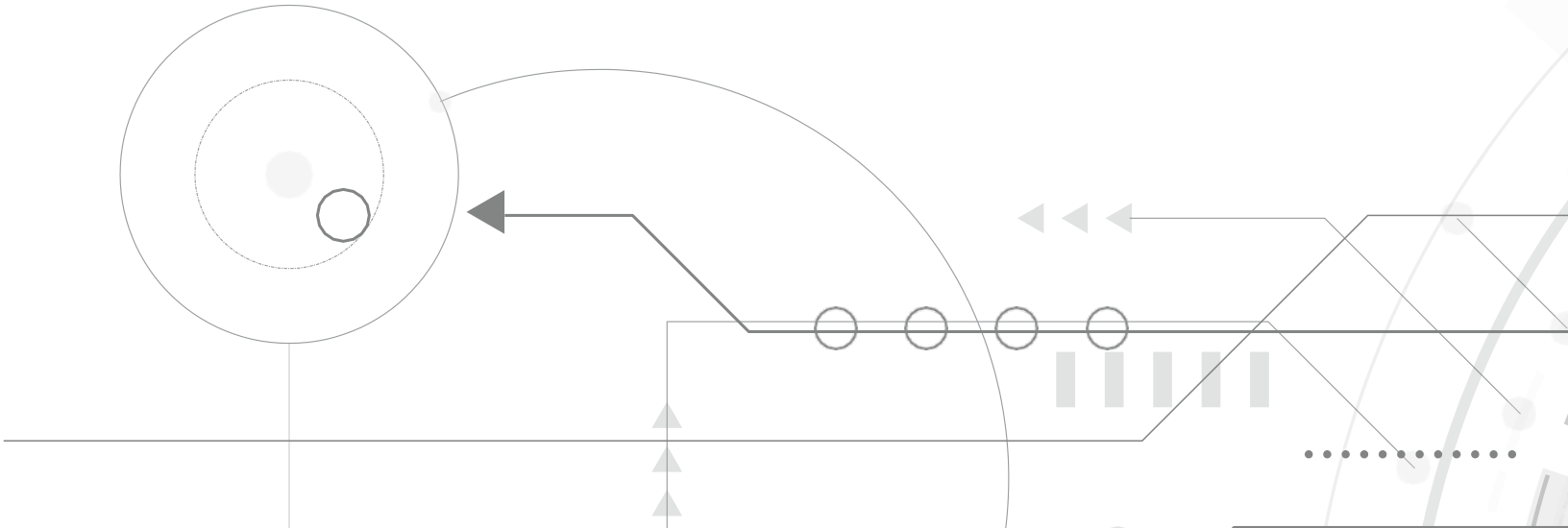
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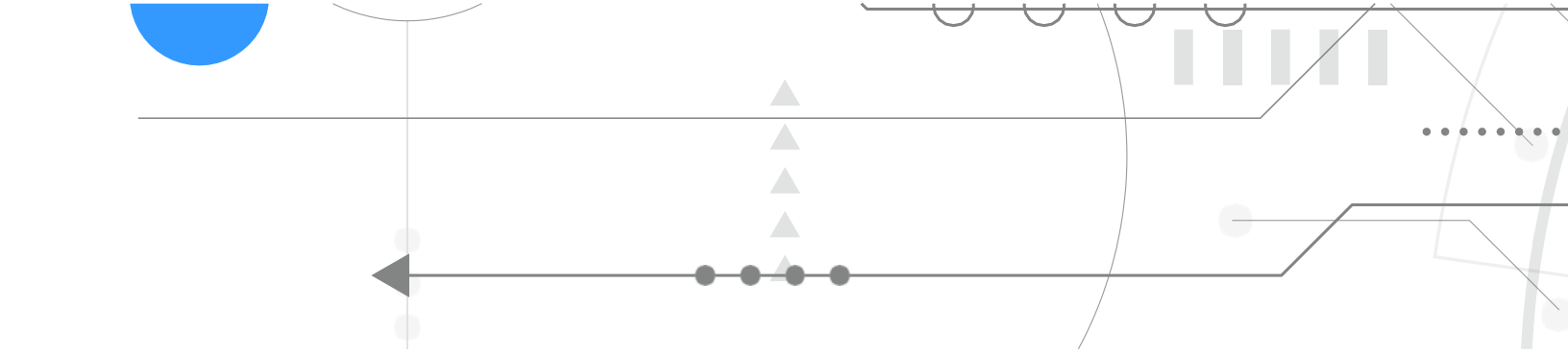
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Acronyms

AWS	America's Water Systems
CAF	Development Bank of Latin America
ECLAC	United Nations Economic Commission for Latin America and the Caribbean
EIP	European Innovation Partnerships
EU	European Union
GIS	Geographic Information Systems
GWM	Global Waste Management
IDB	Inter-American Development Bank
INTAL	Institute for the Integration of Latin America and the Caribbean
ISWA	International Solid Waste Association
LAC	Latin America and the Caribbean
OECD	Organisation for Economic Co-operation and Development
R&D	Research and development
R&D&I	Research, Development and Innovation
RICYT	Network for Science and Technology Indicators
SDG	Sustainable Development Goals





SIWI	Stockholm International Water Institute
SME	Small and Medium Enterprise
TTO	Technology Transfer Office
UN	United Nations
USEPA	U.S. Environmental Protection Agency
WEF	Water Environment Federation
WEF	World Economic Forum
WIE	Water Innovation Engine
WIN	Water Integrity Network
W&S	Water and Sanitation
WSA	IDB's Water and Sanitation Division

Foreword

Our main challenge is to promote a virtuous cycle that reinforces itself over time; in other words, to keep innovation closely linked to the day-to-day issues of Latin America and the Caribbean's water and sanitation sector. Developing knowledge and skills, working with other stakeholders, and improving innovation management promote risk taking, which in turn inhibits the status quo culture.

Innovation has always boosted a society's generation of value. In line with the reality of the past two decades, which was marked by the acceleration of multiple challenges and shifts in lifestyles worldwide, innovation has become more central and is expected to become even more so in years to come.

Given the United Nation's Sustainable Development Goals (SDGs) and the importance the Water and Sanitation Division (WSA) of the Inter-American Development Bank (IDB) assigns to innovation, this report aims to contribute to fostering innovation efforts in the water and sanitation (W&S) sector in Latin America and the Caribbean (LAC).

The main challenges innovation faces in the W&S sector in LAC can be split into three categories: 1) Governance efforts; 2) Research, Development and Innovation (R&D&I); and 3) Water, sanitation, and solid waste utilities. Therefore, studying innovation experiences in other parts of the world in the aforementioned fields may result in a valuable contribution to the learning process in our region.

Based on regional challenges and international experiences, this document provides elements to reflect on opportunities for action from the perspective of each sector's stakeholders and from their joint efforts.

In this context, we offer a roadmap that can serve as a guide to improve people's quality of life. It includes a series of "cardinal points" that provide general direction and specific action items. Regarding governance in the innovation section, the cardinal points are to: i) promote public policies and regulations, and ii) support integration mechanisms to bolster innovation and its sustainability. In the R&D&I sector, they are to: iii) facilitate research and development based on relevant challenges, and iv) encourage cooperation between the sector's innovation ecosystem stakeholders. Regarding utilities, the cardinal points are to: (v) encourage the adoption of innovation, and (iv) strengthen the management of its implementation and associated capacity for innovation. Overall, every sector should promote the development of a favorable environment to catalyze innovation in water and sanitation.

The background features a complex network of blue lines and dots, resembling a circuit board or data flow. The lines are of varying thickness and color, ranging from light blue to dark blue. Some lines end in small blue circles. In the bottom right corner, there is a decorative graphic consisting of several overlapping, curved bands in shades of blue, creating a sense of motion or a stylized arc.

1

Introduction

Introduction

- 1.1 **The importance of innovation for development.** Innovation has always contributed – through new ideas that solve relevant problems – to enhance societies’ competitiveness, efficiency, and the sustainability of its value generation processes (legal, technological, managerial, etc.). Together with knowledge management, innovation boosts economic and social development, promoting a better quality of life¹. By tackling challenges and technological, economic, social, and environmental risks, innovation is key to the development of both global production and productivity².
- 1.2 **Speedy changes and evolution of innovation.** In line with the fast-moving last two decades, marked by quick-changing lifestyles worldwide, innovation has become more central and is expected to become even more so in coming years³. Its scope has recently evolved through various conceptual frameworks depending on its purpose (technology, relationships between people, business, etc.), the sector (transportation, education, health, sanitation, etc.), and the stakeholders involved (public sector, private sector, third sector, academia, etc.).
- 1.3 **Definition of innovation adapted to context.** According to the Oslo Manual⁴, innovation is a new or improved product or process (or a combination of both) that differs significantly from previous products and processes, and that is available to potential users (in the case of products) or is in use by an organization (in the case of processes). Although this definition is the most broadly accepted, it has been modified over time⁵ and there are different adaptations available depending on the context⁶, priorities and internal characteristics, and the level of risk the managing entity or body is willing to allow. This leads to different types of innovation: incremental or disruptive⁷; central, adjacent, transformational⁸; open⁹; social¹⁰ or inclusive¹¹; public¹²; and green¹³, among others.

¹ The OECD Innovation Strategy. Scientific and Technological Advisory Forum, AC. OECD. 2012.

² Oslo Manual (4th edition). Guidelines for Collecting and Interpreting Innovation Data. Eurostat & OECD. 2018.

³ The future is faster than you think. How converging technologies are transforming business, industries and your lives. Diamandis and Kotler. Simon & Schuster. 2020.

⁴ Oslo Manual (4th edition). Guidelines for Collecting and Interpreting Innovation Data. Eurostat & OECD. 2018.

⁵ Oslo Manual (3rd edition, OECD 2005) included two additional types of innovation— organizational and commercial.

⁶ The Bogota Manual is an unavoidable standard for Latin America and the Caribbean given that it adapts its conceptual framework (from Oslo 2005) to the region. Among “innovation activities”, it includes “technological efforts” – in other words, every measure adopted by the organization to introduce, acquire, assimilate, and incorporate knowledge, research, etc.

⁷ What is disruptive innovation. Harvard Business Review. 2015.

⁸ The innovation ambition matrix. Managing your innovation Portfolio. Nagji & Tuff. HBR. 2012.

⁹ The era of open innovation, MIT Sloan Management Review. Chesbrough. 2003.

¹⁰ How to Promote High-Impact Innovations through Social Innovation Funds. A Call for Public-Private Partnerships. Guaipatin. IDB-DP-319. IDB. 2013.

¹¹ Making Innovation Benefit All: Policies for Inclusive Growth. OECD. 2017.

¹² Innovation for Better Management: The Contribution of Public Innovation Labs. Acevedo & Dassen. Technical note IDB-TN.1101. IDB. 2016.

¹³ A Conceptual Framework to Measure Green Innovation in Latin America and the Caribbean Discussion Paper. Grazi, Sasso & Kemp. No. IDB-DP-730. 2019.

- 1.4 **Innovation as the means to achieve sustainable development.** Within the framework of a United Nation's initiative, the Sustainable Development Goals¹⁴ (SDGs) for 2030 were laid out in 2015. SDG #9 Industry, Innovation, and Infrastructure outlines several goals linked to innovation. Among them **SDG 9.5**, "Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending"; **SDG 9.b**, "Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities."

Apart from the SDGs directly associated to innovation, many other SDGs need innovation to reach the goals they have set for 2030. Regarding the SDGs linked to drinking water and sanitation (W&S), **SDG 6.1** emphasizes the need to "achieve universal and equitable access to safe and affordable drinking water for all"; **SDG 6.2** establishes the need to "achieve access to adequate and equitable sanitation and hygiene for all, and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations"; **SDG 6.3** mentions the need to "improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally"; and **SDG 6.4** identifies the need to "substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity, and substantially reduce the number of people suffering from water scarcity".

The issue of solid waste is mostly covered¹⁵ by SDG 12, Responsible Consumption and Production, under **SDG 12.3**: "halve per capita global food waste at the retail and consumer level, and reduce food losses along production and supply chains including post-harvest losses". **SDG 12.4** also touches on the issue as it sets out to "achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment"; and **SDG 12.5** states the need to "substantially reduce waste generation through prevention, reduction, recycling, and reuse". To reach **SDG 6.1** and **6.2**, Latin America and the Caribbean (LAC) would require an accumulated investment of \$14 billion per year¹⁶. Thus, fostering innovation in the water and sanitation sector is essential to meet them quickly and effectively.

- 1.5 **Central role of companies in innovation.** Companies play a crucial role in innovation development. They are the main agents who transform experience and knowledge into new and effective solutions their clients can apply, benefitting both themselves and the entire economy¹⁷. To companies, innovation is reflected in sales increases or

¹⁴ Sustainable Development Goals. United Nations (<https://www.un.org/sustainabledevelopment/>) 2015.

¹⁵ Cross-cuttingly linked to SDGs about social and environmental development.

¹⁶ The Costs of Meeting the 2030 Sustainable Development Goal Targets on Drinking Water, Sanitation, and Hygiene. Hutton and Varughese. World Bank. 2016.

¹⁷ The Need to Innovate: The Road to Progress in Latin America and the Caribbean". 2nd edition. IDB. 2011.

- 1.6 cost reductions¹⁸. That's why companies implement both technological innovation (of products and/or processes) and non-technological innovations (i.e., new business or management practices and/or business models). From a theoretical perspective, there seems to be overall consensus on the positive relationship between research, development, and innovation (R&D&I) and a company's productivity¹⁹. Companies that invest more in knowledge²⁰, for example, have more innovative results (new products or processes), and more innovative companies tend to be more productive.
- 1.7 **Key agents in the innovation ecosystem.** The same way biological ecosystems tend towards a state of balance, innovation ecosystems²¹ model the economic dynamics of complex relationships between stakeholders to foster the development of technology and innovation²². In an innovation ecosystem²³, governance and regulatory entities play a key role. They define the rules and frameworks for action, while promoting the creation of favorable environments that encourage the development and adoption of innovative solutions, including the provision of complementary public goods, such as scientific knowledge and high-level human capital²⁴. Research and development (R&D) institutions such as academic institutions, technological institutes, testing labs, etc. are also relevant to the ecosystem because they create and offer the technology (equipment, applied knowledge, etc.) for entrepreneurs²⁵ (startups) and/or public or private enterprises, or other entities to transform (apply, replicate, improve and/or scale) their ideas into innovative products and services (R&D&I) that benefit their clients, beneficiaries and society as a whole.
- 1.8 **Emerging innovation in the region.** LAC faces enormous integration and development challenges in innovation. Some positive steps are being taken in terms of science, technology and innovation in the information and communications technology sector of the region²⁶. However, when compared to that of developed countries, these steps "fail to modify the region's overall situation, defined by low technological intensity and severe deficits in terms of human capital, investment in research and development (mostly public), technology infrastructure, coordination between institutions, and institutional efficiency²⁷." Therefore, according to a study conducted by the Network for Science and Technology Indicators (RICYT) and published by the Inter-American Development Bank's Institute for the Integration of Latin America and the Caribbean (IDB-INTAL), only 23% of people in the region believe innovation is substantial to their country's development. The indicators concerning government and corporate investments in research and development, patent production, the private sector's involvement in innovation practices, or the creation of disruptive innovations for the worldwide market reveal major challenges and a long road ahead for innovation and technological advances to strengthen social dynamism, economic growth, and

¹⁸ La persona protagonista de la innovación. Encuentros Empresariales. Cotec Foundation for Technological Innovation. 2007.

