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Abstract[*]

This paper provides high-level strategic insight for taking forward water and sanitation regulation in Latin America and the Caribbean (LAC). To do this, the paper analyzes the expected impact of future changes facing the sector; unpicks the England and Wales (E&W) benchmark case study; and reviews the current situation of the sector in LAC. The main conclusion of the paper is simple but powerful: *Water and sanitation sector regulation should keep the focus on solving the known problems of the past*. The paper also discusses a number of regulatory innovations, some of which may be worth implementing in LAC. However, the authors of the paper recommend that those innovative regulatory policies should only be pursued if the focus on solving the known problems of the past is not jeopardized.

JEL classifications: L43, L95, N56, Q25
Keywords: Water and sanitation, Regulation, Climate change, Latin America and the Caribbean, New technologies

[*] The views expressed in this paper are strictly those of the authors and not necessarily those of their respective institutions.

Executive Summary

Fresh water of sufficient quantity and quality is essential for all aspects of life, and water resources are embedded in all forms of human development. As a result, human rights to water and sanitation are widely recognized around the world.

The water and sanitation sector is heavily regulated, not only because water is essential for life, but also because water and sanitation are most efficiently produced by regional monopolies, which need to be regulated to ensure maximum benefits for society.

The main objective of this paper is to provide high-level strategic insight for taking forward water and sanitation regulation in Latin America and the Caribbean (LAC).

The paper's analysis is divided into three parts:

- **Part 1** analyzes several changes that may have the potential to produce a paradigm shift in the sector. The changes analyzed are technological change, climate change and increasing social demands. The conclusion of Part 1 is that the sector is unlikely to undergo a paradigm shift in the foreseeable future. This is because changes facing the sector are found to be likely to have a limited impact, localized either geographically or in specific parts of the value chain.
- **Part 2** reviews in detail the benchmark case study of England and Wales (E&W). The conclusion of Part 2 is that the E&W case has achieved full coverage of exceptional quality based on a solid governance structure and regulatory framework, which are constantly being improved to provide resilience for the type of challenges that could be expected in the future. We were able to identify a number of regulatory innovations that may be used as inspiration to develop future regulatory policy in the LAC region.
- **Part 3** contrasts the E&W benchmark with current regulatory practice in LAC. The conclusion of Part 3 is that, as opposed to E&W, LAC has not done enough to achieve basic sector objectives that been in place for almost three decades. For example, more than 75 percent of sewage collected is discharged without any treatment, 40 percent of the LAC population is not connected to a sewerage network, service quality is poor, and infrastructure is often in bad

condition and operated inefficiently. There are also significant gaps in terms of governance and regulatory arrangements, which could partly explain the other shortcomings.

One of the strongest messages for future regulation that emerges from the paper's analysis is the following: *Changes facing the water sector are not expected to lead to a change in paradigm and therefore the old regulatory objectives, which have not been achieved so far, remain valid*. In other words, the water and sanitation sector in LAC needs to ensure it remains focused on solving the known problems of the past.

There are, however, a number of new challenges that those future changes could bring about, and they may drive some degree of regulatory reform. These challenges include the following:

- New technologies such as resource recovery may have the potential to significantly impact specific parts of the value chain. Regulatory frameworks should therefore be capable of maximizing these new technologies' potential positive impact.
- Climate change is expected to bring uncertainty on the future availability of raw water. Regulatory frameworks should therefore be able to allocate raw water efficiently should it become a scarce resource.
- Customers are expected to increase the level of scrutiny and the requirements they place on utilities. Regulatory frameworks should therefore be able to foster utilities that are responsive to customer needs.

The paper identifies a number of examples of regulatory policies that may be implemented to address such new challenges. These policies are summarized in the table below.

These example policies serve to provide an idea of the direction that sector regulatory policy may take in the future, and they could be used as a starting point to design region-specific policies aimed at addressing new challenges. The exercise of deciding which regulatory policies should be implemented in each region is very complex and has not been undertaken in this paper. This exercise would weigh costs and benefits in the light of local circumstances (e.g., institutional constraints).

Examples of Future Regulatory Policies to Address New Challenges

Regulatory policy	Rationale
Develop water abstraction rights trading markets	Create a method to improve the allocation of raw water resources in a future context in which there will be increased uncertainty on raw water availability generated by climate change
Implement additional incentives (such as the abstraction incentive mechanism in E&W) to deal with over-abstraction	Ensure environmental sustainability in the context of increased uncertainty on raw water availability generated by climate change
Implement upstream competition	Ensure that the regulatory system enables the development of innovations in areas such as resource recovery
Implement retail competition	Ensure that the regulatory system is able to respond to future more demanding and empowered customers Retail and water upstream competition could leverage the impact of abstraction rights markets, further improving the allocation of scarce raw water resources
Develop a customer engagement framework	Ensure that the regulatory system is able to respond to future more demanding and empowered customers
Introduce a degree of discretion embedded in the regulatory regime so that both regulators and utilities are able to endogenously determine the outcomes to be pursued and the incentive schemes needed to encourage companies to achieve those outcomes	Provide resilience to tackle future challenges that are currently unknown

Source: Authors' compilation.

In summary, the key insight from this paper for future regulation is that regulatory policy should keep focusing on achieving old and well-known objectives. Innovative policies appear to be worth pursuing to tackle future challenges. However, if these innovative policies were to be implemented, that should be done without losing focus on the policies aimed at addressing the known problems of the past.

1. Introduction

1.1 Background and Objectives

Fresh water, in sufficient quantity and quality, is essential for all aspects of life, and water resources are embedded in all forms of human development. As a result, the human rights to water and sanitation are widely recognized around the world.

The water and sanitation sector is heavily regulated, not only because water is essential for life, but also because water and sanitation are most efficiently produced by regional monopolies, which need to be regulated to ensure maximum benefits for society.

The main objective of this paper is to provide high-level strategic insight for taking forward water and sanitation regulation in Latin America and the Caribbean (LAC).

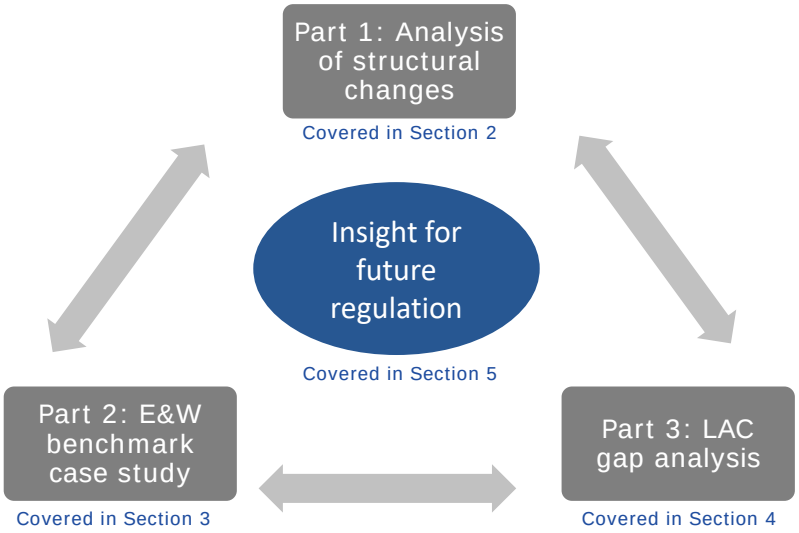
1.2 Methodology

To provide insight on future regulation we use a three-part methodology:

- **Part 1** (covered in Section 2): analyzes several changes that have the potential to produce a paradigm shift in the sector, and as a result represent challenges for future regulation of the sector.
- **Part 2** (covered in Section 3): reviews in detail the benchmark case study of England and Wales (E&W).
- **Part 3** (covered in Section 4): contrasts the E&W benchmark with the current regulatory practice in LAC.

This methodology is depicted in the figure below.

Figure 1. Three-Part Methodology



Note: Two-way arrows denote information flows among different parts of the methodology.
Source: Authors' compilation.

The idea behind this methodology is to provide a framework to understand where the region stands today, relative to a good practice case from one of the leaders in economic regulation of the sector in the context of a changing environment, along economic, social, climatic or technological dimensions. This approach can be thought as a first step to start thinking about potential reforms of the sector to deal with current and future challenges. Admittedly, providing insight for future regulation is a challenging task that cannot be fully exhausted in this paper. The methodology proposed here is flexible enough to be expanded in different directions by other researchers or practitioners interested in similar questions.

1.3 Ideas to Expand the Analysis Undertaken in This Paper

The analysis undertaken in this paper could be expanded without losing consistency in every aspect of our methodology:

- **Part 1** assesses whether changes in three areas (i.e., technology; climate; and social demands) are likely to generate a paradigm shift. Further work could assess changes, or areas, that Part 1 of this paper does not cover. Additionally, the analysis of the impact of changes is mostly for the whole LAC region.

Further analysis could be undertaken to understand more deeply the impact of changes in specific countries.

- **Part 2** limits its scope to the E&W case study, but there are other interesting cases that could also be used as international best practice benchmarks. Further work could consider these cases. In terms of the E&W case study it would be possible to undertake further research to understand how effective the latest regulatory policies have been in addressing target problems or challenges.
- **Part 3** reviews the key features of regulation in LAC from a high level by presenting research that has been undertaken by others, and by outlining certain aspects of certain case studies that are useful to show the points being made. The only case study that we will be covering to certain level of detail in Part 3 is the Chilean case. Further work could be done to review specific LAC countries in more detail.
- **Insight for future regulation**: We identify several gaps between E&W and LAC, but we do not discuss in detail the specific regulatory policies to bridge each of those gaps. This is work that is best done using the available toolkit for each country to support policy recommendation (e.g., Cost-Benefit Analysis). To do this work it will be essential to consider the local specificities of each country, such as the local institutional context, which is a key element to design and implement any sustainable reform (Mumssen, Saltiel and Kingdom, 2018). In other words, the gap analysis should not be used as an automatic source of policy recommendations that copy the international best practice.

This possibility of expanding the analysis in a consistent way provides a framework to orientate the efforts from others so that more enlightened conclusions on which should be the way forward for water and sanitation regulation in LAC are reached collectively.

2 Analysis of Structural Changes

2.1 What Are the Relevant Structural Changes?

There seem to be three main structural changes that are likely to lead to a paradigm shift in infrastructure regulation around the world:

- technological change,
- climate change, and
- increasing social demands.

In this section, we assess the expected impact of these three changes in the water and sanitation sector with a focus on LAC.

2.2 How Do We Assess the Impact of These Changes?

The starting point to do this is to define what is meant by a paradigm shift. We define a paradigm shift in broad terms as a material modification of the economics of the sector.

We then need to define the economics of the sector, which we do by delineating the following two key sector dimensions:

- Configuration of the value chain. This is a description of the way the industry is organized. Or in other words, the productive processes that are followed to provide water and sanitation goods or services.
- Cost structure of each element of the value chain in the context of existing demand. This is basically a view that clarifies the fundamental question for regulation of whether cost structures suggest the existence of a natural monopoly.

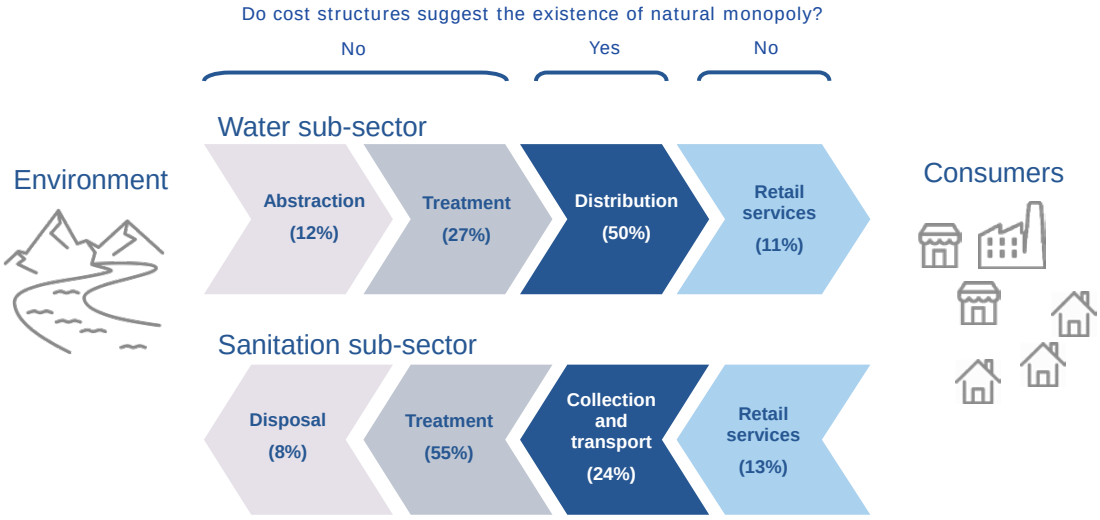
It is worth noting that the structural changes discussed in this section may affect these two dimensions via changes in supply and/or demand. Most notably, technological change and climate change may affect mostly the supply side of the industry, while changes in social demands may affect mostly the demand side.

Note also that the economics of the sector is region-specific (Navajas, 2002). For example, every element of the water value chain (as well as probably almost every economic activity) is likely to have natural monopoly characteristics in a very small island economy, while

some segments may be more suitable for a competitive organization of the industry if the market is larger.

Therefore, we define the economics of the sector in a general way, drawing from research undertaken by Ofwat for the water and sanitation sector in E&W. This general definition of the economics of the water and sanitation sector, depicted in the figure below, should be understood as a starting point. If the economics of the water and sanitation sector in a particular country appears materially different (e.g., in a small island economy), then a modified more specific definition should be used to truly understand the impact of changes in that country. While that detailed analysis is beyond the scope of this paper, we do highlight cases in which exceptions could apply, while discussing the general impact of changes.

Figure 2. General Definition of the Economics of the Water and Sanitation Sector



Note: Percentages represent indicative industry cost allocations in E&W and add up to 100 percent in each sub-sector.
Source: Authors' compilation based on Ofwat (2008).

This general definition has a few simplifications, such as the following

- Value chain elements are very aggregated (e.g., "Treatment" in wastewater could be split into "Sewage treatment" and "Sludge treatment").
- Minor value chain elements are not included (e.g., raw water distribution, which exists in the cases where abstraction takes place in a location that is distant from treatment plants, has not been included).

Additionally, this general definition does not include water that is directly taken from the environment and used for other important purposes. For example, around 72 percent of water consumption in LAC is accounted for by agriculture.[1] This use of water somehow bypasses the whole value chain presented above: water is abstracted, used without treatment to make it potable, and disposed into the environment automatically when it is being used. Although the analysis of this paper does not focus on other uses such as agriculture, we consider these uses when we think about future regulation, especially in the context of climate change where water resources may become scarce and rivalry for accessing those resources may intensify.

In summary, in the following sections we assess whether the changes expected in the sector are likely to be structural changes and lead to a paradigm shift. We do this by understanding how the different changes facing the sector affect our general definition of the economics of the sector. The larger the impact, the larger the chance that the changes will lead to a paradigm shift, which may require a radical modification in the approach to regulating the sector.

This analysis is undertaken separately for each one of the infrastructure structural changes, but we flag interlinkages when these arise.

The analysis is mostly qualitative. This means that there is not a precise measurement of how large is "large enough" to create a paradigm shift. However, to help frame this qualitative discussion, it is possible to refer to examples from other sectors where changes are expected to lead to a paradigm shift.[2]

2.3 Are These Changes Likely To Lead to a Paradigm Shift?

Our analysis suggests that it is unlikely that the changes assessed will bring along an overall sector paradigm shift. We find that some of the changes will generate an impact on the economics of the sector, but this impact is judged to be not significant, as in most cases the impact is likely to be localized, either geographically or in specific parts of the value chain. Note that the fact that the impact may be geographically localized means that in certain countries, for

[1] This number is an estimate provided by AQUASTAT-FAO of the proportion of freshwater withdrawal for agricultural purposed as a share of total renewable water resources, defined as inland waters renewed by the global water cycle, that are available to humans.

[2] For example, in the transport sector, by 2030, 95 percent of U.S. passenger-miles traveled are predicted to be served by on-demand autonomous electric vehicles owned by fleets, not individuals, resulting in cost savings between 75 and 90 percent (Arbib and Seba, 2017).

example countries facing extreme water scarcity, this impact may be significant. However, these countries are understood to be the exception rather than the norm.

The table below summarizes our findings in terms of the impact of each change and all the changes taken together. The following sections provide more detailed discussion on the impact of each change separately.

Table 1. Are the Expected Changes Likely To Lead to a Paradigm Shift?

Change	Will it change the paradigm?
Technological change	Innovations are likely to affect specific geographical regions or specific parts of the value chain, but we do not envisage this will lead to an overall sector paradigm shift (more discussion in Section 2.4).
Climate change	Uncertainty about resource availability and seasonality is likely to become a challenge in many parts of LAC, but we do not envisage this will lead to an overall sector paradigm shift (more discussion in Section 2.5).
Increase in social demands	Socio-economic changes are likely to put additional pressure on getting regulation right and modify specific parts of the value chain, but we do not envisage this will lead to an overall sector paradigm shift (more discussion in Section 2.6).
Overall	**The sector will have to adjust to some new challenging circumstances such as more uncertain environmental conditions. However, we do not expect that these circumstances will bring along an overall sector paradigm shift. Changes are likely to be localized, either geographically or in specific parts of the value chain.**

Source: Authors' compilation.

2.4 Technological Change

In Section 2.4.1 we succinctly define the key technologies that can be expected to emerge more prominently in the future of the water and sanitation sector. In Section 2.4.2 we discuss whether these technologies are likely to have an impact on the economics of the sector.

2.4.1 What Are the Technological Changes Expected in the Sector?

Box 1 summarizes the key technologies emerging in the water and sanitation sector. This list of technologies and their definitions are based on Voutchkov (2019).

Box 1. Key Technologies Emerging in the Water and Sanitation Sector

Digital water

Digital water provides water management solutions that leverage the power of real-time data collection, cloud computing and big data analytics to minimize water losses in the distribution system and maximize operational efficiency, and asset utilization. The digital water management approach provides an integrated platform, which includes water production and supply asset management, water management software, intelligent controls, and professional expertise to drive down operating costs and water losses.

Examples of new and emerging technologies of digital water are Advanced Metering Infrastructure Systems and Satellite Monitoring Systems of Water Distribution Systems and Catchments.

Water reuse

Water reuse involves using water reclamation to produce water of almost any quality desired, from gray water of very low quality which could only be used to flush toilets, to purified water of quality equal to or higher than drinking water.

Examples of new and emerging technologies of water reuse are New Advanced Oxidation Processes; UV-LED Systems; and Automated Water Quality Monitoring Systems.

Resource recovery

Resource recovery entails extraction of energy, valuable nutrients (e.g., in the form of fertilizers), minerals and rare earth elements from influent wastewater and sludge (biosolids) of wastewater treatment plants and from concentrate (brine) generated by desalination plants.

Examples of new and emerging technologies of resource recovery are Improved Plate and Frame Membrane Bioreactor Systems and Crystallization Reactors for Phosphorus Recovery from wastewater treatment plants Sludge.

Desalination

Desalination is the process of purifying salt or brackish water into fresh water.

Examples of new and emerging technologies of desalination are: Nano-structured Reverse Osmosis Membranes, Forward Osmosis, Membrane Distillation, Electrochemical Desalination, Capacitive Deionization and Biomimetic Membranes.

Source: Authors' summary of Voutchkov (2019).

2.4.2 Are Technological Changes Likely To Have an Impact on the Economics of the Sector?

The technologies presented above, acting jointly, seem likely to change the economics of the sector. However, the impact appears to be limited to specific geographical regions or to specific parts of the value chain. Hence, the impact does not appear to be as radical as in other sectors, such as transport or electricity.

Table 2 summarizes the findings of our assessment, with a more detailed discussion for each technology following below.

Table 2. The Impact of Technology on the Water and Sanitation Sector

Technology	Will technology change the economics of the sector?
Digital water	Unlikely
Water reuse	Likely in specific areas with extreme water scarcity; unclear in other areas
Resource recovery	Likely, but limited to the wastewater treatment and disposal activities
Desalination	Likely only in non-coastal regions with water scarcity, via enabling water reuse
Overall	**Likely, although limited to specific geographical regions or specific parts of the value chain**

Source: Authors' compilation

Digital water

Digital technologies may lead to some efficiency gains in different specific parts of the value chain, but it seems unlikely that they will impact materially on the economics of the sector. For example:

- both advanced metering and satellite monitoring of distribution systems could reduce the costs of identifying leakage, but these reductions can only be relatively small as leakage identification costs are small compared with leakage fixing costs, which involve activities such as replacing underground pipes; or
- smart metering for consumption in water is not as relevant as in electricity, given that water can be stored cheaply and thus there is not much to gain from making consumption decisions based on monitoring consumption by the minute.