¹⁹ Firm Innovation and Productivity in Latin America and the Caribbean. The Engine of economic Development. IDB. Grazi. 2016.

²⁰ Abarcando el acceso a datos, el tratamiento de la información, las herramientas de planificación, el desarrollo de tecnologías y procesos, y herramientas de gestión. Innovation and Research in Water Sector. Strategic guidelines. Ministry of Environment. General Water Authority. Spain. 2015.

²¹ Orchestrating Innovation Ecosystems: A Qualitative Analysis of Ecosystem Positioning Strategies. Valkokari. 2017.

²² What is an innovation ecosystem? Nat. Sci. Found. Alexandria, VA, USA, vol. 1, J. Jackson. 2011.

²³ Managing ecosystems for service innovation: A dynamic capability view. Journal of Business Research. Lütje et al. 2019.

²⁴ Innovation, Science and Technology sector framework. Competitiveness, Technology and Innovation Division. IDB, 2017.

²⁵ How to innovate in development projects: 13 cases of success in Latin America. Gomez. Dept. of Andean Group Countries. IDB. 2019.

²⁶ Along with the growing number of academic researches, endorsement of an entrepreneurial culture, and the support of public policies. Latin American Innovation and Entrepreneurship Agencies. Description and future challenges. Angelelli, Luna & Suaznabar. IDB TN 1285. IDB. 2017.

²⁷ Science, Technology, and Innovation in LAC. A Statistical Compendium of Indicators. Science and Technology Division. IDB. 2010.

- 1.9 productivity throughout the region²⁸. In this context, water and sanitation is no exception. Although there are certain specific cases²⁹, there are still significant challenges to overcome in order to move forward in the development of innovation in LAC (more in the following chapter).
- 1.10 **Growing support to innovation based mainly on supply.** In recent years, there have been more public policy efforts to reduce market flaws in LAC³⁰. This includes a series of joint efforts between stakeholders, and moves to boost supply such as establishing regulations and agencies to promote research (encouraging patents and students' scholarships, etc.), development (i.e., funding equipment and technological centers), entrepreneurship endorsement through technical assistance, training, etc. and their financing mechanisms (i.e., seed capital and investment funds), as well as supporting the private sector (i.e., creating prototypes and scaling them up). Examples worth mentioning include instruments developed by Uruguay's National Agency for Research and Innovation (ANII)³¹, Chile's Economic Development Agency (CORFO)³², Innovate Peru³³ through its Ministry of Production. The demand for innovation has also been recently boosted³⁴ through innovative public procurement, including in the water and sanitation sector³⁵. Empirical studies suggest that the effects of public procurement on innovation are in fact more significant than the effects of supply-side mechanisms³⁶.
- 1.11 **Contents of this report.** In the foreword (Chapter I), the most important concepts and the context of the innovation ecosystem in the W&S sector in LAC are described. Then, the sector's main challenges in the region are laid out (Chapter II) in three spheres, i) governance efforts, ii) research, development, and innovation, and iii) delivery of services. Similarly, and consequently, international experiences linked to innovation in the sector are analyzed (Chapter III). Lastly, a roadmap to the development of innovation in the W&S sector in LAC is offered considering six cardinal points and pathways that lead to mitigating risks and boosting efforts to promote innovation in each of the aforementioned areas (Chapter IV). For the purpose of this report, Water and Sanitation encompasses the economic sector that includes services linked to water for human consumption (collection, treatment, storage, and distribution, including integrated water management as a water resource), sewerage systems (collection, treatment, disposal of wastewater and rainfall, and reuse), and solid waste (collection, handling, final disposal).

²⁸ The New Imperative of Innovation: Policy Perspectives for Latin America and the Caribbean. Navarro. IDB. 2016.

²⁹ Water and Sanitation: Innovations you didn't know were from Latin America and the Caribbean. Mastrangelo. IDB. 2018.

³⁰ The New Imperative of Innovation Policy Perspectives for Latin America and the Caribbean. Navarro, Crespi & Benavente. 2016

³¹ www.anii.org.uy

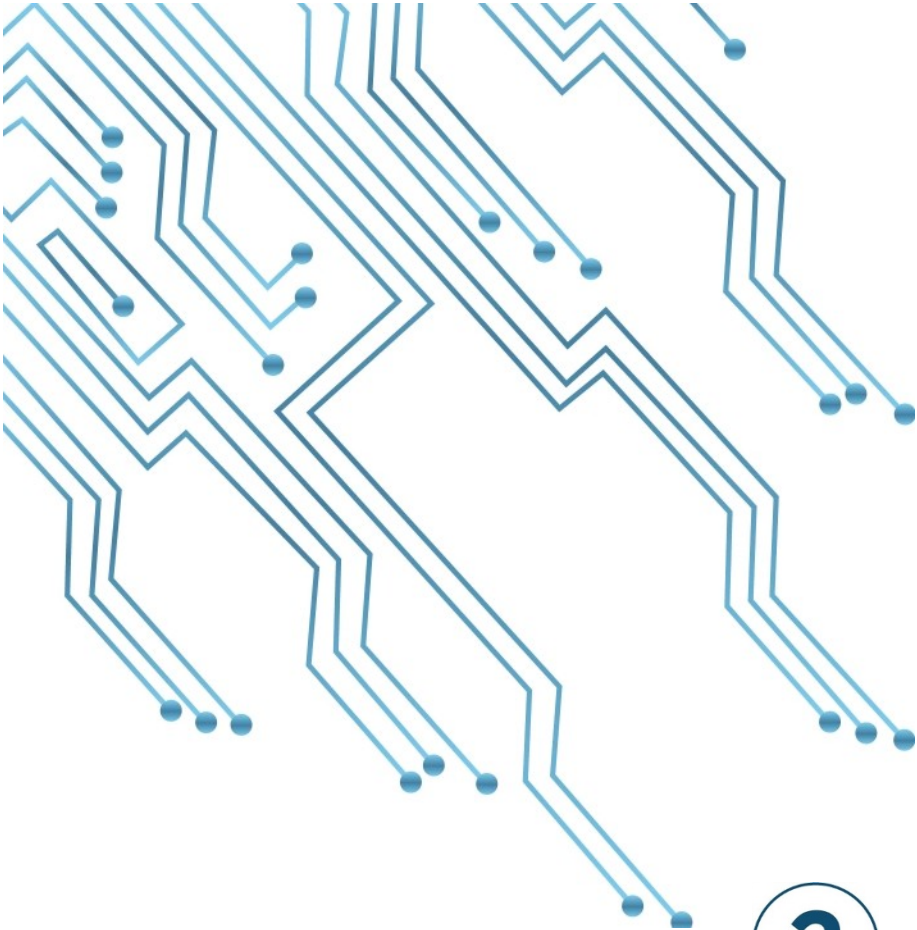
³² www.corfo.cl

³³ www.innovateperu.gob.pe

³⁴ Demand Side Innovation Policy. Innovation Strategy. OECD. 2011.

³⁵ II Foro Iberoamericano de Compras Públicas e Innovación Abierta. The Public Metropolitan Drinking Water and Sanitation Company (EPMAPS) case. <https://forocpi.com/>. Colombia. 2019.

³⁶ Aschhoff and Sofka, 2009; Guerzoni & Raiteri, 2015. Spurring Innovation led Growth in Latin America and the Caribbean through Public Procurement. IDB-DP-488. Moñux, Uyarra. IDB. 2015.



2

Main innovation challenges for the W&S sector in LAC



Main challenges for innovation in the W&S sector in LAC

- 2.1 **Spheres for innovation development in the W&S sector in LAC.** To the effect of their assessment, the main challenges for innovation in W&S in LAC can be divided into three categories³⁷: governance; research, development, and innovation (R&D&I)³⁸; and service provision³⁹. Sectoral governance⁴⁰ of innovation refers to the relationships between the political, social, economic, and administrative systems that significantly affect how innovation is managed in the W&S sector, especially with regards to policy drafting, establishment, and implementation, and legislation, regulations, and institutionalism⁴¹. Meanwhile, R&D&I⁴² is the system that contains all the bodies that take part in each of the stages, from scientific-academic (or basic research), and applied research (or technology research) to innovation in the W&S sector (solutions provided to the end user). Lastly, the service providers or operators are agencies that offer people (clients, users, or end beneficiaries) W&S services, independently of public or private ownership, type of organization (social, community-based, or enterprise), size, urban or rural location, and scope (municipal, city, or national).
- 2.2 **Limited degree of innovation development in LAC.** There are not a significant number of innovation initiatives in the W&S sector in LAC. This could be an indicator that the overall level of innovation is not widely developed in LAC. At the same time, there is a very limited number of reports available on innovation in the region regarding the W&S sector⁴³.

³⁷ Introduction. Origins of the concept, Regional Innovation Systems, Cooke. UCL Press. 1998.

³⁸ As part of a non-linear additive process, several of the ecosystem's entities (such as academia) carry out Research (R) based and/or applied as an input so others (i.e., test tech labs) can generate Development (D). This way, for example, entrepreneurs and/or companies can count on the development of new knowledge to transform it into innovative products and services (I) for their clients.

³⁹ Service provider, also called service operator, refers to a large group of legal subjects depending on the territory in which they operate. They may include public, private, or joint enterprises, councils, institutions, secretariats, local governments, commissions, 'aguateros', and others.

⁴⁰ What is Water Governance? SIWI, UNDP. 2019.

⁴¹ Water Governance Principles. Regional Policy. OECD. 2015.

⁴² Measuring R&D: Challenges Faced by Developing Countries. UNESCO. 2010.

⁴³ This limitation and other findings described in the current document are a result of consultancy works carried out in LAC. On the one hand, Aquarating's components more closely linked to innovation were taken into consideration and surveyed in 40 service providing companies (of which there is complete information and whose compliance and reliability have been verified). On the other hand, a survey revealed information about 77 service operators in the region and 86 international experiences. Cubillo, Aguilar & Peñalver. Internal consulting. IDB. 2019.

A. Innovation Governance in the W&S sector

2.3 Unfavorable Legal and Institutional Context for Innovation.

Although steps have been taken in LAC (Figure 1), most countries do not have or have not completely implemented a legal and institutional framework that favors innovation. Among the general limitations in the region that reduce the chance of innovation emerging in the W&S sector, the following stand out⁴⁴: i) sector policies and goals have not yet been clearly defined, which hinders determining the expected result of the innovation; ii) limited or inexistent regulatory framework and regulated controls, which impedes necessary innovation tracking; iii) the sector is not considered a priority in public policies, as is reflected by the budget assigned to its funding; and iv) the sector's bodies have limited autonomy, while their organizational structure and human resources often do not match their responsibilities, which in turn interferes with the appropriate allocation of resources required for innovation. At the same time, the constant rotation of officials in charge of public policy – as well as sector regulators and public entity authorities – dependent on government cycles obstructs medium- and long-term predictions essential to innovation. The final difficulty is the nearly complete absence of incentives for innovation development through taxes.

2.4 Geographical fragmentation and dispersion within the region's W&S sector.

Decentralization policies and regulations adopted during the 1990's in the W&S sector⁴⁵ led to the atomization of service providers⁴⁶ throughout the region⁴⁷. The extremely diverse geographical contexts (e.g. in Colombia there are around 12,000 community-based organizations in rural areas⁴⁸), the variety of local social and political conditions, the various hierarchies of utility and service providers (from municipal or national, community-based, and/or private to the degree of formality under which they work) get in the way of incentivizing advantageous economies of scale⁴⁹, and deter innovation⁵⁰.

2.5 Regulations that restrain the proliferation of innovation.

Flaws in critical W&S service processes can undermine public health, the environment, and local economies⁵¹. Therefore, stakeholders trust and legitimize entities by granting them social licenses to operate⁵² along with strong regulations. In certain

Legislation promoting sectoral innovation in Peru

1

Law No. 30156 defines the promotion of research and technological development as a role pertaining to the Ministry of Housing, Construction and Sanitation, along with other entities (Art. 10).

Supreme Decree No. 010-14 establishes that the Research and Technological Development Directorate is responsible for contributing to innovation (Art. 76), and lays out a series of roles related to innovation such as setting up regulations, procedures, and guidelines (Art. 80). Supreme Decree No. 017-01 takes innovation into account in rate determination (Art 9).

Source: Peru's Law No. 30156. 2014.

⁴⁴ Extract from "El marco legal e institucional y la organización industrial. El futuro de los servicios de agua y saneamiento de ALC, desafíos de los operadores de áreas urbanas de más de 300.000 habitantes". Discussion paper. IDB-CAF. 2015.

⁴⁵ Water governance in Latin America and the Caribbean: A multi-level approach. Akhouch A. OECD Regional Development Working Papers. 2012.

⁴⁶ Includes urban planning, water and sanitation supply, solid waste, rainfall, water resources, and environment.

⁴⁷ Cubillo, Aguilar & Peñalver. Internal consulting. IDB. 2019.

⁴⁸ Superintendencia de Servicios Públicos Domiciliarios de Colombia. 2019.

⁴⁹ Economías de escala en los servicios de agua potable y alcantarillado; Ferro G., Lentini E. ECLAC. 2010.

⁵⁰ Barriers to Innovation. Increasing Innovation in America's Water Systems. AWS. 2017.

⁵¹ E.g. intoxication by poor water treatment, pollution from sanitation spills, productive losses due to service unavailability.

⁵² Public Consultations with Civil Society: Guidelines for Public and Private Executing Agencies. Milano et al. IDB. 2016.

jurisdictions, service providers who fail to comply with such regulations can face significant monetary and civil or criminal consequences. That is why those in charge of operations and local political leaders are often highly reluctant to engage in the risks of innovation. Meanwhile, due to their unfamiliarity with the matter when modifying regulations, certain premises or crucial legal aspects are added or modified making them technically and financially unfeasible or complicating coordination between organizations to develop innovation.

2.6 **Very recent involvement of the W&S sector in public policy regarding innovation.** Public policy on innovation⁵³ tends to be a relatively new field and its formulation, development, and assessment are still incipient in many LAC countries. In recent years, there has been growing interest in progressively developing policy instruments that spur horizontal or generic innovation (such as supporting the development of innovative prototypes) and some vertical or sectoral innovations (e.g. prototypes in logistics.) In such contexts, there are only few applications of *horizontal* public support calls linked to the W&S sector. As exceptional cases, it is worth mentioning the management of aquifers for the development of innovation in Chile's mining sector⁵⁴ or the *Centro Tecnológico del Agua* (Water Technological Center) in Uruguay⁵⁵.