In other words, digital water sounds appealing, but we do not see how in practice this could revolutionize the sector. We do not see a new digital technology that could be as revolutionary as for example the electric self-driving car in the transport sector.

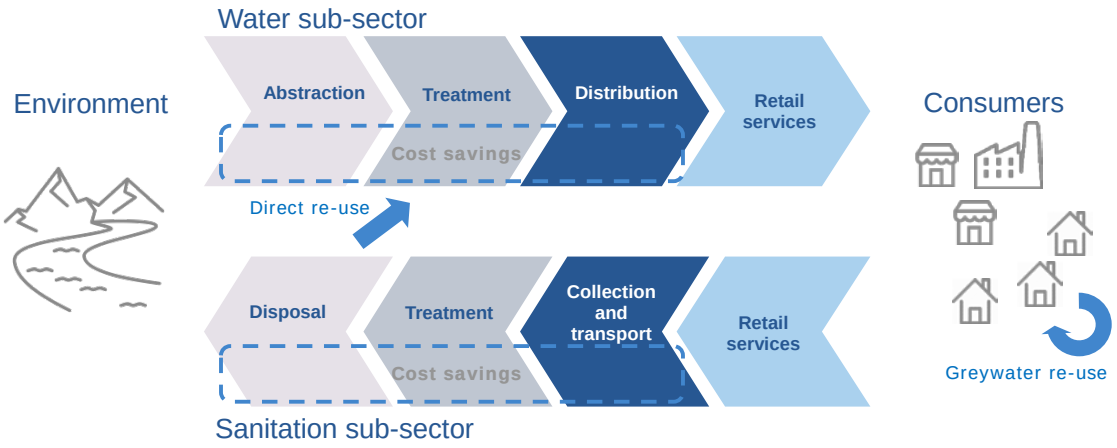
Water reuse

Reuse would work as a shortening of the circular water and sanitation value chain:

- Direct reuse, that could be achieved for example by using new techniques to transform wastewater into potable water, would shortcut the value chain at the disposal stage, just before the water gets discharged into the environment.
- Graywater reuse, which could be achieved by simple water filtering and home piping technologies, would shortcut the value chain at the consumption stage, just before the water gets into the wastewater network.

This shortening of the value chain is depicted in the figure below.

Figure 3. The Impact of Water Reuse in the Water and Sanitation Value Chain



Source: Authors' compilation.

The shortening of the value chain has the potential to lead to material cost reductions across the whole value chain. For example, graywater could be reused to flush home toilets, which in the average home accounts for 35 percent of water consumption. This would generate cost savings across the water value chain, as there would be less demand for treated water and for network capacity, and across the wastewater value chain, as there would be less demand for network capacity. These savings may be leveraged if the impact of resource recovery, discussed

below, is considered, as wastewater that has been reused will contain a larger proportion of bioresources.

It should be noted, however, that achieving this type of cost savings is likely to be a slow process. In the case of graywater reuse, for example, the installation of a graywater reuse system may be cost-beneficial only for new construction, although some new basic graywater systems that can be installed cheaply in existing homes have recently been made available.[3]

Additionally, the question remains whether potential cost savings of the magnitude that can be expected from introducing water reuse technologies are big enough to materially modify the economics of the sector. It is worth noting that cost savings of this magnitude are small when compared to cost savings expected in other industries such as car transport.

For these reasons, our view is that the potential impact of water reuse on the water and sanitation sector remains unclear, except probably in areas where raw water is extremely scarce and thus the value of water as a commodity is so high that having the possibility of reusing it enables the existence of the sector. This case is discussed below in the desalination section.

Resource recovery

Resource recovery means that the nature of wastewater is changing. Previously considered waste, it is now becoming a commodity. This has potential to impact the economics of the sector by changing the productive process.

The main change is that wastewater treatment activity becomes a resource production activity. This change would transform the wastewater industry from a single product industry (where clean water is the only product) into a multiproduct industry (where clean water is just one of the many goods or services that are produced).

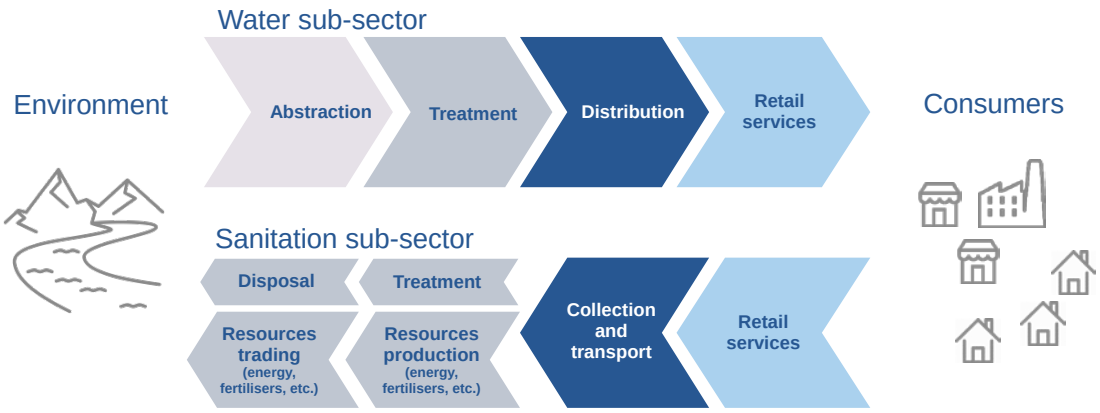
Some of the resources produced may be used internally by the water and sanitation operator. For example, clean drinkable water may be reinserted into the water network, as discussed in the reuse section above, or energy generated in treatment plants may be used in the same resource production activity. This has the potential to achieve substantive cost efficiencies. For example, energy recovery technology development is projected to be able to make treatment

[3] For example, new toilet models with an integrated sink to the cistern are readily available for sale. In these products, water is first used to wash hands and then fills the cistern for the next usage.

plants 100 percent energy self-sufficient by the year 2030 (Voutchkov, 2019). Other resources may be sold to other users, creating a whole new activity focused on trading resources.

The new configuration of the water and wastewater value chain resulting from changes in resource recovery is depicted in Figure 4.

Figure 4. The Impact of Resource Recovery in the Water and Sanitation Value Chain



Source: Authors' compilation.

In summary, our perception is that the fact that wastewater is changing in nature into a valuable commodity will impact the economics of the sector and may require a rethink of some existing regulatory approaches. However, this impact is limited to the treatment and disposal elements of the sanitation value chain.

Desalination

According to Voutchkov (2019), new desalination technologies have the potential to reduce energy consumption by 20 to 35 percent and capital costs by 20 to 30 percent. The impact on the economics of the sector of this potential cost reduction is likely to be different in the following three types of regions:

- **Regions where there is availability of non-saline water**. The impact is likely to be negligible. The reason for this is that, in these regions, desalination is not at the productive efficiency frontier by far (i.e., it is much more expensive to treat water using desalination than using other water treatment technologies). So, depending on how the costs of the other treatment technologies evolve, desalination may or may not become a technology at the

productive efficiency frontier. If it does become a frontier technology, however, most of the savings mentioned above would have been spent getting to the frontier, rather than pushing the frontier. This means that the overall costs savings of treating water resulting from desalination are unlikely to be material.

- **Coastal regions where non-saline water is scarce**. In these regions, desalination is likely to already be at the productive efficiency frontier. Therefore, cost savings of desalination are likely to be translated fully into cost savings of water treatment. This means that there may be costs savings of circa 20 percent to 35 percent in the treatment element of the value chain resulting from new desalination technologies. The question remains, however, of whether cost savings of this magnitude are large enough to materially modify the economics of the sector, given that they are small compared to cost savings expected in other industries such as car transport.
- **Non-coastal regions where non-saline water is scarce**. In non-coastal areas wastewater may be reused. This, as discussed in the reuse section above, may have a material impact on the economics of the sector. In non-coastal areas, this opens the possibility of having a water and sanitation sector at all.

In summary, desalination is more likely to impact on the economics of the water sector via opening the possibility to reuse water than via achieving productive efficiency gains, but this impact is limited to non-coastal regions suffering from water scarcity.

2.5 Water Resources and Climate Change

The supply and demand for water resources are both affected by man-made climate change and other socio-economic changes such as urbanization, population growth, economic growth, and changes to land use. As water is a local resource, the incidence of hydric stress is dependent on the interactions of these phenomena at low levels of aggregation, and the effects could be heterogeneous both across and within countries. In some cases, the supply of water may increase (e.g., by an increase in river runoff) or decrease (e.g., through droughts). In some cases, the quality of the water may be affected, affecting the reliability and costs of provision of water services.

In this section, we analyze how the supply and the demand for water may be affected by climate change in the LAC region.

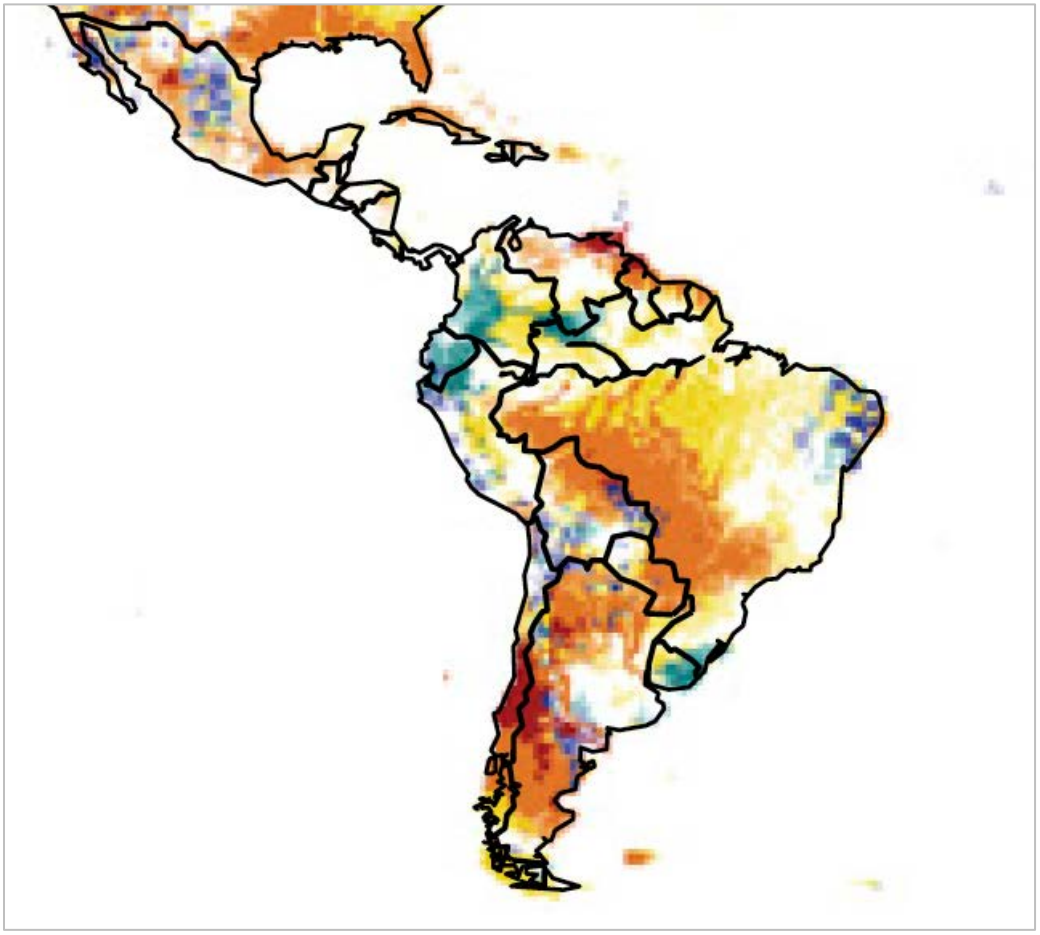
2.5.1 What Are the Changes Expected in the Sector?

Climate change will be associated with several phenomena that are expected to increase the number of people experiencing hydric stress in many areas of LAC. An increase in temperatures and in the number of extremely hot days, changing rainfall patterns, rising sea levels and greater incidence of extreme weather events such as droughts and floods are among the climate-related changes that may affect both the supply of and the demand for freshwater resources. However, these effects will most likely be heterogeneous, as some parts of the continent may end up better off in terms of water availability. Figure 5, taken from Schewe et al. (2014), captures the disparate expected changes in water availability across the region by the end of the century, under the most pessimistic climate change scenario (more on climate change scenarios below).

Focusing on the reduction in annual streamflow (or losses of water flows volume), Figure 5 shows areas in green and blue, that are projected to increase their water resources by between 10 and 30 percent or more, respectively, and areas in orange and red, that are expected to lose water resources in the same amounts. Areas in yellow are expected to have changes in the range of -10/+10%.

Similarly, estimations by ECLAC (2015a) for Central America show a sharp reduction in freshwater availability for all countries under different scenarios. Their estimates for the region show an average loss of 80-90 percent by 2100. While countries like Belize, Costa Rica and Panama would be able to avert a hydric crisis, due to their large amount of water resources, some other countries in the region such as El Salvador, Honduras and Nicaragua would move to a situation of dire water scarcity, with levels below 800 m^3 per person per year.

Figure 5. Changes in Water Flows Volume for LAC



Source: Schewe et al. (2014).
Note: The paper predicts the relative change in annual discharge at 2 °C, under climate change model RCP8.5

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2.5.2 Are These Changes Likely To Have an Impact on the Economics of the Sector?

Climate change will not necessarily affect how we think about the water sector, resource scarcity and its appropriate regulation, whether in terms of pricing, incentives to innovation, infrastructure needs or financial sustainability. However, countries and their regulators will certainly have to change practices to cope with a more challenging and unpredictable environment.

The water sector has been, up to now, relatively stable and predictable in terms of resource availability, seasonal changes, local consumption, etc. Likely, this is going to change and will create new challenges for local and national governments. Areas traditionally rich in water may need to learn how to manage scarcity, while others may be less constrained in terms

of water availability than they are now. It could be argued that this new uncertainty about the availability of the key resource at different points in time and across locations represents a paradigm shift in a sector unfamiliar with substantial volatility. However, the sector has been dealing with water scarcity in some regions for a long time and should be able to adapt to scarcity scenarios emerging in regions that did not face scarcity before.

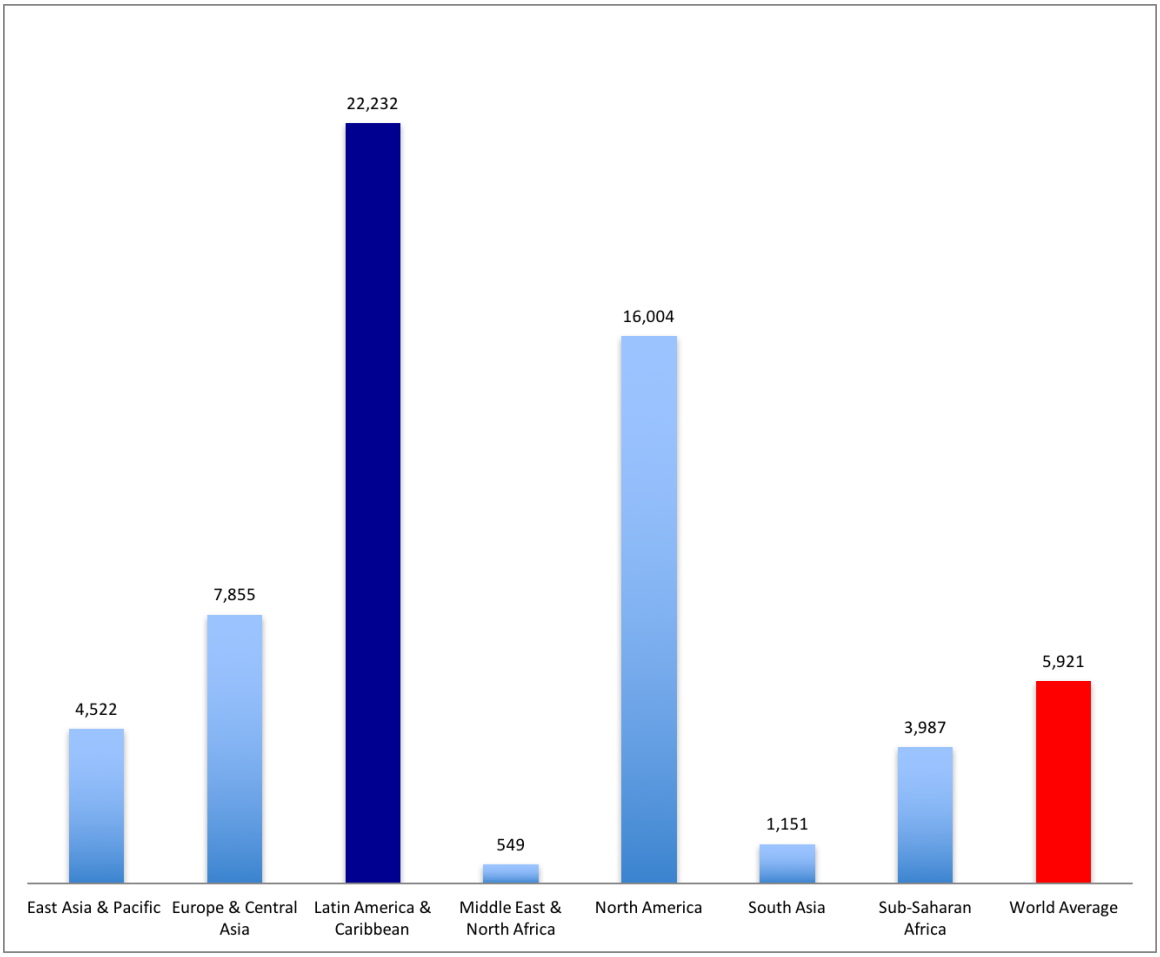
In the rest of this section we show how climate change will inevitably become a challenge for the supply of water services to the population of LAC countries, by affecting resources, delivery and by increasing uncertainty: Section 2.5.3 presents information on the availability of freshwater resources in the region, Section 2.5.4 discusses the potential channels through which climate change can affect water resources and the delivery of water services, and Section 2.5.5 shows key climate change projections for the region along many dimensions that will likely affect the water sector.

2.5.3 Water Resources in LAC

According to the United Nations, water scarcity can be defined in relation to two thresholds. A situation of hydric stress is defined when the water supply drops below 1,700 m^3 per person per year. Scarcity is defined in situations when the supply falls below 1,000 m^3 per person per year.

Figure 6 shows that LAC, as a region, currently has very high levels of renewable freshwater resources relative to all other regions in the world. Its average levels are almost four times greater than the world average. While some other regions, such as the Middle East and North Africa and South Asia, are under a chronic water shortage, LAC levels are around 13.2 times greater than the hydric stress threshold.

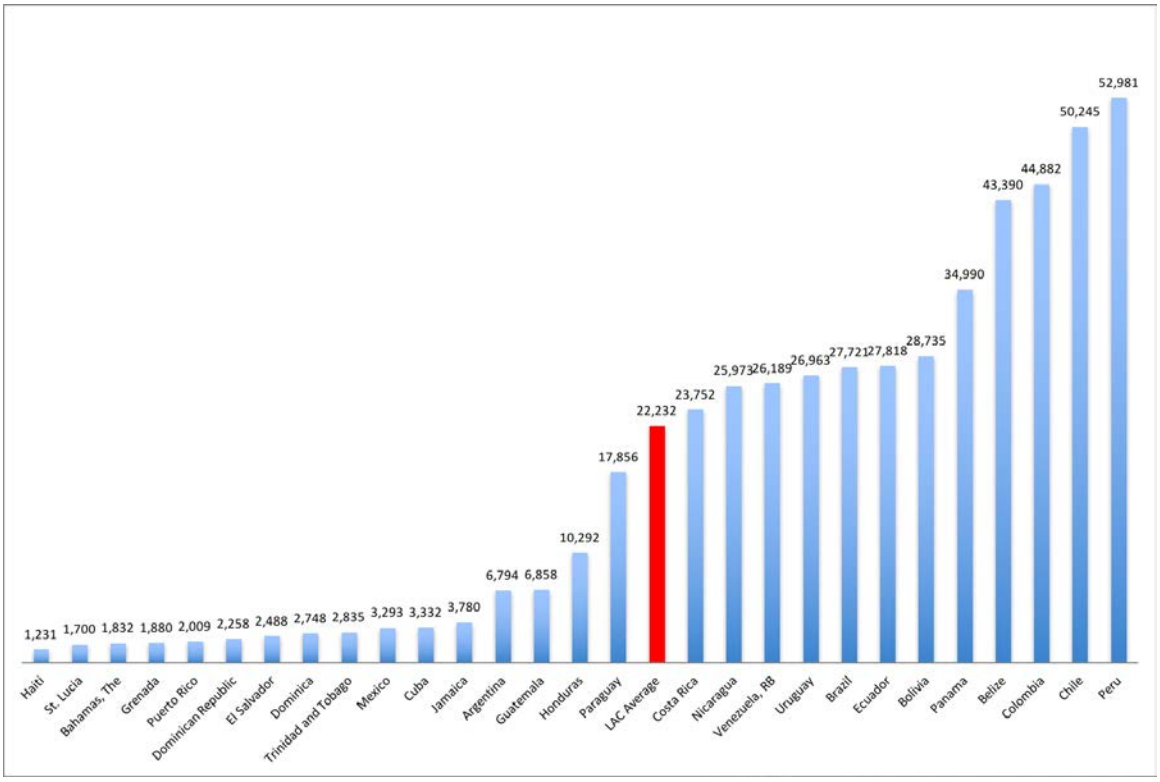
Figure 6. Total Renewable Water Resources per Capita by Region (in m^3/person/year, 2014)



Source: Authors' calculations using data from Aquastat-FAO and World Bank.