2.7 **Difficulties in implementing existing regulations in the W&S sector.** The few existing regulations in the area pose challenges to their effective implementation. For example, in the solid waste sector, regulations on innovation development are making headway in some regional countries, but their execution is hitting snags. In Colombia, innovative regulation was introduced in the design, implementation, and operation of sanitary landfills⁵⁶ for alternative and complementary treatments, as well as for power production or biological mechanical treatment of waste.

In Uruguay⁵⁷, a decree sets out guidelines for the *Plan Nacional de Aguas* (National Water Plan) including research, innovation, and capacity building; meanwhile, the integral legislation on solid waste was regulated through a law, which includes a waste recovery program and innovation management. Nevertheless, effective implementation of regulations in the region is often inefficient due to the absence of management plans for execution and the cost-benefit ratio, which does not guarantee the sustainability of such innovations⁵⁸.

2.8 **Risk regarding integrity⁵⁹.** Lack of stakeholder participation in the information process, limited experience in management of new technologies, and/or little transparency⁶⁰ in regulations linked to innovation can restrain the involvement of companies with a more innovative profile in the market and/or obstruct the sustainability of generated innovations. This occurs when companies partake in tenders offering innovative solutions and are disqualified because they fail to comply with certain conditions based on inadequate regulations. Similarly, seniority requirements, high level of assets, and demands of an excessive number of warranties of supply and faithful fulfillment of the contract restrict the inclusion of innovations developed by medium-sized enterprises and/or entrepreneurs. Different forms of corruption also affect the organizational culture of entities' operations because they fuel skepticism and reluctance to stimulate and enable the assimilation of innovations. This discourages their clients, beneficiaries, and the sector overall.

⁵³ Innovation Policies for Latin America and the Caribbean. Nuevos Caminos. Navarro, Olivari et al. IDB. 2016.

⁵⁴ Reduction of energy and water consumption of mining operations by fusion of sorting technologies (ERAMIN 2). CONICYT. 2018.

⁵⁵ <https://ctagua.uy/>

⁵⁶ Government of Colombia. Decree No. 1784 of 2017.

⁵⁷ In Uruguay, Decree No. 205 of 2017 and Law No. 19829 of 2019.

⁵⁸ Circular Economy and Technological Innovation in Solid Waste. Opportunities in Latin America. CAF. 2018.

⁵⁹ Integrity is defined as the combination of efforts directed at improving transparency, involvement, accountability, and corruption control (WIN, 2016). Integrity control and management in the water and sanitation sector through performance assessment systems. IDB-TN-1760. IDB. 2019.

⁶⁰ Integrity control and management in the water and sanitation sector through performance assessment systems. IDB-TN-1760. 2019.

B. Research, development, and innovation (R&D&I) in the W&S sector

2.9 **Insufficient research and development (R&D), focused mostly on universities' research institutes.** Although the contribution of R&D to the sector may be very relevant⁶¹, there are very few service providers involved in the generation of R&D in LAC's W&S sector⁶². Very few enterprises offer development and knowledge transfer services focused on W&S. At the same time, the sector's challenges, problems, and obstacles do not seem to be aligned with the calls for scholarships for students or young researchers in national science, technology, and innovation programs⁶³. Therefore, research efforts solely take place in universities (see Figure 2), and their ability to develop new licensable technologies is all but stagnant.⁶⁴ Meanwhile, the requests for new licenses in LAC (including those sought by foreign stakeholders) has plunged vis-à-vis those sought at the global level⁶⁵. This is partially due to the near inexistence of incentives to develop applied knowledge in the sector. Researchers are acknowledged for generating articles in publications that contribute mainly to basic sciences⁶⁶. Their tasks are tied to the institutions' need to generate income through rotating consultancy projects with attractive revenue, such as environmental impact or water characterization studies⁶⁷.

2.10 **Limited multidisciplinary work.** The limited inclusion and integration of multiple disciplines (e.g. data management, statistics, sociology, industrial design, logistics, etc.) is due, in part, to the lack of common goals and shared language. This slows down technological development for innovation and constitutes a major barrier to efficient service provision in the sector's R&D&I centers⁶⁸.

Mexico's technological transfer

2

According to a report by Pragmatec Technology Transfer Office, of the 117 technology transfer offices (TTO) extant in Mexico, few make assessments that either confirm or deny the pertinence and feasibility of projects and processes. By overlooking background studies and not defining a market-disrupting goal, only a few TTO search for, or are ready to search for potential experts before launching tech development projects. That's why a considerable number of intangible assets remains unused.

Sources: Cienciamx. Scientific policy. Challenges and perspectives of innovation. SánchezTrejo. Mexico. 2016

⁶¹ Research '...can make irreplaceable contributions to ensuring the water supply for our population, to the conservation of our ecosystems and the prosperity of our biodiversity, and to the sustainability of our productive and exportation matrix...'. R&D&I National Strategy for the Sustainability of Water Resources. Chile. 2016.

⁶² Spending on R&D is between 0.1% and 0.2% of operators' revenue. Cubillo, Aguilar & Peñalver. Internal advisory. IDB. 2019.

⁶³ Applied research project evaluation. Scientific and Technological Advisory Forum Report. 2014.

⁶⁴ Tendencias del patentamiento en ALC. Alpízar. (rcei.uh.cu). 2017.

⁶⁵ Caracterización del desarrollo de los indicadores de patentes en ALC. Del Roció. Universidad C. de Ecuador. 2017.

⁶⁶ Publications or papers contribute knowledge to the public domain. "Scientists publish to pursue the right to professional recognition of their contribution to the collective construction of scientific knowledge. This recognition is reflected in the citations that other authors include in their own reports." Guggenheim. 1982.

⁶⁷ Cubillo, Aguilar & Peñalver. Internal consulting. IDB. 2019.

⁶⁸ Modelos de gestión de centros tecnológicos sectoriales: elementos de un análisis comparado, ECLAC. 2017

- 2.11 **Absence of reliable open data regarding service provision.** With a few exceptions, such as in Peru⁶⁹, researchers in LAC have little access to reliable, replicable, and comparable data on the most critical service provision issues, either due to lack of monitoring, transparency, and/or systematization regarding water quality, source availability, physical losses, commercial losses, invoicing and/or revenue, and the state of final solid waste disposal infrastructure. This situation is even more critical in rural areas, due to fewer economic, technological and organizational resources and insufficient media outlets.
- 2.12 **Absence of innovation-supporting service providers in the region.** In some countries such as Costa Rica, Chile, Peru, or Brazil there are only a handful of technical assistance or qualified training service providers. Knowledge-intensive service companies⁷⁰ as well as solutions specifically tailored to the W&S sector are also scarce. Furthermore, field evidence⁷¹ suggests that it's more profitable for global digital transformation suppliers⁷² to invest in the development and commercialization of innovations for public utility enterprises in concentrated markets due to the benefits of scale economies (i.e., in the energy and telecommunications sectors) rather than in fragmented markets such as W&S in LAC.
- 2.13 **Insufficient connection and coordination between sector agencies.** The multiplicity of national, regional, and/or municipal public agencies with different competences and roles⁷³ hampers their ability to cooperate in the design, approval, and execution of strategies and policies, or to promote R&D&I. At the same time, over twenty-five tech centers⁷⁴, university departments, and think tanks have been identified as possible innovation "engines" in the sector⁷⁵. However, current R&D&I support programs have not been able to develop mechanisms to effectively articulate stakeholders in the W&S ecosystem to foster the development and adoption of innovative solutions.
- 2.14 **Poor demand profile for innovation and entrepreneurship in the W&S sector.** One of the factors affecting innovation opportunities overall⁷⁶, specifically business opportunities for entrepreneurs⁷⁷, is related to the size and dynamics of the target market. The company profile and structural business fragmentation in the W&S sector in LAC generate little demand for new or emerging requirements that encourage R&D&I institutions' services, as well as for innovative startups. In addition, activities that foster new initiatives (see Figure 3) in the sector remain very scarce⁷⁸. In the solid waste sector, for example, demand for new technological solutions is still incipient in composting, given to the lack of the necessary conditions such as the convergency among acceptance of source separation, operational and transportation costs, and the quality of the end product⁷⁹.

⁶⁹ Peru, for example, has developed monitoring programs for the rural sector on a national level that provide access to relevant information for decision-making in the sector. DATASS: <https://datass.vivienda.gob.pe/>. The urban sector is developing its national monitoring program (DOTASS).

⁷⁰ As an example, in engineering, tests and/or R&D intensive tech suppliers.

⁷¹ Interviews with digital asset management solution suppliers (IBM/Maximo), geolocation (ESRI), and data analytics (InfoSys) for public service entities. Cubillo, Aguilar & Peñalver. Internal consulting. IDB. 2019.

⁷² Maximizing the benefits of the digital transformation for innovation, growth, and social prosperity is one of the key pillars of the current global agenda. "Digital Economy Outlook 2017." World Bank. 2017.

⁷³ Water Governability in Latin America and the Caribbean: A multilevel point of view. OECD. 2012.

⁷⁴ Regarding waste, none are specific; there are no outstanding developments with the exception of some specific case supported by the National Agency for Investigation and Innovation (UCU - Unilever) in Uruguay. 2017.

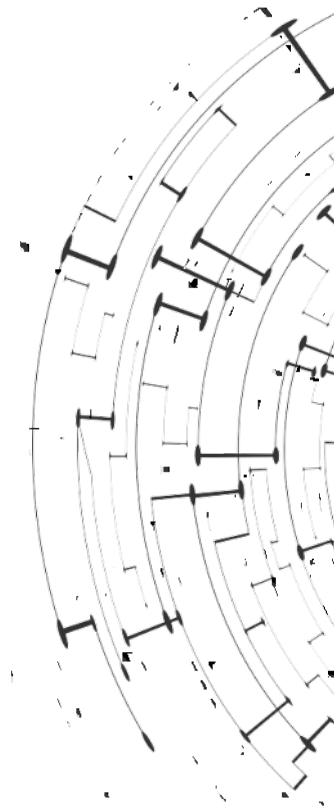
⁷⁵ Colombia, Mexico, Peru, and Brazil are the countries with the most organizations. Cubillo, Aguilar & Peñalver. Internal consulting. IDB. 2019.

⁷⁶ The Global Competitiveness Report. 2019.

⁷⁷ There are other factors as well such as entrepreneurial human capital, culture, social conditions, education system, financing, social capital, and policies and regulations. Index of Dynamic Entrepreneurship, Prodem. 2019.

⁷⁸ Notably, the *Premio de Procesos de Innovación en Servicios de Agua Potable y Saneamiento* (IMTA. Mexico), FAMA Water Challenge (ECOTEC. UNAM. Mexico), and the IDB-FEMSA Awards to innovation on water and sanitation.

⁷⁹ Circular Economy and Technological Innovation in Solid Waste. Opportunities in Latin America. IDB - CAF. 2018.



- 2.15 **Extended innovation implementation times and performance bonds.** Apart from the period which all innovations require between the pilot (trial and error) and its execution and scaling, there are also official publication dates that must be met before the implementation is authorized as well as bidding and formal acquisition periods. This extends innovation timeframes in W&S⁸⁰ to the point where it can inhibit prototype developers from bidding. In addition, there are charges associated with proposal fulfillment guarantees. As a result, the number of requirements demanded by traditional W&S legislation restrain the feasibility of investing in relevant innovations.
- 2.16 **Lack of appropriate funding.** W&S stakeholders in LAC lack access to financing mechanisms adapted to the specific needs and characteristics of each link in the R&D&I process. Examples of this include short repayment terms, lofty guarantees, and almost inexistent grace periods for tech centers seeking to purchase equipment. At the same time, costs associated with the risks of designing and building prototypes, carrying out pilots, and scaling tests can quickly jeopardize a well-established company's budget if they must fund them on their own. Unfortunately, unlike with Fintech and Agtech ventures, there aren't many Venture Capital Funds actively seeking to invest in startups in their initial stages (or their passage through the "valley of death")⁸¹.

Presentación de ideas en

3

In order to promote access to innovative initiatives, the Basic Sanitation agency of the State of Sao Paulo promotes their open innovation through Pitch SABESP Innovative Solutions. To do so, they set up a challenge, submitted solutions are assessed, there is a pitch, and the best solutions are selected and promoted. They are supported by local and regional sanitation agencies and the IDB.

Source:

<http://www.sabesp.com.br/pitchsabesp/>

C. W&S service provision

- 2.17 **The importance of innovation to W&S service providers.** Service providers are in direct contact with end users to satisfy their demand. Service providers' ability to innovate directly impacts the quality, efficiency, and service the society obtains.
- 2.18 **Marginal innovation in few W&S service providers.** The level of innovation among service providers throughout the region is marginal in most cases⁸², dropping even lower in rural areas. The same assessment reveals that operators who claim to have carried out innovation activities or projects between 2018-2019 are largely described as *marginal*.
- 2.19 **Poor culture of innovation.** The culture of innovation⁸³ –as occurs with belief systems, habits, values, attitudes, and traditions that foster innovation– is crucial to the development of W&S service providers⁸⁴. However, the culture of innovation⁸⁵ among service providers in LAC represents slightly more than one-fifth of the international reference threshold value for the sector⁸⁶.

⁸⁰ Long testing and review periods before they can be adopted (Forer and Staub 2013). The Path to Water Innovation – Discussion paper. Stanford Woods Institute of the environment. 2014.

⁸¹ David and Goliath: a false dilemma for innovation in the WASH sector. IDB Blog.

⁸² Over 60% of survey respondents claimed to invest under US\$2,500 per month on innovation. Cubillo, Aguilar & Peñalver. Internal consulting. IDB. 2019.

⁸³ The New Imperative of Innovation Policy Perspectives for Latin America and the Caribbean. Navarro, Crespi & Benavente. 2016.

⁸⁴ Three of the five main innovation inhibitors for W&S suppliers are linked to organizational culture. Fostering Innovation Within Water Utilities Water Research Foundation & Water Environment and Reuse Foundation Project #4642. 2017.

⁸⁵ La importancia de la cultura de la innovación. Factor clave para la competitividad de las empresas. Community of Madrid. 2010

⁸⁶ The result is 18% as compared to the international benchmark. Cubillo, Aguilar & Peñalver. Internal consulting. IDB. 2019.

- 2.20 **Lack of research and development promotion, as well as connection to sector stakeholders.** W&S service providers⁸⁷ lack internal incentive mechanisms to promote research and development activities such as budget allocation and recognition for staff engaging in R&D activities. Furthermore, joint innovation activities with other stakeholders (open innovation⁸⁸) such as suppliers, tech centers, and/or entrepreneurs are exceptional (see Figure 4) although there are some signs of higher predisposition to collaborate in pilot projects⁸⁹. There are few references to innovation solutions implemented cooperatively on a country level that foster these kinds of activities.