Figure 7 shows that this high average hides a large heterogeneity in freshwater resources across countries. The geographical distribution of water availability shows that many countries in different parts of the region are water rich, from South America (e.g., Peru, Chile and Colombia) to Central America (e.g., Belize, Panama and Nicaragua). Only a handful of Caribbean countries (e.g. Haiti, St. Lucia, The Bahamas) are close to the water stress threshold.

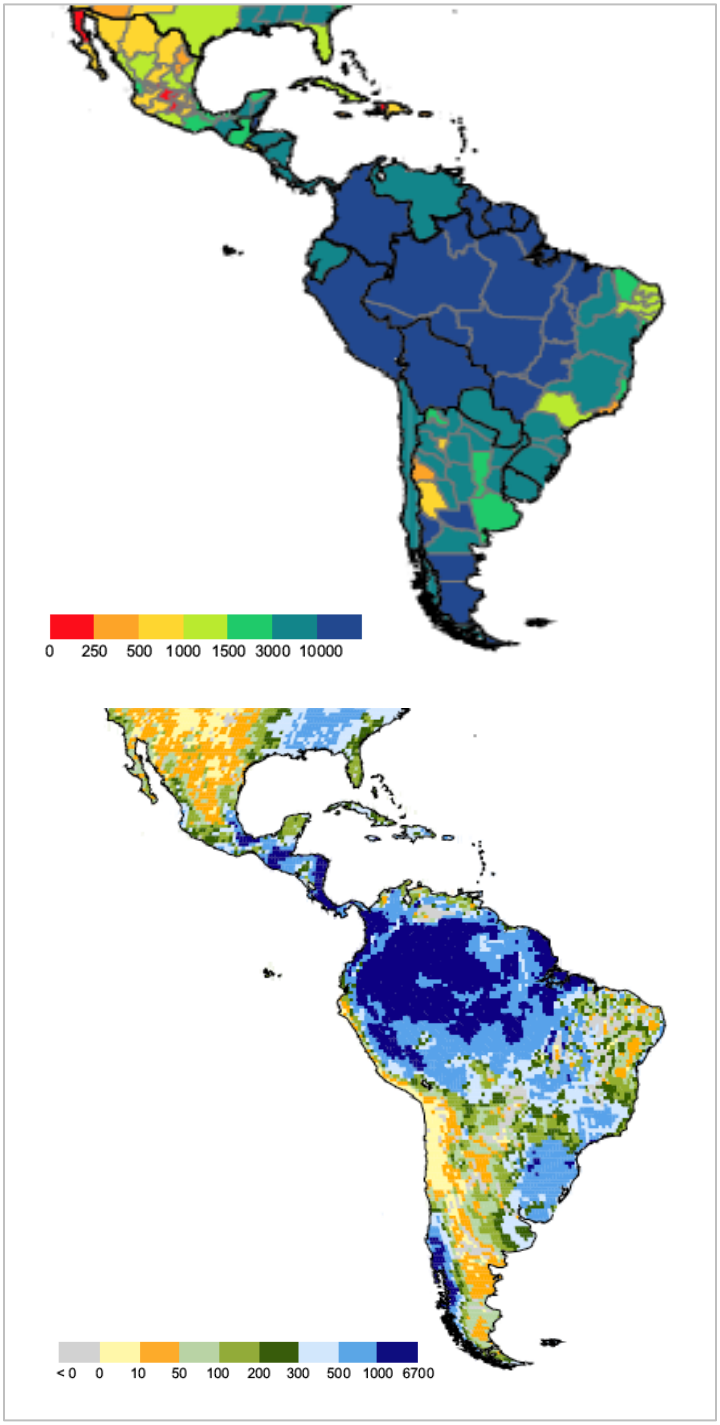
Figure 7. Total Renewable Water Resources Per capita in Selected LAC Countries (in m^3/person/year, 2014)



Source: Authors' calculations using data from Aquastat-FAO and World Bank.

While the general picture in terms of water availability is one of abundance, because water is a local good, some areas within some water-rich countries can still be subject to water stress or scarcity. Figure 8 shows maps of groundwater (top map) and surface water (bottom map) availability. This suggests that some countries with average levels of freshwater substantially above the stress threshold may nonetheless have some geographically localized water shortages, like the north of Chile and east and north of Argentina, areas in the coast of Peru and Brazil and central and northern Mexico.

Figure 8. Groundwater and Surface Water Availability in LAC Countries



Source: Döll and Fiedler (2008).
Top map: Per capita groundwater resources, in m^3/person/year for the time period 1961–1990. Bottom map: Long-term average total runoff from land and open water, in mm/year, for 1961–1990.

2.5.4 Channels of Effect

Man-made climate change has been linked to an increase in average temperatures all over the world and a change in precipitation patterns across regions. Additionally, there has been an increase in the variation of both phenomena, including an increase in days with extreme heat, a decrease in cold days, floods, droughts, etc. All climate change models, to different degrees, predict a deepening of this warming and more variable processes.

Water resources are potentially affected by this evolution in the climate in many ways, even though current evidence cannot always clearly identify whether changes can be attributable to climate change or to other human-related activities, such as urbanization or population growth. Water resources can be affected by changes to the following:

- The process of evapotranspiration, i.e., evaporation and plant transpiration from the Earth's land and ocean surface to the atmosphere, that are key in the water cycle that replenishes freshwater resources. Local changes to precipitation and a warmer cycle can affect the speed of the water cycle and the replenishment of water resources. There is evidence that areas already rich in water are more likely to get more water and drier areas are more likely to become even drier.[4] The greater incidence of droughts will certainly increase hydric stress by decreasing water supply in newly or already challenged areas.
- The cryosphere, i.e., areas where water is now in solid form, such as glaciers, ice caps and ice sheets, may change. The cryosphere reduces the inter-annual variability of water resources, as it stores water in cold years and releases it in warm years. Losing the influence of cryosphere on the water supply may imply a lower reliability of freshwater resources.
- Surface and groundwater, i.e., river, lakes and stream runoffs and aquifer levels, depend on temperatures, precipitation and evaporation. Projections suggest that annual runoffs will increase in high latitudes and wet tropics and decrease in in dry tropical regions. Much uncertainty remains as projected

[4] See, for example, Durack, Wijffels and Matear (2012). The authors explore the speed of the water cycle using changes in the salinity of oceans and find that that high-salinity oceans are becoming saltier, while fresher oceans have been becoming fresher over time as the speed of the water cycle accelerates.

patterns of precipitation vary much across scenarios. The recharge of groundwater is highly correlated with water runoff. These changes may generate greater need for artificial storage of water. Additionally, other events related to climate change, such as a permanent rise in sea levels or transitory ones (e.g., due to storm surges) may introduce saltwater into freshwater sources at surface or groundwater levels.

- Damage to facilities is likely in the presence of extreme weather events, which may also become more likely with climate change. Storm surges, floods or hurricanes may destroy water supply and wastewater facilities or overload them. Extreme heat may crack main and sewer pipes in drier soils and conditions. Using data from DesInventar, an online inventory of the effects of natural disasters, we find that around 9 percent of climate-related events (such as heat waves, hurricanes, storm surges, etc.) have affected the water supply or the wastewater infrastructure.[5]
- New issues related to water quality may arise, as natural hazards or greater temperatures increase sedimentation, microbial contamination or other changes to the chemistry of the water. For example, the warming of lakes and rivers, chemistry changes, erosion, or increased runoffs may imply an increase in pollutant concentration (e.g., arsenic or other heavy metals) that will require additional treatment of drinking water. As mentioned above, the sea rise may increase the salinity of coastal water resources, and floods and storm surges may mix water and wastewater.

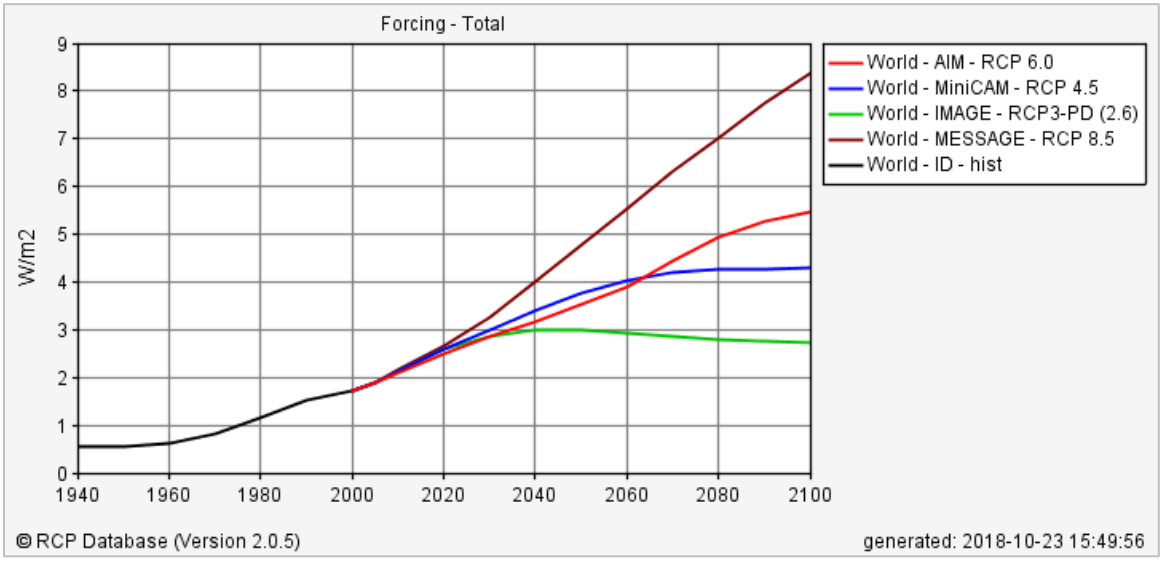
2.5.5 Projections for LAC

In the climate change literature, projections are done under four theoretical different trajectories of human emissions of greenhouse gases until 2100. These "Representative Concentration Pathways" (or RCPs) capture the net balance of energy intake from the Earth (absorbed minus radiated), also called radiative forcing, and measured in watts per square meter (W/m^2). As shown in Figure 9, the most pessimistic scenario (RCP8.5) shows a rising and non-stationary

[5] https://www.desinventar.org/.

radiative forcing trajectory leading to 8.5 W/m^2 in 2100. The following two scenarios suggest some type of stabilization in emissions around 2100, at different levels, namely RCP6 (at 6W/m^2) and RCP4.5 (at 4.5W/m^2). Finally, the least pessimistic trajectory is depicted by RCP2.6, which assumes that after peaking at 3W/m^2, radiative forcing declines and stays around 2.6W/m^2 by 2100.