Articulation and investment in startups in Colombia

4

In line with their articulation project, Empresas Públicas de Medellín is joining efforts with Ruta N (public entity that promotes knowledge economy) and Créame (incubator and company accelerator). They have also developed the *Fondo Capital Privado Emprendimiento e Innovación SP – FCP Innovación* (2013), which aims at investing capital in startups and working with them to develop innovations that improve their users' quality of life.

Source: <http://www.fcp-innovacion.com/>

- 2.21 **Limited associations between service providers.** As occurs with the sector's fragmentation⁹⁰, the scarce links and relations between suppliers and service operators reduce their potential to transfer knowledge and share lessons learned⁹¹, subduing the chances for technological and innovation development. However, many stakeholders are interested in collaborating with other entities on innovation projects⁹².
- 2.22 **Nearly inexistent innovation management.** Most operators do not consider or manage innovation as a business process; most of them admit they apply very few innovation practices, mostly in planning (i.e., metrics). The incorporation of innovation procedures is, comparatively, slightly over 40% of the international benchmark for the sector⁹³.
- 2.23 **Low technology adoption.** In LAC, W&S service providers use technology 40% less than the sector's international benchmark⁹⁴. According to the most recent survey of W&S providers in LAC, innovation could contribute to improving water and energy efficiency, water quality and financial sustainability⁹⁵. Other studies⁹⁶ show that the three areas where W&S companies have challenges to overcome and where implementing available solutions internationally is a true opportunity are: i) reducing leaks and enhancing network efficiency; ii) boosting energy efficiency; and iii) wastewater treatment and circular economy development. Regarding solid waste management, while LAC usually uses landfills and open dumps for final disposal, some countries such as Chile, Barbados, Colombia, and Mexico have developed waste recovery technologies that segregate specific types of waste such as electrical and electronic appliances.

⁸⁷ Four sectoral patterns of innovation have been identified: science based, supplier specific, production intensive, supplier dominated. Sectoral patterns of technical change: towards a taxonomy and a theory. Pavitt. 1984.

⁸⁸ The era of open innovation, MIT Sloan Management Review. Chesbrough. 2003.

⁸⁹ Cubillo, Aguilar & Peñalver. Internal consulting. IDB. 2019.

⁹⁰ Institutional fragmentation and lack of coordination is an underlying challenge for development. Integrated Urban Water Management. Blue Water – Green Cities. World Bank. Water Partnership Program. 2012.

⁹¹ The Future of Water and Sanitation Services in Latin America. The challenge of urban area operators. IDB-CAF. 2015.

⁹² Cubillo, Aguilar, and Peñalver. Internal consulting. IDB. 2019.

⁹³ Cubillo, Aguilar, and Peñalver. Internal consulting. IDB. 2019.

⁹⁴ Cubillo, Aguilar, and Peñalver. Internal consulting. IDB. 2019.

⁹⁵ Cubillo, Aguilar, and Peñalver. Internal consulting. IDB. 2019.

⁹⁶ Adopción de soluciones tecnológicas innovadoras en el sector del tratamiento de agua en América Latina Revisión de tecnologías disponibles para mejorar la eficiencia en los servicios de agua y saneamiento. ISLE. 2019.

2.24 **Insufficient Resources for innovation.** According to a recent survey⁹⁷, there is a correlation between an operator's capacity to carry out innovation processes and the economic and human resources allocated to them. Having the appropriate equipment, inputs, external services, and employee time devoted to innovation facilitates the development of new initiatives. Nevertheless, W&S operators in LAC lack enough external or internal financial investment sources (i.e., from tariff) to invest in the aforementioned categories and boost innovation development⁹⁸. As a result, only 20% of W&S suppliers invest a fraction of their income on innovation: 1% invests over 5% of their income; 4% invests 4% of their income; 5% invests 2% of their income; and an additional 10% invests less than 1%⁹⁹ of their income on innovation. At the same time, in terms of human resources, it is essential to have at least one person in touch with authorities defending the key success factors for the management and development of corporate innovation. On this issue, only 20% of surveyed service providers claim to have a unit totally or partially dedicated to innovation¹⁰⁰.



⁹⁷ Cubillo, Aguilar, and Peñalver. Internal consulting. IDB. 2019.

⁹⁸ The report by Ajami, Thompson, and Victor (2014) based on data analyzed by Cleantech i3 and the OECD shows that on a global scale, investment in water innovation is significantly lower than in the energy sector. *The Path to Water Innovation*; Stanford Woods Institute for the Environment, Brookings. 2014.

⁹⁹ In nominal terms, 9 of the operators that agreed to disclose the sum they invest annually on innovation projects reported US\$30,000 or less. Four of them claimed to invest US\$100,000 or more per year. Cubillo, Aguilar, and Peñalver. Internal consulting. IDB. 2019.

¹⁰⁰ Seventy-seven service operators answered the survey. Among them, 6 innovation teams were composed by 1 or 2 people, another 6 by 3 to 5 members, and 3 reported to have an innovation division with over 10 collaborators. It is possible that some confused the technology division with an innovation division. Cubillo, Aguilar, and Peñalver. Internal consulting. IDB. 2019.



3

International Evidence

International Evidence

- 3.1 **Innovation is permeating every area of our society.** Innovation's recent international evolution is not solely based on computer processing capacity and speed together with global connectivity, but also on increasingly complex and intertwined changes in various disciplines leading to a revolution in knowledge¹⁰¹, interpersonal relationships, and organizations based on technology, collaborative spaces, and new policy frameworks¹⁰².
- 3.2 **Innovations and international opportunities for improvement in W&S can be shared throughout LAC.** Innovation examples and experiences in W&S from other regions can be shared in LAC, contributing to learning and decision-making processes for possible roadmaps. Additionally, in both geographies there are challenges and opportunities yet to be explored common to all innovation developments.
- 3.3 **Areas for international innovation in W&S.** As previously established, the key factors for innovation in W&S worldwide take place in three spheres: governance; research, development, and innovation (R&D&I); and service provision.

A. Innovation Governance in the W&S sector

- 3.4 **Active policy development to support innovation in W&S.** Different regions are implementing policies to foster innovation¹⁰³, including in W&S. Europe, for example, has established European Innovation Partnerships (EIPs) – high-level workgroups that make policy recommendations to the European Commission and aim at defining R&D&I priorities, concentrating efforts, and avoiding duplicates in strategic sectors. One of these groups is EIP WATER¹⁰⁴, which has established the backbone of their policy around eight priorities. Three of these are “horizontal”: water governance, decision-making and tracking systems, and funding for innovation. The remaining five are more specific: water reuse and recycling, wastewater treatment and resource recovery, water-energy nexus, flood and drought risk management, and natural systems. Using smart technologies is crucial to all these priorities. Other initiatives in Europe with an international projection include the Water Joint Programme Initiative, which has defined a Strategic Research & Innovation Agenda¹⁰⁵ to achieve sustainable water systems.
- 3.5 **Conceptual and institutional frameworks at country- and subregional-levels to foster innovation in W&S.** The capacity for innovation in the W&S sector is strongly linked to the national innovation strategy¹⁰⁶. That is why Spain founded its Spanish Strategy on Science, Technology and Innovation 2020, and the Ministry of Economy and Finance defined strategic innovation goals for water. Each autonomous community establishes priorities in coordination with the Directorate General for Water, which outlines fields, lines of action, and support and

¹⁰¹ Industry 4.0—Manufacturing the Future. Basco, Beliz, Coatz & Garnero. IDB – Intal. 2018.

¹⁰² Políticas 4.0 para la cuarta revolución industrial Benavente & Suaznábar. Blog IDB. 2018.

¹⁰³ Innovation policy aims at creating and reinforcing institutions and capabilities required for innovation. Innovation policy and international relations. European Journal of Futures Research. Leijten. 2019.

¹⁰⁴ European Innovation Partnerships. EIPs. European Union website. 2019.

¹⁰⁵ SRIA Water JPI (www.waterjpi.eu/mapping-agenda/strategic-research-and-innovation-agenda-sria)

¹⁰⁶ National innovative capacity in the water sector: A comparison between China and Europe. Abritta et al. Journal of Cleaner Production. 2019.

coordination instruments for innovation in the W&S sector¹⁰⁷.

- 3.6 **Outlining specific legislation to incentivize innovation.** Some countries have developed specific regulations to help foster innovation technologies to improve processes¹⁰⁸. Such is the case of the law on surface water pollution and wastewater treatment technology outreach from the Netherlands¹⁰⁹. Although policymakers did not take innovation into consideration when designing the Law, they had significant impact on the development and communication of innovation technologies in water treatment. The regulation promoted innovation using market-based instruments following the “polluter pays” principle. The strongest regulatory impact stemmed from effluent charges, partly assigned to finance public water treatment systems, offering enough resources to improve technology and learn from others’ experience. However, these proceeds also managed to change the way industries behave, which led water polluters to invest in innovative biological wastewater technologies in their own industrial facilities. The experience of this Law affected Europe’s current regulations¹¹⁰. Another case is the European Parliament’s draft regulation on minimum requisites for water reuse¹¹¹; its future mandatory implementation is fostering innovation in wastewater treatment.
- 3.7 **Integrating technological and political leadership in the field of W&S to spur innovation.** Singapore, the Netherlands, the United Kingdom, and Israel are world technological leaders in this sector and in policy innovation, given their integrated responses to high-impact local challenges¹¹². Singapore’s National Water Agency program *ABC Water* has catalyzed the integration of the city’s response to water infrastructure challenges through recycling and desalination technologies and the challenges of urban distribution, as well as commercial development, and recreational areas¹¹³. Israel’s NewTech¹¹⁴ program promotes the coordination between government entities to favor innovation in W&S by providing education materials on the sector’s challenges and supporting R&D&I activities.

¹⁰⁷ Innovation and research in the water sector. Strategic Guidelines. Directorate General of Water. Ministry of Agriculture, Food and Environment. Spain. 2015

¹⁰⁸ The need to find the right balance between control and innovation. Emerging Trends in Infrastructure. KPMG. 2019.

¹⁰⁹ Innovation union. European research area. Screening of the regulatory framework. European Commission. 2018.

¹¹⁰ Water Framework Directive (https://ec.europa.eu/environment/water/water-framework/index_en.html). 2000.

¹¹¹ “Proposal for a regulation of the European parliament on minimum requirements for water reuse”

(<https://data.consilium.europa.eu/doc/document/ST-9498-2018-INIT/en/pdf>)

¹¹² Clusters: Overcoming Barriers to Water innovation in the US. Water Environment Federation (WEF). 2018.

¹¹³ From resource to asset: Building a water resilient Singapore. Infrastructure. Insights. McKinsey. 2019.

¹¹⁴ The strategy of water. Grossberg. Knowledge Center for Innovation, Technion. Israel Institute of Technology. 2016.

3.8 **Government initiatives to approach innovation ventures.** Several governments around the world (see figure 5)¹¹⁵ have developed programs – AKA *GovTech* – to promote the approach, dialog, and implementation of joint innovation projects between their work teams and entrepreneurial companies.

3.9 **The public sector is a key leader in developing innovation environments.** Experimenting is essential to changing the way things are conceived or done, and therefore to innovation. However, these trials do not always pay off. That is why it is instrumental to reduce the risks for companies and organizations linked to, for example, waste management, by implementing best practices that are already being used and learning from them. To this end, many countries have implemented publicly-funded programs to foster cooperation between sector organizations. For example, the public sector of the United Kingdom financially supports a best practices program called Waste Minimisation Clubs and Resource Efficiency Clubs. The Netherlands shares a similar approach by facilitating cooperation between a wide range of stakeholders and fostering the generation of communities involved in zero waste and food waste prevention¹¹⁶.

3.10 **Regulatory influence on innovation culture.** The W&S sector is regulated in every country due to its high importance for society. As a result, the W&S industry has historically been conservative towards change compared to other sectors,

making it particularly slow to implement innovations; it normally relies on traditional proven methods to achieve its goals. In a highly regulated context, utility providers direct their efforts primarily towards guaranteeing public health and following legal requirements, and secondarily towards keeping services working despite constant financial restrictions. Innovation comes only after these in order of priorities¹¹⁷. By contrast, since regulators determine a significant part of service provision standards, they have a tremendous opportunity to catalyze regulations, mechanisms, and instruments to foster interaction among stakeholders¹¹⁸ and encourage innovation. For example, the United States Environmental Protection Agency and the European Union determine regulations through benchmark thresholds, leaving it up to the utility provider to find new and improved ways to meet these standards.

Governments get closer to innovative ventures

To gain access to new sources of innovation, many governments are supporting startups. This has led to 'GovTech startups' that exist at national, regional, and local levels. Among them, GovTech Lab (Lithuania), CivTech (Scotland), Public Sector Innovation Fund (Australia), GovTech Catalyst Programme (UK), GovTech (Portugal), Startup in Residence (USA), and GovTech Polska (Poland).

Source: GovTech and the future of government - A new pathway for the digital innovation of Iberoamerica's public institutions- PublicTheLab. CAF.2019

¹¹⁵ GovTech is the term used to describe the ecosystem where governments cooperate with startups and MSMEs that use data science, digital technologies, and innovative methods to offer goods and services that solve public problems. GovTech and the future of government. A new pathway for the digital innovation of Iberoamerica's public institutions. PublicTheLab. CAF. 2019.

¹¹⁶ United Nation Environment Program and International Solid Waste Association. Outlook. Global Waste Management (GWM). 2015.

¹¹⁷ Innovation in the water industry: barriers and opportunities for US and UK utilities. WIREs Water published by Wiley Periodicals, Inc. 2015.

¹¹⁸ Examining the complex relationship between innovation and regulation through a survey of wastewater utility managers. Journal of Environmental Management. Sherman et al. 2019.



- 3.11 **Promoting innovation in waste management by encouraging and regulating a circular economy.** In Europe, circular economy guidelines¹¹⁹ are up-to-date and there is a strategy for processing plastics¹²⁰. This spurs innovation in design, production, use, and recycling (see Figure 6.) By 2030, all plastic packaging must be recyclable. To achieve this ambitious goal, the strategy outlines steps to improve the economy and quality of recycling, to stop plastic waste and garbage, to encourage investment and innovation, and to harness global actions.



In 2015, an action plan was defined to contribute to “closing the entire life cycle”, including everything from production and consumption to waste management and the secondary raw materials market, with a revised legislative proposal for waste, which brought benefits to the environment, economy overall, and innovation in particular.

In line with these guidelines, Switzerland is promoting recycling¹²¹ and France has put together a circular economy roadmap¹²².

- 3.12 **Applying regional regulations to promote innovation in a flexible and integrated manner.** Northern Ireland was one of the first areas to add the EU Floods Directive to the country’s Water Environment Regulations in 2009¹²³. This mandate offers flexibility in terms of implementation if its requirements are met. The country’s legal authority for flood management¹²⁴ produced the Strategic Flood Map – a novel solution relying on online Geographic Information System (GIS). It is the only region in the United Kingdom where this map is available to the general public, even though this is not a requirement. This geospatial technology was awarded the Northern Ireland Area Innovation for Water prize in 2012 for its groundbreaking features. It is also worth mentioning the case of Germany, with its smart policy instruments that promote state-of-the-art decentralized rainwater and effluent management technologies¹²⁵, and Spain, with its set up specific regulations¹²⁶ and supporting documents for local entities to effectively incorporate innovation¹²⁷.

- 3.13 **International opportunities to improve innovation are still available.** Some of the challenges of promoting innovation in W&S in certain developed countries relates to the sector’s fragmentation into jurisdictions, and technical service standards. This critical barrier hinders the development of an economy of scale for W&S innovation quality, quantity, and efficiency worldwide and in LAC. In the United States, those seeking to innovate in the sector struggle to generate disruptions due to the

¹¹⁹ New Circular Economy Action Plan (https://ec.europa.eu/commission/presscorner/detail/es/ip_20_420). European Union. 2020.

¹²⁰ EU Plastics Strategy. (<https://eur-lex.europa.eu/legal-ontent/EN/TXT/?qid=1516265440535&uri=COM:2018:28:FIN>). European Union. 2018.

¹²¹ Switzerland public policies favoring recycling make it a leading country in this regard. Library of Congress of Chile. 2016.

(<https://www.bcn.cl/observatorio/europa/noticias/politicas-publicas-pro-reciclaje-hacen-de-suiza-un-pais-lider-en-la-materia>).

¹²² France unveils circular economy roadmap. Environment, land and resources. 2018.

¹²³ Strategic flood map. Rivers and flooding. Infrastructure United Kingdom. 2019.

¹²⁴ DfI Rivers (<https://www.infrastructure-ni.gov.uk/dfi-rivers-overview>).

¹²⁵ The German water sector - Policies and experiences.

(<https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/2752.pdf>). Germany. 2001.

¹²⁶ Public Sector Contract Law No. 9/2017. 2017.

¹²⁷ Integrity guide in local public procurement. Spanish Federation of Municipalities and Provinces. Network of Local Entities for Transparency and Citizen Participation. 2019.

multiple administrative obstacles that delay and make development and distribution much more expensive as a consequence of the number of people involved¹²⁸. International regulations also face challenges yet to be addressed to adapt to innovation. As technologies quickly emerge and boost new business and service models, governments must swiftly create, modify, and enforce legislation¹²⁹. The main difficulty is upkeeping and/or improving citizens' rights and guaranteeing contexts that promote fair market rules, while encouraging innovation. As policymakers and government regulators tackle these challenges, four fundamental questions about global innovation¹³⁰ remain unanswered and should be taken into consideration as a guideline for regulations in the region: Which is the current legislative state in the area? When is the right time to regulate? What is the most convenient approach to regulations? And what is the right timeframe to update and control regulatory efficiency?

Research, development, and innovation (R&D&I) in the W&S sector

- 3.14 **Internationally, W&S registers less investment in R&D&I than other sectors.** The urgent need to innovate and approach society's multiple, interconnected challenges is becoming more apparent, as demonstrated by the growing interest in assessments, bibliographic references and the resources allocated to this end. However, unlike other sectors, W&S is less innovative¹³¹. In general, there is a significant absence of academic studies and research linked to the dynamics of innovation in W&S. Accordingly, while the patent requests for clean energy have grown dramatically, particularly in the European Union, Japan, and USA, the number of patent requests linked to W&S (mainly to improve purification processes) has remained relatively stable worldwide throughout the past decade¹³². In the 2018 records of the World Intellectual Property Organization (WIPO), W&S sector entities (tech centers, universities, companies, etc.) are not even mentioned¹³³.
- 3.15 **Updating W&S infrastructure through innovation in digital technology.** Digital technology is one of the crucial agents of change that can modernize the sector's infrastructure worldwide. Adopting remote sensors (satellites, drones, fixed equipment), monitoring assets in real time¹³⁴, client loyalty (constant access and close communication), predictive analytics¹³⁵ (forecasting supply and demand), artificial intelligence¹³⁶ (asset management), augmented and virtual reality¹³⁷ (repairment training) and the accompanying use of cybersecurity (access to information and distribution services)¹³⁸ are examples of these technologies. In Spain, the National Plan for Scientific Research, Development and Technological Innovation aims at improving knowledge to tackle scientific and technological obstacles. It promotes the use of advanced information and system development technologies for decision making, communication systems, management networks, and new applications for the electronic management of water¹³⁹. The Technology Center of Catalonia

¹²⁸ The US water sector on the verge of transformation. Clusters: Overcoming Barriers to Water innovation in the US. Water Environment Federation. 2018.

¹²⁹ The future of regulation. Principles for regulating emerging technologies. Deloitte. 2018.

¹³⁰ However, some sectors that have a direct impact on people's quality of life as high as the W&S sector or higher, are advancing in its clarification. E.g. the autonomous vehicle industry (Australia), gastronomy (Boston), and medication (FDA, USA), and others such as drones and global stock market investments.

¹³¹ Exploring the dynamics of water innovation: Foundations for water innovation studies. Wehn (IHF Delf) and Montalvo (TND), 2017.

¹³² The Path to Water Innovation. Stanford Woods Institute of the environment. 2014

¹³³ Patent system. University of Barcelona. Gian-Lluís Ribechini Creus. Spain. 2018.

¹³⁴ What is a Water Utility in a Digital World? Water Finance and Management. Karmous-Edwards, and Sarni. 2018.

¹³⁵ Predictive analytics is a technology that can predict individuals' future behavior based on their experiences to help them make better decisions, Eric Siegel. Predictive analytics: techniques and models employed and their uses - Open Source tools that allow their implementation. Timon & Fontes. 2017.

¹³⁶ Artificial Intelligence. Blog. Open Knowledge. IDB. 2019.

¹³⁷ Augmented reality allows the fusion between virtual data and the physical world, broadening the perception of reality. Virtual Reality is a combination of synthetic computer-generated sensory experiences communicated to an operator or participant. Abasolo Sanso & Venere. "Virtual reality and augmented reality. Advanced interfaces." ISBN 978-950-34-0765-3. 2011.

¹³⁸ How Digital Technology Can Be the Fundamental Agent of Change in the Modernization of Global Water Infrastructure. Water - Finance and Management. 2018.

¹³⁹ Innovation and research in the water sector. Strategic Guidelines. Directorate General of Water. Ministry of Agriculture, Food and Environment. Spain. 2015.

(EURECAT) offers a blockchain¹⁴⁰ platform capable of enabling new water services and strengthening the relationship between consumers and water management entities¹⁴¹. In terms of logistics, tracking, control, and technologies, several alternatives for waste services are currently being tested, improved, and monitored. China, the Scandinavian countries, Germany, the Netherlands, Japan, and South Korea are among the most advanced countries in technological innovation for waste treatment such as reducing the costs of “waste to energy”. Europe, Spain, Portugal, and Greece should also be observed closely, as their situation is closer to that of LAC countries.

- 3.16 **Open innovation is a pillar of research and development.** In Europe, the Strategic Innovation and Research Agenda ¹⁴² is based on open sciences¹⁴³, in other words, in opening up¹⁴⁴ to cooperate with agents outside organizational limits and thus promote collective intelligence. The perspective for 2030 is to extend the value of water and its contribution to society. It has four components: the value of water, new digital and water technologies, a hybrid gray and green infrastructure, and inclusive governance for multiple stakeholders. The strategic agenda aims at combining experimental real-life environments (*Living Labs*) with research and innovation.
- 3.17 **Cooperation as a key element to innovation in W&S.** Europe’s water innovation associations (EIP-Water) created an **online market-place** to foster strong collaboration and necessary effective networks by providing a match-making tool that offers sector stakeholders a chance to share ideas and make useful connections. EIPs aim to develop, extend, and introduce innovation technologies to the market, as well as to set off and promote processes of collaboration for change¹⁴⁵.
- 3.18 **Developing connections between innovation ecosystem stakeholders throughout the W&S sector.** In addition to institutional, regulatory, tariff reforms, Israel has promoted the creation of an **innovation triangle** where entrepreneurs bring new ideas and technologies, the government provides funding, and service operators obtain a real site for testing and execution¹⁴⁶.
- 3.19 **Encouraging quick innovation initiative development in W&S.** Time is of the essence to validate ideas and make them available to the market for initiatives to prosper. In Australia, the United Nations set up a high-level panel on water to create the Water Innovation Engine (WIE), a state-of-the-art association to foster innovation and investment¹⁴⁷ in urban sanitation, water-related data management, and water resources. The WIE brings together governments, financial entities, and enterprises to boost the innovations that contribute the most to SDG6 for disadvantaged populations. The WIE receives proposals from researchers, developers, and entrepreneurs, and expeditiously selects and funds their pilots to solve problems acknowledged by the Steering Committee.
- 3.20 **However, innovation faces challenges such as access to venture capital.** Emerging technologies’ development in W&S is at a disadvantage in the competition for financial investment compared to other sectors, because the traditional business model of venture capital funds tends to prioritize initiatives with high potential to generate return in a relatively short period. The level of exposure for venture capital investors in the United States is significantly lower in W&S than in clean energy because the demand for new products or services in the sector is still emerging and regulations require extended periods before effective implementation¹⁴⁸.

¹⁴⁰ Decentralized information registry stored in the form of transactions, reliably grouped into blocks. Three key elements are needed: members, assets, and rules. Information on the IDB blog: open knowledge, key elements of blockchain; innovation and intellectual property and IDB Lab’s LACChain seeks to consolidate this space (how to innovate in development projects: 13 successful cases in Latin America). Andean Group. IDB. 2019.

¹⁴¹ Smart water tech, futuro ya está aquí. Laura Zarza. Iagua. 2018.

¹⁴² Strategic Innovation and Research Agenda. Water Smart Society. European Union. 2016.

¹⁴³ Research and innovation. Strategy. Goals research and innovation policy. Open innovation resources. European Union.

¹⁴⁴ International cooperation policies, initiatives and international research agreements. European Union. 2018.

¹⁴⁵ Eip-water. Working groups. Action groups. European Union. 2018.

¹⁴⁶ Water Management in Israel. Key Innovations and Lessons Learned for Water-Scarce Countries. BM. 2017.

¹⁴⁷ Innovation Xchange. Water innovation engine. Government of Australia. 2019.

¹⁴⁸ The Path to Water Innovation. Discussion paper. Stanford Woods Institute of the environment. 2014.

C. Provision of W&S services

- 3.21 **Innovation progress in W&S service provision.** Innovation development, whether based on new technology solutions, processes, services and/or business models, has proven to improve the efficiency and sustainability of service provision in W&S. Key factors to achieve desired results include considering cultural aspects, guaranteeing material and human resources, and promoting stakeholder collaboration.
- 3.22 **Adopting global technology solutions as an opportunity for development.** The international adoption of new technologies¹⁴⁹ can benefit LAC's W&S sector in managing issues such as water leakages, water treatment, and energy improvement¹⁵⁰.
- 3.23 **Using state-of-the-art technologies to reduce water leakages.** Distribution and supply services use smart flowmeters, pressure control systems, gas tracers, thermography, temporary monitoring, and ground-penetrating radars or aerial inspections. In Bordeaux, France, innovative pressure regulators helped reduce water leaks by one-third in three years¹⁵¹.
- 3.24 **Developing technologies to boost water treatment efficiency. Several technologies have been developed for water treatment such as** innovative aeration systems for sand removal in wastewater pre-treatment, electrocoagulation for primary treatment, and aerobic membrane systems for secondary treatment. Water reuse processes¹⁵² include disinfection and nutrient removal filtration systems, which have the potential to recover nutrients and the main compounds present in wastewater to transform them into value added products such as struvite¹⁵³, bioplastics or cellulose.
- 3.25 **Improving energy efficiency through optimization.** Technology for energy efficiency in the W&S sector is based on optimizing the distribution network and monitoring energy-consuming equipment. In wastewater management, energy optimization and smart control systems that rely on *big data*¹⁵⁴ deliver effective predictions by processing large, complex volumes of diverse data quickly with a high level of reliability and representativity. Thermal hydrolysis during pre- or post-treatment in anaerobic sludge digesters and organic waste biodigesters facilitate the energetically efficient generation of biogas, reduce the amount of waste bound to final disposal, and produce compost out of the remaining digestate.
- 3.26 **Incorporating smart management in the W&S sector.** The UK, Japan, Spain, Italy, and South Korea are among the countries in which the W&S sector has implemented the *internet of things* (IoT),¹⁵⁵ while other less-developed regions are quickly progressing in that direction¹⁵⁶. Solid waste collection and management systems based on IoT¹⁵⁷ in the UK and Japan are capable of recognizing the person who recycles and the type of waste, and of notifying when containers are full. In Spain, Italy, and South Korea, there are smart containers with lids that recognize users through a scanner (Radio Frequency

¹⁴⁹ The W&S sector has the chance to lead water risk mitigation in the 21st century by adopting digital water technology. Harnessing the fourth industrial revolution of water. Sarni. 2015.

¹⁵⁰ Adoption of innovative technological solutions in Latin America's water treatment sector. A review of available technologies to improve water and sanitation services efficiency. ISLE. 2019.

¹⁵¹ Public Water and Wastewater Services in France. Bureau d'informations et de prévisions économiques. 2015.

¹⁵² Beaune (France) saw savings equivalent to three months of water use. Public Water and Wastewater Services in France. Bureau d'informations et de prévisions économiques. 2015.

¹⁵³ European project ManureEcoMine (FP7, Grant Agreement No. 603744). Master's thesis on the eco-innovative recovery of struvite as a fertilizer. Tarrago. LEQUIA. 2016.

¹⁵⁴ I.e., managing data of high volume, velocity, and variety as well as variability and complexity with veracity and representativeness. Using Big Data and its Analytical Techniques for Public Policy Design and Implementation in Latin America and the Caribbean. Rodriguez, Palomino & Mondaca. IDB-DP-514. 2017.

¹⁵⁵ Internet de las cosas, una llave para mejores servicios de agua. Blog. WSA. IDB. 2019.

¹⁵⁶ Internet of Things innovation in rural water supply in sub-Saharan Africa: a critical assessment of emerging ICT. Momon et al. Waterlines. 2019.

¹⁵⁷ Internet de las cosas, agua y saneamiento inteligentes. Blog. WSA. IDB. 2019.

Identification¹⁵⁸) to minimize uneducated practices. South Korea has smart solar containers with automatic waste compaction that reduce handling costs up to 80%¹⁵⁹. In Finland, waste recovery facilities have incorporated robotics for a more efficient waste separation¹⁶⁰.