Figure 9. Representative Concentration Pathways under Different Scenarios



Source: RCP Database – Version 2.0.5 available at https://tntcat.iiasa.ac.at/RcpDb.

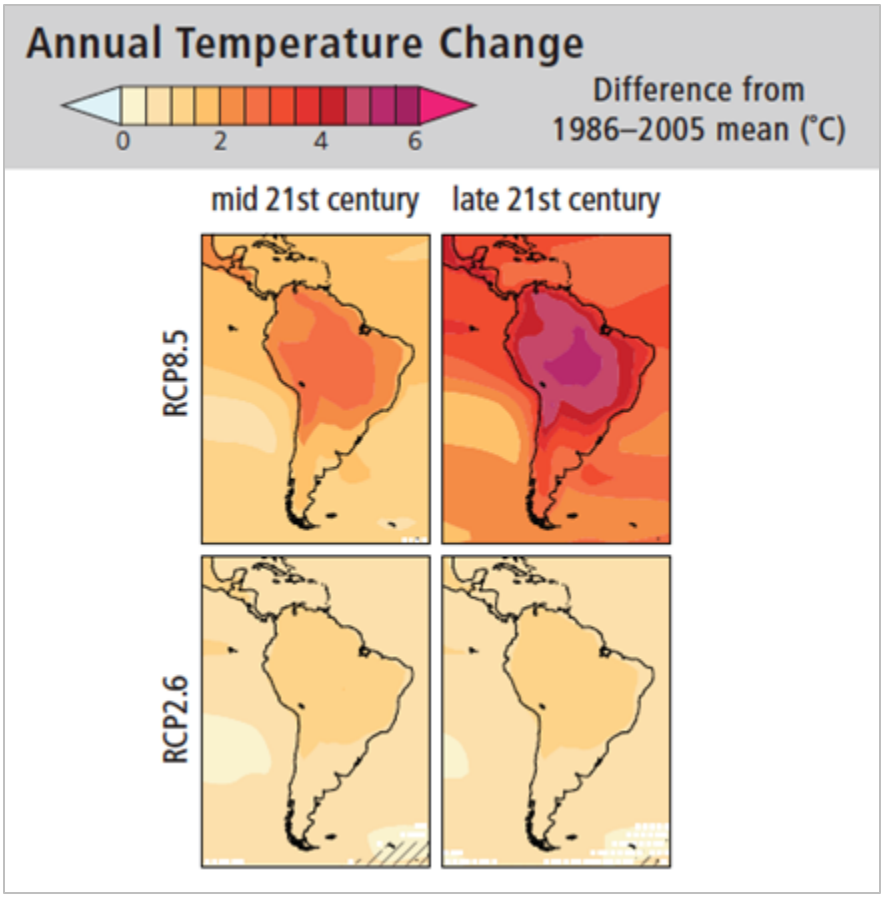
A review of scientific studies suggests that the climate has already been changing in LAC over the last 60 years. Changes have materialized in the form of unusual extreme weather events (such as El Niño), including an increase in average temperature (with more warm days and fewer cold days, and an increase in the length, frequency and intensity of heat waves) and changing patterns in rainfall. In the coast, sea levels have risen, and in the mountains, glaciers have been retreating (Magrin et al., 2014).

In terms of projections, different studies using alternative models generate disparate predictions. For that reason, most reports (including those produced by the Intergovernmental Panel on Climate Change, IPCC) add a measure of agreement between scientists in terms of likely effects. Below we summarize these projections along three different dimensions: temperatures, precipitation, and sea level.

Temperatures

Projections under different climatic models suggest that temperatures will keep rising. Figure 10 shows the estimates from the IPCC as shown in Magrin et al. (2014) who report a high level of agreement among scientists in terms of the potential increase in average temperatures under RCP8.5 and RCP2.6. In the worst-case scenario, large parts of the region may expect up to 6 additional degrees by the end of the century. Even in the best-case scenario, average temperatures are expected to rise almost 2 degrees in most of the region.

Figure 10. Projected Changes in Annual Average Temperature



Source: Figure 27-2 in Magrin et al. (2014).

Table 3 below reproduces the projected changes in temperature by sub-region for the last two decades of this century. All projections, even the most benign, suggest that in the next 80 years, the region will suffer substantial warming. If we consider that since the 1960s the average temperature has risen by around 0.1 degree per decade, every scenario suggests a likely acceleration of regional warming.

Table 3. Projected Changes in Annual Temperatures by LAC Regions by 2080-2100

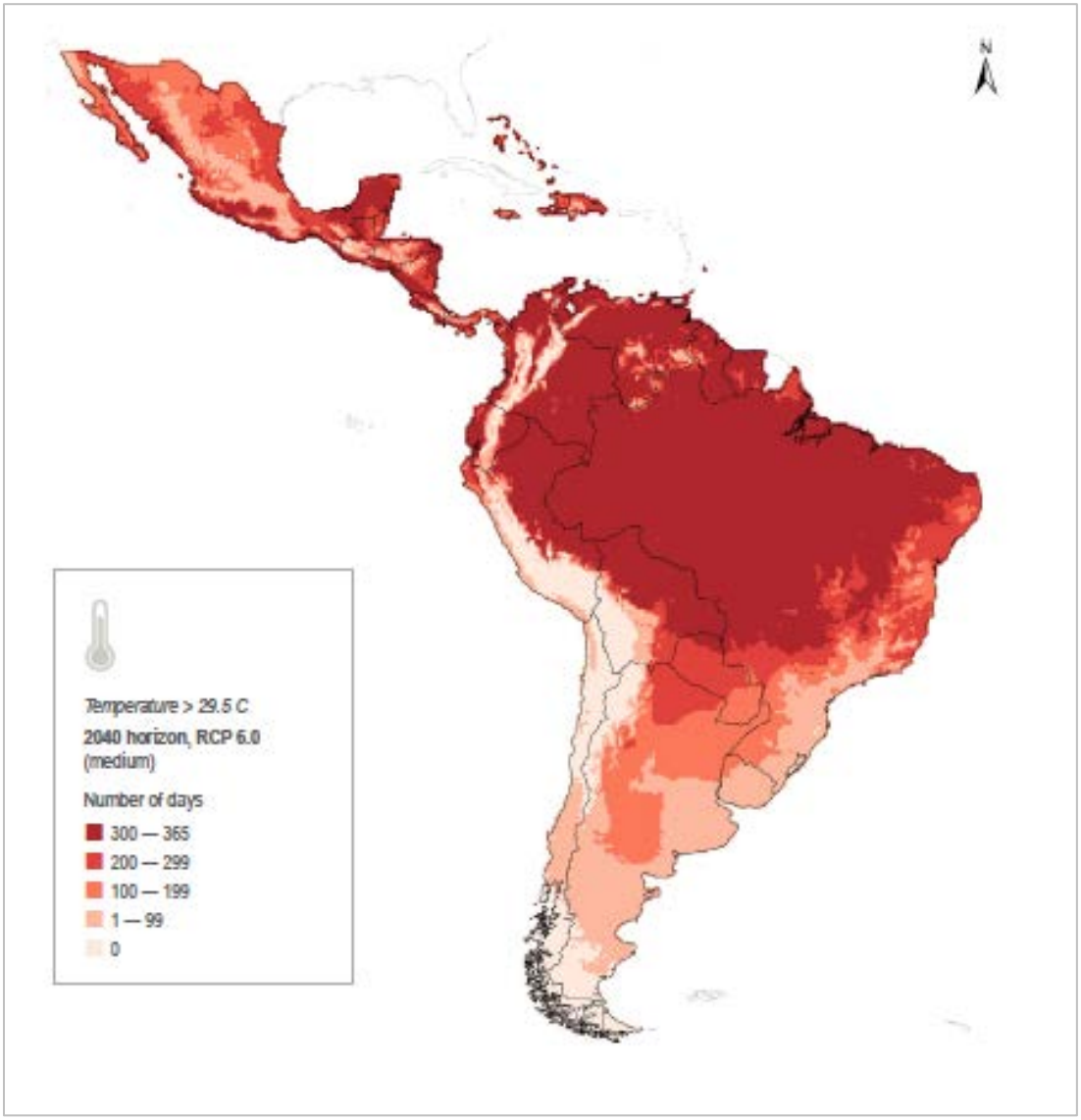
Region	Change in Surface Temperature	RCP2.6	RCP4.5	RCP6.0	RCP8.5
Central America and Mexico	Mean	1	1.9	2.3	3.9
	Likely Range	0.4-2.1	1.2-3	1.8-3.5	2.9-5.5
Caribbean	Mean	0.8	1.4	1.7	3
	Likely Range	-0.1	0.7-2.4	1-2.9	2.1-4.1
Amazonia	Mean	1	2.1	2.5	4.3
	Likely Range	0.3-2	1-4	1.9-4.4	2.4-7
North-East Brazil	Mean	1	1.9	2.5	4.1
	Likely Range	0.3-2	1-3.1	1.6-3.6	2.5-5.6
West Coast South America	Mean	0.9	1.8	2.2	3.8
	Likely Range	0.3-2	1.1-2.8	1.8-3.4	2.8-5.1
South-East South America	Mean	0.8	1.6	2	3.6
	Likely Range	0.4-1.8	0.7-2.7	1.4-3.3	1.9-5.3

Source: Table I.2 in ECLAC (2015b).