3.27 **The relevance of recent associations between service providers and an innovation culture for the W&S sector.** Over 80 W&S service operators from countries such as Canada, the Netherlands, Singapore, and Australia have come together in a joint initiative to strengthen their members' innovation capabilities¹⁶¹. In this context, over 70% of the organizations have implemented innovation programs launched over the past 10 years because more than 90% of them believe innovation is essential for the future of their organizations. Three of the main five detected internal inhibitors are directly linked to culture¹⁶² and for them to prosper, communication is paramount. For example, in the USA, the Metro Wastewater Reclamation District includes innovation as part of their organizational values by adopting a "commitment to develop a culture of innovation at all levels¹⁶³."

3.28 **Promoting innovation through delegation of services contracts.** Encouraged by the national and EU legislation, and given the local context and characteristics, the French model of delegation of services can lead to innovation¹⁶⁴. A strong reputation among their clients for the services they render incentivizes service providers to invest in innovation. In this way, the service operator tries to and can extend the duration of its contract.

3.29 **Innovation as an integrated component of strategic and executive management of W&S service providers.** In the face of the challenges W&S worldwide service providers must respond to regarding innovation in the sector, Sydney Water (see Figure 7) stands out for focusing on innovation management. On the one hand, they maintain a strategic approach to medium- and long-term corporate innovation, and on the other hand, there is a systematic plan at the executive level that is constantly connecting ecosystem stakeholders. Another example is Mekorot WaTech¹⁶⁵, an open innovation management platform by the Israeli national provider that keeps an active dialog with the ecosystem of technology companies, entrepreneurs, and researchers, and takes practical steps to bring innovation from research, to development, pilots, and scale implementation. In terms of innovation management standards, Spain relies on UNE standard 166002¹⁶⁶ and the recently issued ISO 56002 at an international level¹⁶⁷. As for innovation execution, the most frequent initiatives target emerging pollutants, asset maintenance management, leak detection (unaccounted for water), and real-time quality of water as well as operational efficiency¹⁶⁸

¹⁵⁸ Allows remote meter readings so that operators can obtain information from afar; at the same time, clients can check their consumption online and get alerts if any issues occur.

¹⁵⁹ Circular Economy and Technological Innovation in Solid Waste. Opportunities in Latin America. Development Bank of Latin America. CAF. 2018.

¹⁶⁰ Remeo Company in Helsinki, Finland. How Industry 4.0 transforms the waste sector. ISWA. 2019.

¹⁶¹ Fostering Innovation Within Water Utilities Water Research Foundation & Water Environment and reuse Foundation Project #4642. 2017.

¹⁶² Innovation in the Water Industry: Barriers and Opportunities for the US and UK Utilities. Wires Water. Speight. 2015.

¹⁶³ Fostering Innovation Within Water Utilities Water Research Foundation & Water Environment and reuse Foundation Project #4642. 2017.

¹⁶⁴ Innovation union. European research area. Screening of the regulatory framework. European Commission. 2018.

¹⁶⁵ Clean-Tech Clustering as an Engine for Local Development. Potter. OECD. 2012.

¹⁶⁶ R&D&I Management System (<https://www.aenor.com/certificacion/idi/gestion-idi>). Spain. 2019.

¹⁶⁷ Innovation Management System (<https://www.iso.org/standard/68221.html>). International standard. 2019.

¹⁶⁸ Experiences documented outside of LAC, mainly service operator companies, as well as authorities, regulators, and institutions that promote innovation. Cubillo, Aguilar & Peñalver. Internal advisory. IDB. 2019.

The importance of innovation to service provider Sydney Water,

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Based on multiple data processing and deep analysis of their own surroundings and context, Sydney Water takes on challenges that contribute to reducing innovation inhibitors and boosting innovation enablers so that, alongside research and development experts, they can define their own innovation goals, monitor them, and achieve desired results.

This requires persistent collaboration to share knowledge within and outside of the organization (e.g. with the government), evaluate and adopt technology (e.g. prototyping), and developing capacity (e.g. connection to universities).

Source: Sydney Water's Research & Innovation Strategy. Towards 2020 and beyond. 2018.

3.30 **Sinergy with R&D&I providers and other ecosystem stakeholders.** Considering W&S service operators' specific R&D&I needs and requirements, the articulation with suppliers of goods and services capable of supporting their innovation generation efforts is essential. In France¹⁶⁹, water utilities are members of *Competitiveness Clusters* (Dream: Eau & Milieux, Aqua-Valley & Hidreos¹⁷⁰), that seize innovation capabilities and generate growth. These operators take part in collaborative R&D initiatives and partner with entrepreneurs, SMEs, research centers, and training centers within the business ecosystem to generate joint projects on smart water management, sustainable infrastructure, and recycling. Water Europe¹⁷¹ is another example of workgroup integration that offers technical and scientific contributions on several topics that express the challenges, needs, and opportunities of each field regarding water in the entire continent. Water Knowledge Europe – a specialized event to develop new connections and access R&D&I funding programs – is held every year.

3.31 **Leadership and incentives in the face of innovation inhibitors.** Given that public health and safety are the priorities of every W&S service provider and that their tariff scheme is hard to modify in a rigid regulatory context¹⁷², executive teams often feel inhibited to act¹⁷³ due to the risks involved in innovation. At the same time, for both the service provider and users to benefit from innovation, there must be an adequate investment in material resources, spatial resources, and dedicated personnel. Fostering this paradigm change requires a holistic approach including, regulations, administrative processes, and cultural processes, all based fundamentally on incentives and shared leadership. In 2013, in France alone, 120 million euros were invested on research and development in the W&S sector. This financial effort was possible due to their leaders' conviction in the returns it will generate, which accounts for its social and economic feasibility. On a regional level, programs such as Horizon 2020¹⁷⁴ can rely on the EU for economic resources for innovation through a series of instruments regarding the articulation of academia, government, and service providers.

3.32 **Nevertheless, there are also opportunities for improvement in W&S innovation for service providers around the globe.** Given the relentless and quick expansion of innovation, just as in LAC, many service providers worldwide still need to appropriately integrate innovation management among their strategic and/or tactical priorities.

¹⁶⁹ Public Water and Wastewater Services in France Bureau d'informations et de prévisions économiques. 2015.

¹⁷⁰ www.poledream.org/ecosysteme/

¹⁷¹ Water Europe (www.watereurope.eu)

¹⁷² Increasing Innovation in America's Water Systems. Bipartisan policy center. 2017.

¹⁷³ Fostering Innovation Within Water Utilities. Water Research Foundation & Water Environment and reuse Foundation Project #4642. (Global Survey: 60 utilities). 2017.

¹⁷⁴ Horizon 2020 is the EU's research and innovation program. It has a budget of nearly €80 billion available during 7 years (2014 to 2020), in addition to the private investment it attracts.



4

A Roadmap to Develop W&S
Innovation in LAC

A Roadmap to Develop W&S Innovation in LAC

- 4.1 **Roadmap development.** Based on the W&S sector's innovation challenges in LAC (Chapter II) and taking into consideration the evidence gained from international experiences (Chapter III), the following ideas aim at contributing to the development of innovation in this sector. First, there is a description of the roadmap's *destination* together with its approaches, and secondly some general cardinal points¹⁷⁵ and the *pathways* to follow to achieve the proposed goals.

A. Roadmap destination and approach

- 4.2 **Destination.** In order to contribute to improving the quality of life for the population of LAC, the purpose of innovation in the sector is to facilitate the development and application of solutions towards the universal access to quality W&S services that are efficient and sustainable over time.
- 4.3 **Approaches.** For the expected benefits to effectively reach society as a whole, the approach to innovation in the W&S sector must be integrated, systemic, flexible, and articulated:

a. **Integrated.** Approaching W&S services through a varied range of innovation incentives and facilitators, seeking to leverage their impact; taking into consideration gender, inclusion, safety, and evolution of workforce talent in the face of the automation brought by the fourth industrial revolution, geographical priorities (considering the specific situation in terms of institutions, funding, and capabilities in rural areas), climate change, environmental sustainability, energy, etc.

b. **Systemic.** Approaching the sectoral innovation ecosystem focusing on entities that comprise the sector's governance, R&D&I-related institutions, and service providers, contributing to their shared efforts and synergies.

¹⁷⁵ To the effects of this document, *cardinal points* are used in the sense of guidelines to help get oriented on a map.

C.

Flexible. Innovation dynamics¹⁷⁶ require developing the ability to adapt to every circumstance and the plasticity to deal with constant changes that are bound to occur during the innovation's effective implementation.

d.

Articulated. Local, regional, and international stakeholders need to work together. Entrepreneurs, incubators, accelerators, investment networks and others must work together along with multilateral institutions such as the Inter-American Development Bank¹⁷⁷, the World Bank, the United Nations¹⁷⁸, the Development Bank of Latin America, other international cooperation agencies, NGOs, etc.

B. Cardinal points and pathways for action

I. Sphere of innovation governance in the W&S sector

- 4.4 **Governance beyond legislation.** The approach to governance in the W&S sector includes not only what to do but also who and why they should do it, at which government level, how, and when. Coherent policy solutions are only feasible if stakeholders coordinate, regulatory frameworks are well designed, the appropriate information is available, and there is enough action and integration capacity.¹⁷⁶⁷⁹

Cardinal Point I. 1. Promote public policies and regulations that encourage innovation in the W&S sector

- 4.5 **Policy and regulatory frameworks that promote innovation.** It is essential to send clear-cut signals to the W&S sector in LAC regarding the importance of innovation by generating policy and regulatory frameworks that embrace its development.
- 4.6 **Pathways to promote public policies.** The following pathways promote the appropriate public policies for the development and implementation of innovation:

I.1.1. **Facilitate the articulation between national and regional policymakers through meetings and joint initiatives with medium- and long-term perspectives.**

Encourage policymakers to travel within and outside the region, to engage in exchanges, debates, and regional agreements linked to W&S innovation both regional and extra-regionally, taking into consideration the differentiating characteristics between urban and rural areas.

¹⁷⁶ How to innovate in development projects. IDB. 2019.

¹⁷⁷ Through its Water and Sanitation sector, and in coordination with IDB Lab, IDB Invest, CTI, and other IDB divisions. The IDB is fostering the adoption of innovation solutions in the W&S sector in LAC, taking into consideration the strategic routes laid out in this document.

¹⁷⁸ UNDP and UNIDO.

¹⁷⁹ Water Governance Principles. Adopted by the Regional Development Policy Committee. OECD. 2015.

I.1.2. Promote policies that spur innovation in the sector.

Endorse policy designs¹⁸⁰ that lead to favorable environments that mitigate risks for innovation based on local regulations (constitutional, civil, criminal, administrative, etc.) at the national legislative level (i.e. Congress), subnational levels (departmental authorities, provincial representatives, etc.), and lower levels (mayors, governors, etc.). Policy is an essential tool to create or adjust the tactical and/or operational regulatory approach to new innovation challenges¹⁸¹. This requires: i) shifting from a regulation-based approach to a much more iterative and responsive perspective¹⁸², ii) focusing on the results that regulations pursue rather than on how those results are achieved¹⁸³, iii) migrating from one-size-fits-all legislation to a more segmented approach based on the unique circumstances¹⁸⁴ of each innovation, and iv) aligning regulations by engaging of a broader range of stakeholders¹⁸⁵.

I.1.3. Foster innovation policy impact studies in the W&S sector.

Collaborate with qualitative and quantitative data collection and analysis in regard to its direct and indirect potential to contribute to the innovation ecosystem in the W&S sector in LAC and globally to rely on robust information for legislative decision-making.

4.7 **Pathways to promote regulations.** The following pathways promote the best regulations for the development and implementation of innovation in the W&S sector in LAC¹⁸⁶:

I.1.4. Contribute to developing regulations and tools that help deal with the risks of innovation.

Facilitate access to international best practices and the assessments of each country's regulatory context. Eliminate obsolete regulations and/or redefine those that hamper the goals of innovation such as using technology for water resource recovery and access to user information¹⁸⁷. Develop regulatory instruments that foster the creation, funding, and sustainability of technology centers and other goods and services that support innovation. Promote tax incentives to reduce the costs of financial mechanisms, demand less guaranties, and extend repayment terms.

I.1.5. Bolster the development of specific regulatory environments to develop and leverage innovation in the W&S sector.

Collaborate in the creation of regulatory frameworks¹⁸⁸ such as sandboxes¹⁸⁹ or technology testbeds¹⁹⁰, focused on the W&S sector's specific needs. These tools offer favorable environments in which to carry out tests and/or prototypes quickly and flexibly¹⁹¹, which in turn contribute to reduce the timeframe for market access, enable more effective market and product testing, advance launching the new technology, improve client security, and reduce transaction costs by data-sharing¹⁹².

¹⁸⁰ Rethinking Productive Development: Sound Policies and Institutions for Economic Transformation. Crespi, Fernandez-Arias & Stein. IDB. 2014.

¹⁸¹ The future of regulation. Principles for regulating emerging technologies. Deloitte. 2018.

¹⁸² AKA "adaptive regulation." The future of regulation. Principles for regulating emerging technologies. Deloitte. 2018.

¹⁸³ AKA "outcome-based regulation." The future of regulation. Principles for regulating emerging technologies. Deloitte. 2018.

¹⁸⁴ AKA "risk-weighted regulation." The future of regulation. Principles for regulating emerging technologies. Deloitte. 2018.

¹⁸⁵ AKA "collaborative regulation." The future of regulation. Principles for regulating emerging technologies. Deloitte. 2018.

¹⁸⁶ The water Utility Adoption Model (wUAM): Understanding influences of organisational and procedural innovation in a UK water utility. Tanner et al. 2016.

¹⁸⁷ The Regulation of Public Utilities of the Future in ALC. Arias et al. IDB-TN-1678. 2019

¹⁸⁸ Exploring the pathways: Regulatory experiments for Sustainable Development - An interdisciplinary approach. Dierk. Universität Göttingen. 2019.

¹⁸⁹ Regulatory sandboxes in Latin America and the Caribbean for the FinTech ecosystem. Herrera & Vellido. Connectivity, Markets, and Finance Division. IDB. 2018.

¹⁹⁰ Blade Runner y la regulación de tecnologías emergentes. Los puntos sobre las i. Ciencia, tecnología e Innovación. IDB. 2019.

¹⁹¹ The future of regulation. Principles for regulating emerging technologies. Deloitte. 2018.

¹⁹² Fostering Innovation Within Water Utilities Water Research Foundation & Water Environment and reuse Foundation Project #4642. 2017.

I.1.6. Facilitate regulations that incentivize the creation and development of a supply for innovation.

Promote the development of tax incentives that favor startup emergence¹⁹³ as well as activities to support them, incubators, co-work spaces, and accelerators. Promote actions that help reduce innovation time to market¹⁹⁴ by boosting the development of small and medium enterprises (SMEs) and favorable financial instruments.