This process will be led by an increase in the number of hot days. Figure 11 below, taken from Ríos Flores et al. (2016), suggests that many areas of Mexico, the Caribbean Central and South America will have hot days for the greater part of the year. We constructed Table 4 using data from the World Bank's Climate Change Knowledge Portal to illustrate the projected increase in the number of very hot days (i.e., temperatures above 35 degrees Celsius) for different countries.[6] Countries will experience global warming in different ways. Many countries, such as Bolivia, Brazil, Paraguay and Venezuela are expected to have many additional hot days per year, regardless of whether emissions are leveled off (RCP2.6) or whether they are expected to continue to grow (RCP 8.5) until the end of the century. Other countries such as Chile, Haiti, Panama and Uruguay are not projected to increase substantially the number of hot days. Only under RCP8.5 would these countries experience an additional month of extremely hot days, on average, by the end of the century.

[6] http://sdwebx.worldbank.org/climateportal/index.cfm.

Figure 11. Projected Number of Days with Temperatures above 29.5C by 2040 under RCP6.0



Source: Map 3 in Ríos Flores et al. (2016).

Table 4. Projected Increase in the Number of Days above 35C: Most and Least Affected Countries

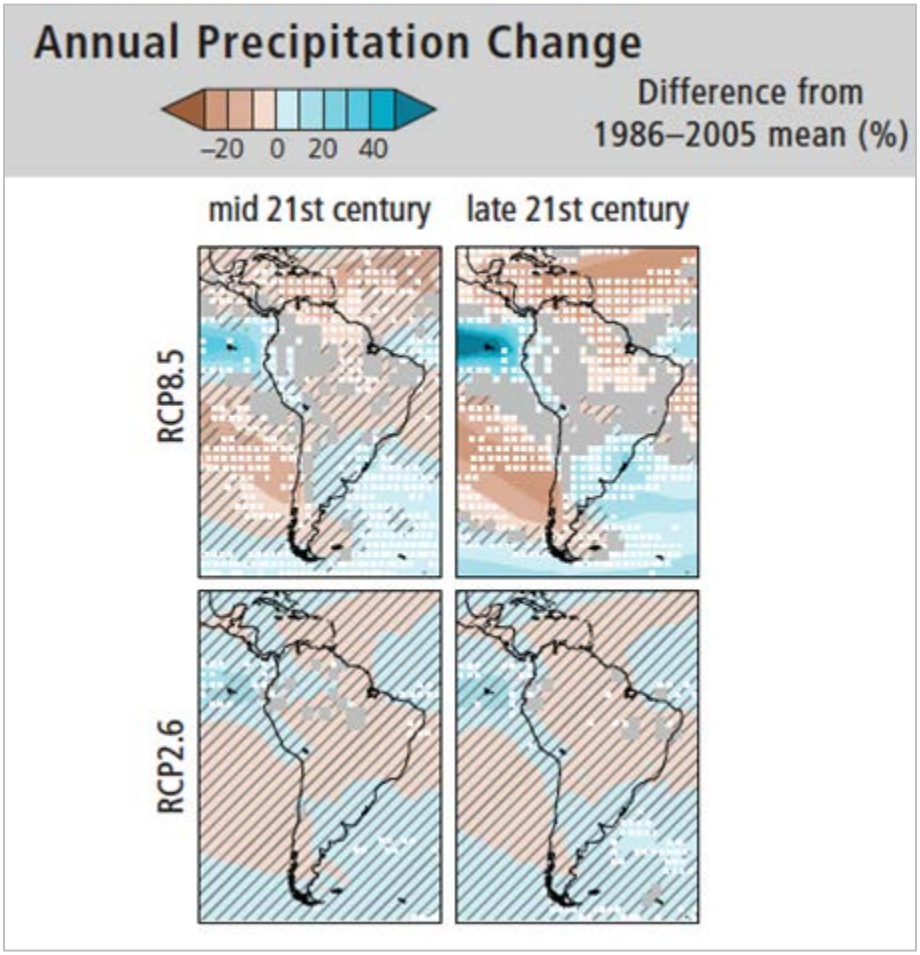
	Projection	RCP2.6				RCP8.5			
	Period	2020-2039	2040-2059	2060-2079	2080-2099	2020-2039	2040-2059	2060-2079	2080-2099
Most affected countries (top 25%)	Mean additional days	21.4	27.8	28.8	29.47	25.7	52.5	93.3	144.1
	Countries	BOL BRA MEX PRY VEN	BOL BRA GTM PRY VEN	BOL BRA GTM PRY VEN	BOL BRA MEX PRY VEN	BOL BRA MEX PRY VEN	BLZ BOL BRA PRY VEN	BLZ BOL BRA GTM VEN	BLZ BRA COL SLV VEN
Least affected Countries (bottom 25%)	Mean additional days	1.7	2.5	2.9	2.6	2.4	6.3	14.1	29.7
	Countries	CHL DOM HND HTI PAN URY	CHL DOM HND HTI PAN URY	CHL DOM HND HTI PAN URY	CHL DOM HND HTI PAN URY	CHL DOM HND HTI PAN URY	ARG CHL DOM HTI PAN URY	ARG CHL DOM HTI PAN URY	ARG CHL DOM HTI PAN URY

Source: Authors' calculations using projections from The Climate Change Knowledge Portal.

Precipitation

As discussed above, the projections in relation with precipitation are much less clear than in the case of temperatures. This is in part because changes are less monotonic. Figure 12 below, also taken from Magrin et al. (2014), illustrates these projected changes. The solid colors represent very strong agreement (there are relatively few areas in this situation) while the white dots represent when there is strong agreement (i.e., more than two-thirds of the models agree on the magnitude and sign of the change). This can be found mostly under scenario RCP8.5. The gray areas show regions where predictions diverge in sign and diagonal lines show areas where little change is expected. These can be found mostly when mean changes are small in relation to the likely ranges.

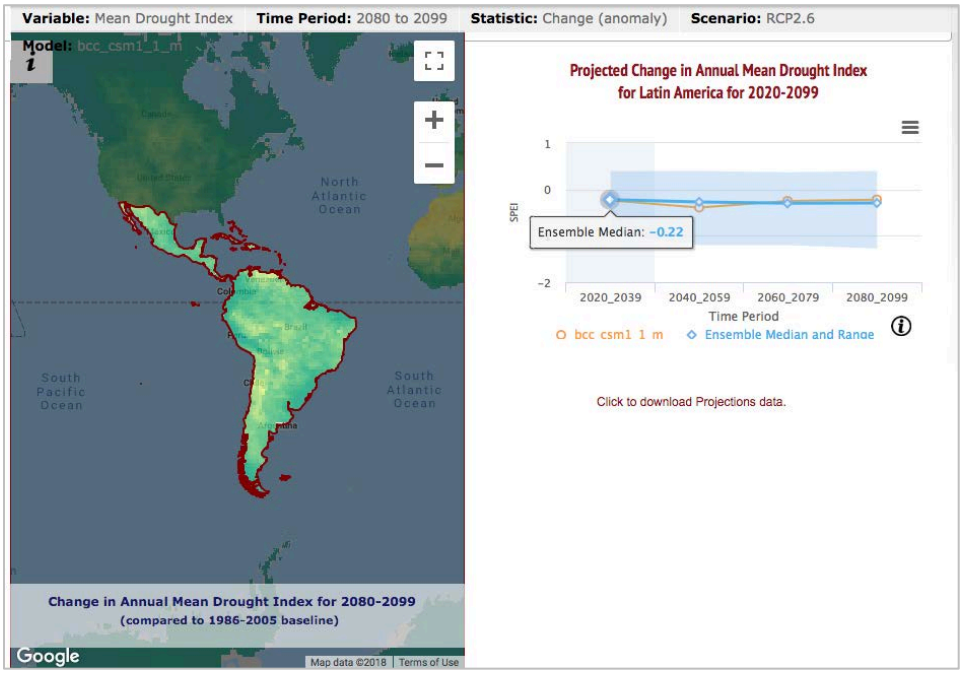
Figure 12. Projected Changes in Annual Average Precipitation



Source: Figure 27-2 in Magrin et al. (2014).

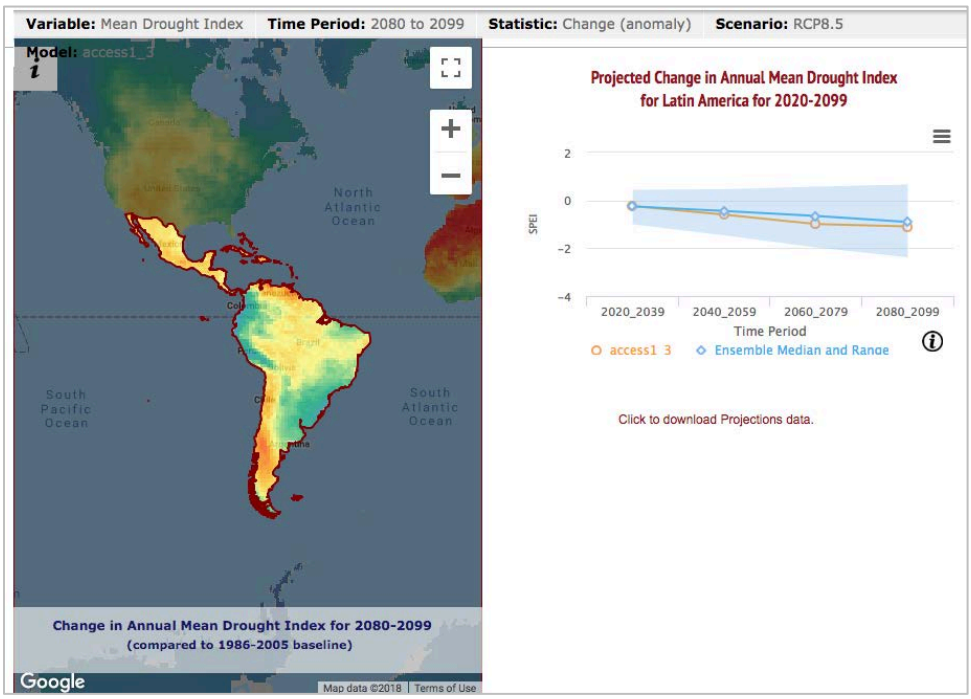
The combination of temperatures and precipitations can be measured through SPEI, the Standardized Precipitation-Evapotranspiration Index, or Mean Drought Index. SPEI is a measure of drought severity according to its intensity and duration. Projections show that droughts are likely to become more severe over this century, with heterogeneity across countries, for RCP8.5, even though the variability across model estimations remains too large to draw any strong conclusions. For RCP2.6 the region would remain at very similar levels during this century (Figures 13 and 14).