I.1.7. Promote regulations that incentivize the demand for innovation.

The public sector has the potential to foster the development of a market relevant enough to compensate for the technological and market-related uncertainty linked to R&D as well as to make up for the lack of interaction and/or asymmetries between users¹⁹⁵ and innovation producers¹⁹⁶. Thus, public procurement of innovation¹⁹⁷ in the W&S sector can also benefit the local industry¹⁹⁸, with environmental and sustainable criteria¹⁹⁹ to foster innovation²⁰⁰.

Cardinal Point I.2. Promote integrity mechanisms

4.8 **Legitimacy to make the importance of innovation sustainable.** Although the existence of fertile policy and regulatory frameworks is essential to bridge gaps and mitigate risks, the governance of innovation in the W&S sector in LAC also requires integrity mechanisms in its management²⁰¹ to legitimize innovation and make it relevant over time.

4.9 **Pathways to promote integrity mechanisms.** The following pathways promote integrity mechanisms in the regulation of innovation:

I.2.1. Foster the engagement of all W&S stakeholders.

Integrate all W&S stakeholders in the ecosystem, whether they are linked to design, implementation, or they are beneficiaries²⁰². To gain credibility and desired behaviors²⁰³ and contribute to the sustainability of the managed solutions over time, there must be bottom-up involvement and engagement – with special consideration for those who are more vulnerable to marginality and lack of opportunities in the wide range of spheres where innovation is produced²⁰⁴.

¹⁹³ The GovTech Latin America Needs. Project Syndicate. Santiso. 2019.

¹⁹⁴ Length of time between a conception and its availability in the market.

¹⁹⁵ Using public procurement to achieve social outcomes. Natural Resources Forum. McCrudden. 2004.

¹⁹⁶ Public procurement as a driver of innovation and entrepreneurship. Bentancour et al. ORT. 2019.

¹⁹⁷ Spurring Innovation-led Growth in Latin America and the Caribbean through Public Procurement. IDB-DP-488. Moñux, Uyarra (Aschhoff & Sofka, 2009; Guerzoni & Raiteri, 2015). 2016.

¹⁹⁸ Public procurement and innovation. Resurrecting the demand side. Manchester Institute of Innovation Research, Georghiou, 2007.

¹⁹⁹ The Case for Green Infrastructure in LAC Conclusions from Stockholm World Water Week 2018.

²⁰⁰ <https://blogs.iadb.org/innovacion/es/la-orden-de-compra-que-puede-cambiar-la-vida-de-una-startup/>. IDB.

²⁰¹ Control y gestión de la integridad en el sector de agua y saneamiento a través de los sistemas de evaluación del desempeño. IDB-TN-1760. 2019.

²⁰² All affected stakeholders must understand their role and act accordingly. Innovation in Solid Waste Management through Clean Development Mechanism in Developing Countries. International. Conference on Solid Waste Management, 5IconSWM. Potdar, A., Singh, A., et al. 2015.

²⁰³ Applying insights from behavioral economics to policy design. National bureau of economic research. Madrian. 2014.

²⁰⁴ For example, innovation generated in a watershed or rural area, peri-urban area.

I.2.2. Promote management integrity.

Encourage the incorporation of transparency and accountability²⁰⁵ in innovation calls, tenders, and/or procurement²⁰⁶. Evaluate and recommend policies that encourage the integration of emerging technologies for safe²⁰⁷ data treatment²⁰⁸.

II. Sphere of R&D&I

- 4.10 **R&D&I adjusted to LAC reality.** Develop knowledge²⁰⁹ in LAC to have effective and appropriate solutions in the medium term²¹⁰ adapted to the W&S sector's characteristics.

Cardinal Point II. 1. Promote research and development based on relevant sectoral challenges

- 4.11 **Efforts in R&D&I that have an impact on the region.** The guidelines that shape R&D&I efforts must focus on the difficulties or challenges in the W&S sector that have the highest impact on the quality of life of people in LAC.
- 4.12 **Pathways to promote research.** The following pathways promote research:

II.1.1. Foster academic projects and/or research with a multidimensional perspective.

Keeping in mind the SDGs²¹¹, facilitate the execution of research projects that integrate different dimensions of innovation, such as environment or logistics, based on challenges relevant to the W&S sector that affect LAC socially and territorially in the medium term. Promote systematic tracking mechanisms to evaluate cases and panel studies linked to key aspects and experiences in generated innovation.

II.1.2. Support scholarships linked to W&S.

Support scholarship programs for university students, recent graduates, doctorates, and post-doctorates to strengthen the human talent in specialized research in W&S throughout the region.

II.1.3. Promote visits to success cases.

Encourage researchers to visit colleagues regionally and internationally to exchange best practices and lessons learned on research connected to W&S. Promote reverse missions, encouraging international experts to visit the region.

²⁰⁵ La transparencia en agua y saneamiento llegó para quedarse. Blog. WSA. IDB. 2019.

²⁰⁶ Compra pública de innovación en América Latina. Recomendaciones para su despliegue en Uruguay. IDB-DP-542.

²⁰⁷ Cybersecurity: Are We Ready in Latin America and the Caribbean? Observatory. OAS. IDB. 2016.

²⁰⁸ La gestión ética de datos. ¿Por qué importa y cómo hacer uso justo de los datos en el mundo digital? Buenadicha et al. IDB. 2019.

²⁰⁹ Conocimiento endógeno (combinación de recursos para innovar). ¿Qué podemos aprender del Premio Nobel de Economía 2018 sobre el valor del conocimiento abierto? Open Knowledge blog. IDB. 2018.

²¹⁰ The Future of Water - A collection of essays on "disruptive" technologies that may transform the water sector in the next 10 years.

Daigger, Voutchkov et al. Discussion Paper IDB-DP-657. IDB. 2019.

²¹¹ Sustainable development. Water and Sanitation. United Nations. 2018.

II.1.4. Endorse research on emerging technologies that can have a potential impact on the W&S sector.

General use technologies are usually cross-sectional and their actual impact depends on the specific application developed (based on their general use) for each sector. Reducing underinvestment in these technologies in the W&S sector²¹² requires promoting coordination, research, and sectoral application efforts of the internet of things and sensors or smart tools, big data, cloud technology, artificial intelligence, blockchain²¹³, augmented and virtual reality, advanced robotics, automation, 4D printing, energy storage, renewable energy²¹⁴, advanced materials (nanotechnology), autonomous vehicles²¹⁵, and the use of open data. For waste management, support the implementation of technologies related to thermal treatment, co-processing²¹⁶, bio-digestion (small scale, anaerobic, methanation)²¹⁷, and dynamic routing. Promote services to support the management of intellectual property.

4.13 **Pathways to promote technology development.** The following pathways promote the development of technology based on specific issues:

II.1.5. Validate pilots and prototypes.

Foster activities that validate concepts, methods, and/or technologies connected to the W&S sector through the development and execution of pilots and/or prototypes, such as data management that integrates information and generates knowledge about service supply and demand (leak sensors based on the internet of things) and purification technologies that filter, disinfect, and produce different qualities of waters according to their use. There are also technologies that produce resources from alternative or non-traditional sources (desalinization and rainwater) and (over- or under-the-surface)²¹⁸ storage technologies.

II.1.6. Set up contests for technologists in relevant topics to apply their knowledge in the W&S sector.

Launch application calls or contests for technologists and/or experts who can bring their experience to develop solutions to specific challenges the W&S sector faces in LAC²¹⁹.

II.1.7. Promote startups with innovation value proposals for the W&S sector.

Support activities throughout startups' entire development process. Carry out activities to promote the emergence of startups through short presentation events for innovation initiatives (i.e., "elevator pitch"²²⁰ night") or for their collaborative development over a few days (i.e., "hackathons"²²¹) together with potential solution seekers, such as service providers and investors. Encourage and facilitate the articulation with universities or other institutions that

²¹² Emprendimientos de base científico-tecnológicas en América Latina. Importancia, desafíos y recomendaciones de futuro. Kantis & Angelelli. IDB. 2020.

²¹³ Blockchain technology and complex flow systems as opportunities for water governance innovation. Universidade Estadual do Campinas (Unicamp). Sobrinho et al. Brazil. 2019.

²¹⁴ Solar energy farming as a development innovation for vulnerable water basins. Al-Saidi. Routledge. 2019.

²¹⁵ Sydney Water's Research & Innovation Strategy. Towards 2020 and beyond. 2018.

²¹⁶ Technical guidelines on the environmentally sound co-processing of hazardous wastes in cement kilns. Basil Convention (UNEP 2011). Projeto Modelo de produção de Combustível Derivado de Resíduos Urbanos mediante Tratamento Biológico Mecânico, para o Estado de São Paulo (ATN/JF-16079-BR). Technical note prepared by IDOM. IDB. 2019.

²¹⁷ Oportunidades para el desarrollo de un sector sostenible de biodigestores de pequeña y mediana escala en ALC. Red de Biodigestores para Latinoamérica y el Caribe RedBioLAC (2017). GEF program for the implementation of Prioritized Projects in Three Mexican Cities within the framework of the PCES (3133/OC-ME). IDB. 2017.

²¹⁸ The Path to Water Innovation. Stanford Woods Institute of the environment. 2014.

²¹⁹ An example is "Ideas para el cambio" in Colombia. <https://minciencias.gov.co/cultura-en-cte/ideas-para-el-cambio>. Colciencias.

²²⁰ The Perfect Elevator Pitch. Mrgriffin Bloomberg Business Week. 2007.

²²¹ A hackathon is an event where, originally, programmers work together intensely for a weekend or short period on a specific project. Hackathons foster experimenting and creativity, and can be aimed at challenges. Digital Innovation: The Hackathon Phenomenon. Briscoe y Mulligan. Queen Mary University and Imperial College. London. 2019.

offer support services for startups such as incubators²²² and accelerators²²³. Promote financial support through innovation grants from public entities and service providers, and financing through corporate venturing²²⁴, smart capital²²⁵ through angel investments²²⁶, venture capital²²⁷, and Patient Capital²²⁸ to circumvent the *valley of death*²²⁹.

Cardinal Point II.2. Promote the relationship between stakeholders in the innovation ecosystem of W&S

4.14 **The importance of relationships.** How much leverage innovation can achieve in a society depends on the available capacity and how strong²³⁰ relationships are. Universities, technology centers, innovation support service providers and startups, the productive sector, and government institutions²³¹ complement each other in a recursive non-linear diffuse articulation process. As interactions flourish, more is learned, capabilities develop, and efficiency based on the system's economy of scale increases to timely and resoundingly respond to the challenges in the W&S sector, as occurred with the COVID-19 (Coronavirus) pandemic²³².

4.15 **Pathways to promote stakeholder articulation.** The following pathways promote the articulation of stakeholders in the sector's innovation ecosystem:

II.2.1. Promote appropriate links between entrepreneurial demand and supply.

Support the development of trust among W&S institutions and entrepreneurs through an ongoing dialog based on common language. To this effect, it is essential to share the demand and innovation needs with service providers so that they can respond to users' needs as well as to their own administration's needs. Additionally, collaborate with entrepreneur, consultant, and business selection mechanisms that offer innovation services as well as private commitments taken on during innovation product or service procurement.

II.2.2. Facilitate connections among technology institutions, as well as between them and entities of different fields.

Foster coordinated actions between technology agencies specialized in different fields such as information and communications, materials, energy, financial, marketing, and other technologies. The multidisciplinary nature of technology solutions requires not only managing a highly-specialized topic but also integrating it with other disciplines, which is why collaboration networks are an essential and unavoidable process for organizations that want to become frontrunners of applied knowledge in the W&S sector²³³. Facilitate the transfer of knowledge generated by researchers and developments produced by technology centers to the technology industry in order to exploit their full potential for innovation in the W&S sector.

²²² Organization that provides services to entrepreneurs in the creation, launching, development, and operation stages as well as in their venture's sustainability to boost their chances of success. Chile. Corfo. 2015.

²²³ Organizations that serve startups seeking to gain traction to their growth through mentorship, expediting their connection to the market and attracting private investment. Chile. Corfo. 2015.

²²⁴ Corporate Venturing LatAm. Corporate Giants' Collaboration with Start-Ups in Latin America. IESE –Wayra. 2020.

²²⁵ Provision of financial resources, connections within the industry, and advisory services.

²²⁶ The term "angel" comes from wealthy individuals financing expensive Broadway theater productions in New York. It was first coined as a commercial term in 1983 when Wetzel completed his report on how entrepreneurs obtained seed capital in the USA, and he referred to those investors as "angels" (Wetzel, 1983). Angel Investor. Zhang York University. 2016.

²²⁷ <https://www.ascr.org/que-es-el-capital-riesgo/venture-capital/>

²²⁸ Venture Capital and Cleantech: The Wrong Model for Clean Energy Innovation. Gaddy et al. MIT Energy Initiative Working Paper. 2016.

²²⁹ All the obstacles between basic research and product development (Gou, Li & Ruan, 2013). Prácticas de innovación abierta a la superación del valle de la muerte. Ruiz & Arango. 2019.

²³⁰ Nuevas Instituciones para la innovación. Prácticas y experiencias en América Latina. Rivas & Rovira. ECLAC. 2014.

²³¹ The productive sector is represented by W&S service providers which are discussed in the subsequent point; government institutions are addressed in the previous point.

²³² Responding to COVID-19 with Science, Innovation, and Productive Development. IDB. 2020.

²³³ Modelos de gestión de centros tecnológicos sectoriales: elementos de un análisis comparado. ECLAC. 2017.

II.2.3. Bring together public, private, local, and international stakeholders in the W&S sector in LAC in dialogue.

Facilitate communication channels among government organizations and between them and other institutions in the local, regional, and global R&D&I ecosystem²³⁴. Joint projects boost mutual knowledge, accelerate the predisposition to align common goals, and facilitate the achievement of innovation goals in the sector.

III. Sphere of service provision in the W&S sector

4.16 **Innovation in serving users in the W&S sector.** W&S Service providers²³⁵ play a key role in the innovation ecosystem as the main agents in charge of transforming knowledge into new concrete and applicable solutions that benefit their users.

Cardinal Point III. 1. Promote the adoption of innovation by W&S service providers

4.17 **Fundamental role of organization leaders to adopt innovation.** The board, general management, and top management have a direct and very relevant influence on their organizations²³⁶. Therefore, it is crucial for these leaders to develop behaviors that encourage adopting innovation²³⁷ in W&S service provision²³⁸.

4.18 **Pathways to promote the adoption of innovation.** The following pathways promote the adoption of innovation:

III.1.1. Introduce the topic to service providers' top management.

Involving the president, directors and general managers of the W&S service provider is crucial, given that the adoption process requires leadership, especially in the initial stages, to encourage innovation from the top down to the work team. The organization's leader must be well-informed and assume the risks involved in innovation as well as the positive impact it can have. It is essential to encourage the adoption of innovation by setting clear expectations and by sharing examples, implemented mechanisms, and required resources.

III.1.2. Promote top executive teams to learn novel perspectives

In order to adopt innovation, top management should embrace a range of complementary non-traditional approaches for the design, creation, and implementation of innovative initiatives. This implies the adoption of flexible experimental mechanisms and iteration in the design and development of solutions, focusing on benefiting the service's clients or end users²³⁹. At the same time, promote incentive schemes to reinforce motivation in achieving results and incorporate new skills such as tolerance to ambiguity and non-linear or abductive reasoning to rethink problems, and new capabilities such as collaborative pilots design and prototypes iterating after trial and error.

²³⁴ The innovation system's performance depends not only on what develops within it but also beyond its limits. Advanced Introduction to Regional Innovation Systems. Asheim, Isksen & Trippl. 2019.

²³⁵ Includes a wide range of legal configurations depending on the area where it takes place. I.e., public, private, or combined enterprises, councils, institutions, secretariats, local governments, commissions, "aguateros", etc.

²³⁶ Uppers echelons. The organization as a reflection of its top managers. Hambrick & Mason. 1984. Leadership and Organizational Culture: Linking CEO Characteristics to Cultural Values. T. Gebersons. 2009.

²³⁷ Leadership and innovation. Barsh, Capozzi & Davidson, 2008.

²³⁸ The water Utility Adoption Model (wUAM): Understanding influences of organisational and procedural innovation in a UK water utility. Tanner et al. 2016.

²³⁹ For example, the "lean" approach (http://universityinnovation.org/wiki/The_Lean_Startup_Movement; Ries, 2011); "agile" approach (Cooper & Sommer, 2016; Glen et al., 2014); "Design thinking" (Carlgren et al., 2016; Fixson & Rao, 2014; Liedtka, 2015).

Cardinal Point III.2. Promote innovation implementation management for service providers and innovation associativity.

4.19 **Access to innovation.** Apart from leaders adopting innovation, W&S service providers require support to be able to – both individually and collectively – gain access to knowledge and develop skills and abilities with tools and techniques that facilitate their implementation of innovation.

4.20 **Pathways to promote innovation management.** The following pathways promote the management of innovation:

III.2.1. Develop knowledge products linked to innovation management for service providers.

Support the development of guidelines or tutorials on incorporating and implementing innovation plans systemically for service providers. Through methodologies, tools, and proven techniques that channel innovation, they will contribute to the efficiency and effectiveness of the activities executive teams carry out such as selecting initiatives, tracking initiatives, and measuring results.

III.2.2. Strengthen capacities and skills of service providers' human resources.

Contribute to technical assistance or innovation management training, face-to-face or remotely, of each member of W&S service providers. Organize *in situ* or online events, conferences, and/or thematic MOOCs^{240,241}, that facilitate the transfer of knowledge, experiences, and lessons learned.

4.21 **Pathways to promote associativity.** The following pathways promote associativity between service providers to foster innovation:

III.2.3. Promote innovation groups composed of service operators.

In the countries where the sector is fragmented in multiple small service providers or operators, promoting associative actions for joint efforts to foster innovation²⁴² is crucial. This may lead, for example, to the development of local, national, and/or regional operator innovation clubs that contribute to improving efficiency, transferring knowledge, benchmarking²⁴³ and reciprocal learning, encouraging technology development and generating innovation²⁴⁴.

III.2.4. Facilitate open and/or cluster innovation with other organizations in the ecosystem.

Support service operators through incentives to incorporate coordination strategies and develop alliances with other stakeholders in the innovation ecosystem²⁴⁵ of the sector both at the local and regional levels to implement innovation processes. Information, knowledge, equipment, and financial resources are disseminated between different organizations making collaboration²⁴⁶ essential to innovation.

²⁴⁰ Massive Open Online Course.

²⁴¹ E.g. bootcamps, intensive digital training sites. Disrupting Talent: The Emergence of Coding Bootcamps and the Future of Digital Skills. Cathes & Navarro. IDB. 2019.

²⁴² Clusters: Overcoming Barriers to Water innovation. Water Environment Federation (WEF). 2018.

²⁴³ Techniques to find best practices within or outside of a company regarding their methods, procedures, products or services aiming at ongoing improvement oriented at clients. Casadesus. 2005.

²⁴⁴ El futuro de los servicios de agua y saneamiento de ALC, desafíos de los operadores de áreas urbanas de más de 300.000 habitantes IDB-CAF. 2015.

²⁴⁵ Explicating open innovation: Clarifying an emerging paradigm for understanding innovation. Oxford University. Chesbrough and Bogers. 2014.

²⁴⁶ Clusters are geographic concentrations of industries related by knowledge, skills, inputs, demand and/or other features. Defining clusters of related industries. Porter. 2014.

IV. Cross-cutting issues throughout the innovation ecosystem in the W&S sector in LAC

- 4.22 **Issues for members of the ecosystem to tackle together.** Some important issues are cross-cutting to the development of the three previously described spheres. It is therefore essential for the participating stakeholders to secure an adequate context for innovation, inter- and intra-institutional coordination, and resource allocation. These issues affect, in one way or another, the organizations in charge of innovation governance in the W&S sector, R&D&I institutions, and service providers.

Cross-cutting cardinal point. Promote the development of an appropriate context to catalyze innovation in the W&S sector

- 4.23 **Mainstreaming innovation among ecosystem members.** Encouraging innovation involves general aspects that need to be developed by all stakeholders and across every process involved to succeed in the common goal of encouraging innovation in the W&S sector, and the shared end goal of improving the quality of life of people in LAC.
- 4.24 **Pathways to develop a suitable context to boost innovation.** The following pathways can be followed:

IV.1.1 Promote a universal culture of innovation.

Support activities focused on their potential for innovation and the benefits they bring to the W&S sector and help raise social leaders' awareness of this topic. Innovation can contribute to sectoral productivity and its sustainable long-term impact on people's living standards if approached collaboratively by all stakeholders. Mitigate the risk of considering innovation as something unrelated to everyday life and of disregarding its potential. Promote the development of digital venues (platforms, webinars, blogs or others) and/or face-to-face encounters (events, seminars, meetings, conferences, etc.) to share information and knowledge (technical notes, discussion notes, successful business cases, and failed business cases that lead to lessons learned from opportunities to improve, and lessons learned from best practices) of sectoral stakeholders with regards to state-of-the-art innovation, both locally and regionally. Promote role models to be followed or imitated in the public, scientific, and technology fields, and/or members or service operators, both at the local and regional level²⁴⁷. Highlight innovation solutions and organizations' ideas²⁴⁸ as well as initiatives²⁴⁹ within the ecosystem that make relevant contributions to the development of innovation in the W&S sector.

IV.1.2 Foster inter- and intra-institutional coordination.

Develop environments that encourage stakeholder articulation and coordination to boost innovation in each country and between countries in LAC. Establish clear and effective communication lines that promote and encourage coordination for a more efficient administration, sharing and collaborating in programs and interdisciplinary strategies common to countries and on a regional level.

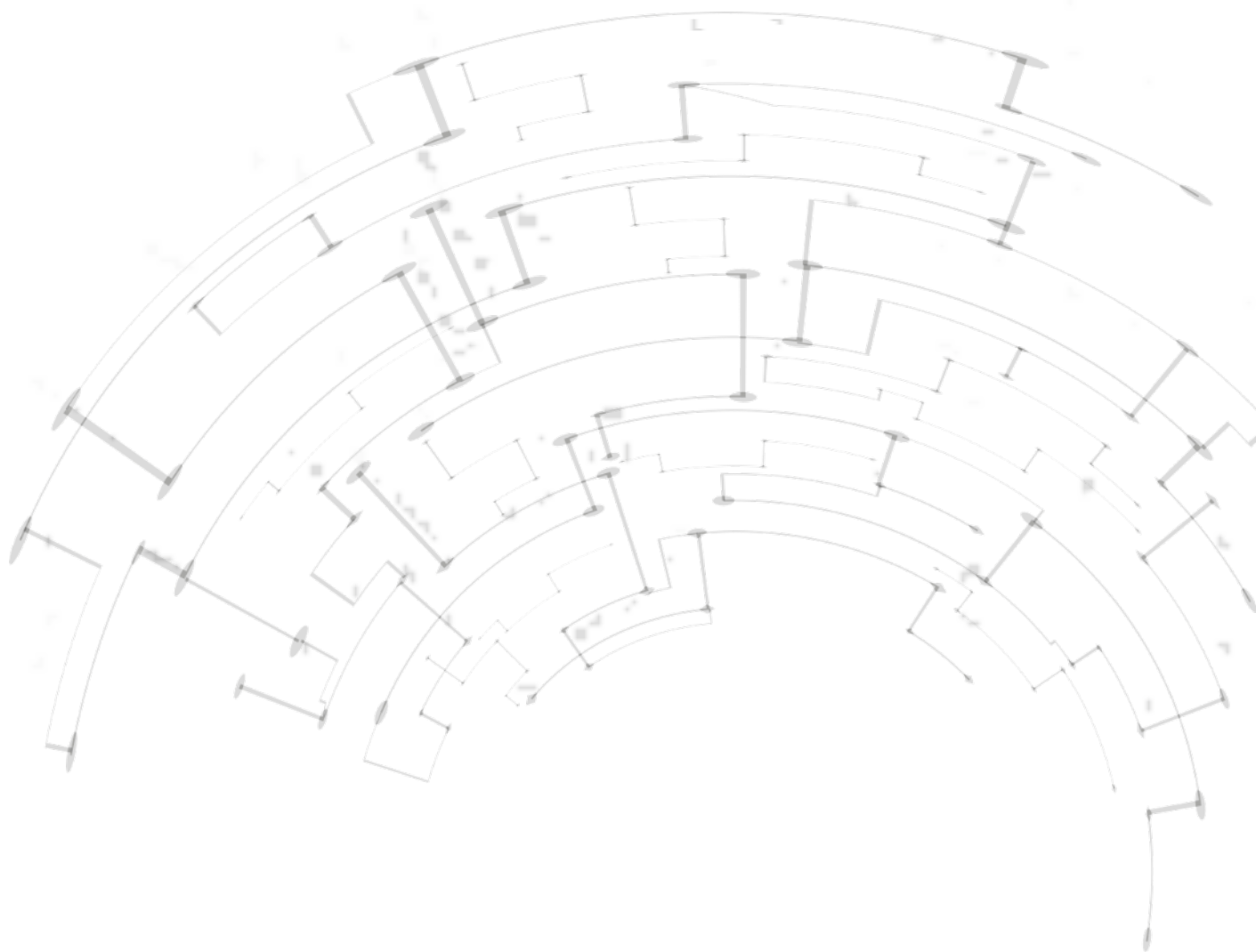
²⁴⁷ As an acknowledgement to the innovation generated by the award *Premio Ideas en Acción* to the most innovative water and sanitation companies in LAC. IDB. 2019.

²⁴⁸ Ideas in Action. Challenges. SocialLab. Argentina. 2019.

²⁴⁹ Waterlution Water Innovation Lab. Mexico. 2019.

M.1.3. Develop resource allocation mechanisms to implement innovation.

Fostering every aspect associated to innovation in the W&S sector requires not only financial resources but also logistics, technical and technological equipment, infrastructure²⁵⁰, technical assistance, and especially, time dedicated by experts. This is why it is essential to boost resource allocation, especially in the earlier stages of innovation and in market access and scaling, promoting, planning, and defining budgets specifically assigned to foster innovation in the three aforementioned spheres. Lastly, and together with traditional non-reimbursable instruments, grants or similar more recent models of funding are worth considering, such as guarantee funds, matching funds, crowdfunding, support to angel investment networks and/or regional funds, green bonds²⁵¹, and soft loans.



²⁵⁰ Evaluation of Smart Water infrastructure Technologies (SWIT). Arniella et al. IDB. 2017.

²⁵¹ Transforming Green Bond Markets, Using Financial Innovation and Technology to Expand Green Bond Issuance in Latin America and the Caribbean – Ketterer et al. IDB. 2019.

Summary of Cardinal points and Pathways for each field of development.

Field:	Cardinal points	Pathways	Cardinal point	Cross-cutting cardinal point
I. Governance	I.1. Promote public policies and regulations that encourage innovation in the W&S sector.	I.1.1. Facilitate the articulation between national and regional policymakers through business meeting and joint initiatives with medium- and long-term perspectives.	IV.1. Promote the development of an appropriate context to catalyze innovation in the W&S sector.	IV.1.1. Promote a universal culture of innovation.
		I.1.2. Promote policies that spur innovation in the sector.		
		I.1.3. Foster innovation policy impact studies in the W&S sector.		
		I.1.4. Contribute to develop regulations and tools that help deal with the risks of innovation.		
		I.1.5. Bolster the development of specific regulatory environments to develop and leverage innovation in the W&S sector.		
		I.1.6. Facilitate regulations that incentivize the creation and development of a <i>supply</i> of innovation.		
		I.1.7. Promote regulations that incentivize the <i>demand</i> for innovation.		
	I.2. Promote integrity mechanisms.	I.2.1. Foster the engagement of all W&S stakeholders.		
		I.2.2. Promote management integrity.		
II. R&D&I	II.1. Promote research and development based on relevant sectoral challenges.	II.1.1. Foster academic projects and/or research with a multidimensional perspective.	IV.1. Promote the development of an appropriate context to catalyze innovation in the W&S sector.	IV.1.2. Foster inter- and intra-institutional coordination.
		II.1.2. Support scholarships linked to W&S.		
		II.1.3. Facilitate missions to success stories.		
		II.1.4. Endorse research on emerging technologies that have a potential impact on the W&S sector.		
		II.1.5. Validate pilots and prototypes.		
		II.1.6. Set up tenders for technologists in relevant topics to apply their knowledge in the W&S sector.		
		II.1.7. Promote startups with innovation value proposals for the W&S sector in LAC.		
	II.2. Promote the relationship between stakeholders in the innovation ecosystem of W&S.	II.2.1. Promote appropriate links between entrepreneurial demand and supply.		
		II.2.2. Facilitate connections among technology institutions, as well as between them and entities from different fields.		
		II.2.3. Promote public-private dialog at local and international levels in LAC's W&S sector.		
III. Service provision	III.1. Promote the adoption of innovation by W&S service providers.	III.1.1. Introduce the topic to service providers' top management.	IV.1.3. Develop resource allocation mechanisms to implement innovation.	
		III.1.2. Encourage top executive teams to learn novel perspectives.		
	III.2. Promote innovation implementation management for service providers and innovation associativity.	III.2.1. Develop knowledge products linked to innovation management for service providers.		
		III.2.2. Strengthen capacities and skills of service providers' human resources.		
		III.2.3. Promote innovation groups comprising service operators.		
		III.2.4. Facilitate open and/or cluster innovation with other organizations in the ecosystem.		