Figure 13. Projected Change in the Standardized Precipitation-Evapotranspiration Index under Scenario RCP2.6



Source: The Climate Change Knowledge Portal.

Figure 14. Projected Change in the Standardized Precipitation-Evapotranspiration Index under Scenario RCP8.5



Source: The Climate Change Knowledge Portal.

Sea level

The projections suggest that over time all the coastal areas of the region will be subject to increases in the sea level (see Figure 15 below). The northern part of South America and Central America are likely to be the most affected areas, with an excess of 20 cm of water over the next few decades.

Figure 15. Projected Increase in Sea Levels by 2040 under RCP6.0

Source: Map 4 in Ríos Flores et al. (2016).

2.6 Increasing Social Demands

Access to safe water and sanitation is perceived as an indicator of progress and human development across countries. Important per se, and instrumental to achieve other goals such as better health, there is a growing increase in the demand for availability of high-quality drinking water and clean and effective sanitation. These pressures come from different sources, such as international organizations and the civil society, or demographic and economic changes that affect the supply or demand of freshwater resources.

2.6.1 What Are the Changes Expected in the Sector?

Box 2 summarizes the key changes that are expected to increase social demands in the water and sanitation sector.

Box 2. Key Changes Driving Increased Social Demands in the Water and Sanitation Sector

International requirements on access to water and sanitation

Universal access to safe water and sanitation is an international priority and a stated development goal.

Population growth and urbanization

The region is quickly urbanizing, adding pressures to maintain high levels of water coverage and improve rapidly the provision of safe sanitation services.

Economic growth

As countries get richer, the wealthier population demands more water and sanitation and a better quality of services.

Negative perception of private operators and reversion to public ownership

The privatization of public utilities that started in the 1990s is still very controversial and lacks public support in many countries, despite the water sector arguably providing high levels of access to clean drinking water at affordable prices.

Source: Authors' compilation.

2.6.2 Are These Changes Likely To Have an Impact on the Economics of the Sector?

We find that the changing economic and demographic environment leading to increased social demands would not fundamentally alter the economics of the sector. However, it will put more pressure on getting regulation right.

Table 5 summarizes the findings of our assessment, with a more detailed discussion for each driver following below.

Table 5. The Impact of Increasing Social Demands on the Water and Sanitation Sector

Driver for increasing social demands	Will it change the economics of the sector?
International requirements on access to water and sanitation	Unlikely.
Population growth and urbanization	Likely (but limited to the retail element of the value chain), due to higher customer care demands.
Economic growth	
Negative perception of private operators and reversal to public ownership	Likely, given constraints on policy options that involve private operators.
Overall	**Likely, but change does not appear to be radical.**

Source: Authors' compilation.

2.6.3 International Requirements on Access to Water and Sanitation

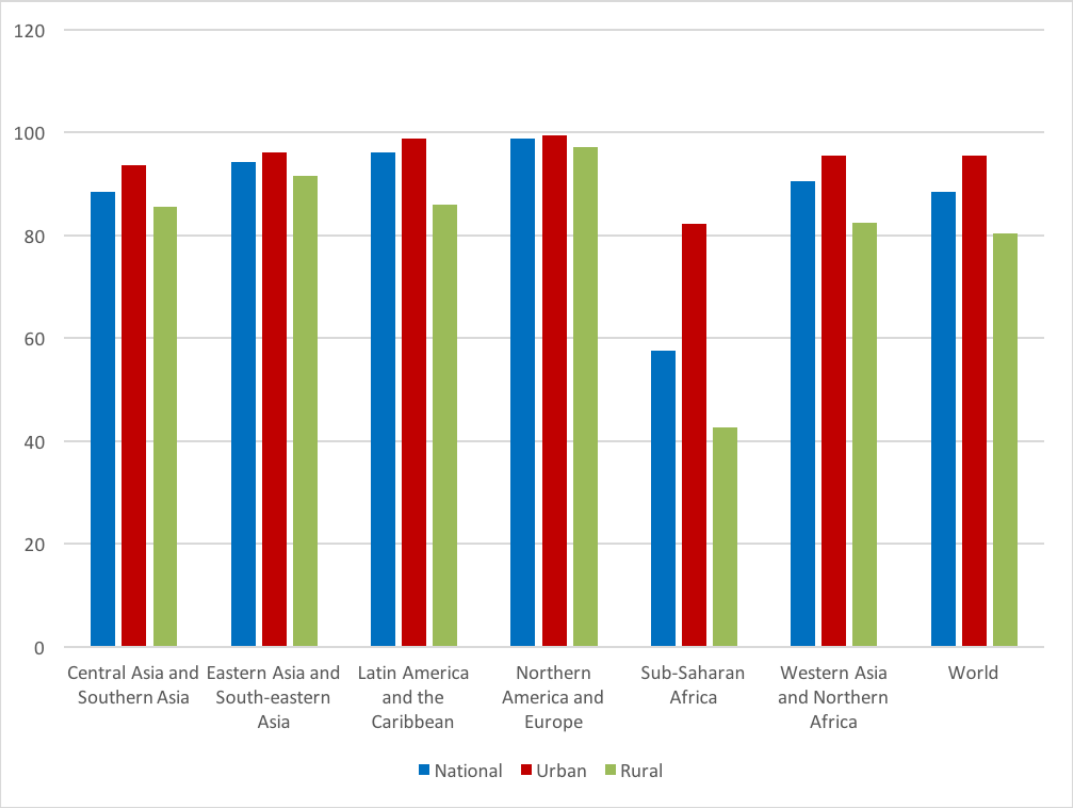
Access to water has become a salient issue in terms of characterizing the living standards of the population. The Millennium Development Goals (MDGs) aimed at halving, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation, as part of the environmental sustainability goal (Goal 7). The United Nations went further and declared a direct link between clean drinking water and sanitation and human rights. A 2010 Resolution of the UN General Assembly encouraged states and international organizations to provide support (e.g., financial resources, capacity-building, technology transfer) aiming at reaching full coverage in terms of access to safe and clean drinking water and sanitation. This became the 6th objective in the newly formulated Sustainable Development Goals (SDGs) that followed the MDGs.[7] Access to water also became one of the 10 components of the Global Multidimensional Poverty Index, designed by the United Nation Development Program to capture the state and evolution of human development across the developing world.

Improved drinking water sources are those which, by nature of their design and construction, have the potential to deliver safe water. The definition of access to safe sources of

[7] Target 7.C of the MDGs was to halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation; whereas SDG 6 is to ensure availability and sustainable management of water and sanitation for all by 2030. More specifically, SDG 6.1 and 6.2 call for closing access gaps (achieving universal and equitable access to safe and affordable drinking water, and to sanitation and hygiene); whereas SDG 6.3 is 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. SDGs 6.4 to 6.6 are environmental targets: 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; implement integrated water resources management at all levels; and protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

clean water that are captured in the SDGs includes a measure of a "safely managed drinking water service" (that includes availability of water in the premises, that can be used when needed and that is free from contamination) or a "basic" service where a service with these characteristics is available after a round trip of 30 minutes or less to collect water. By these standards, the region is performing extremely well. As shown in Figure 16, almost everyone has access to improved drinking water sources, particularly in urban areas (where safely managed service reaches 76 percent of the population and basic service is delivered to a further 23 percent). In rural areas, the coverage consists mostly of basic services, where 85 percent of the population has access to improved drinking water.

Figure 16. Access to Improved Drinking Water by Region in 2015 (%)



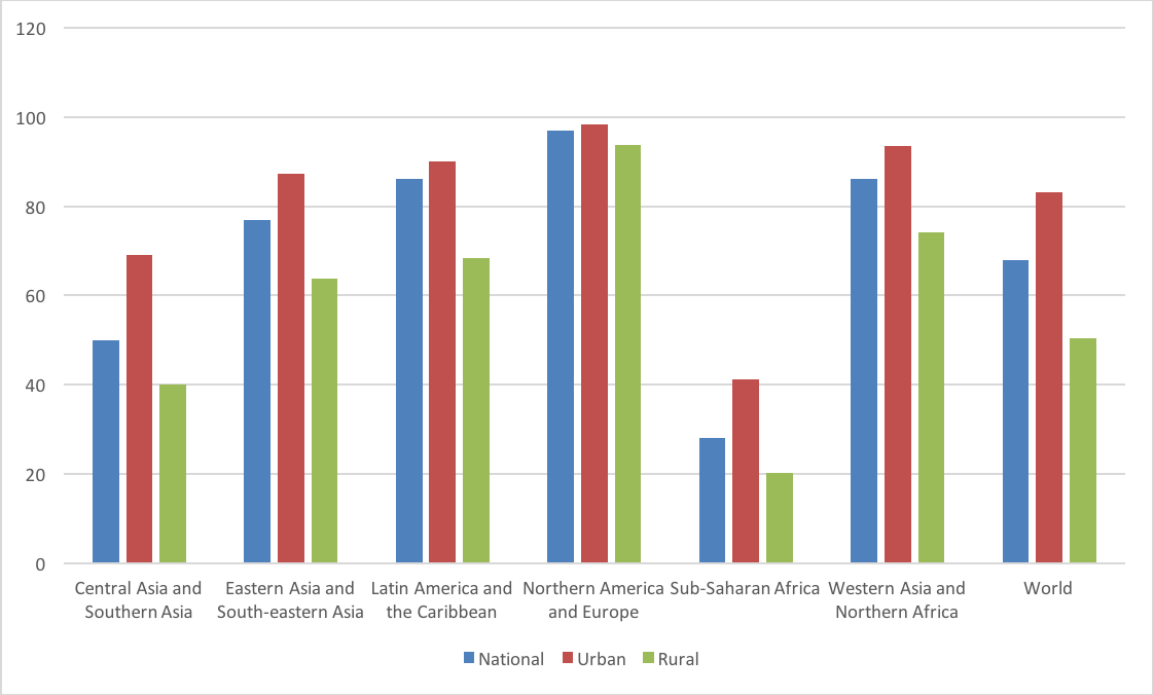
Source: Author's calculation using WHO/Unicef Joint Monitoring Program data available at https://washdata.org/data.

The definition of "improved sanitation facilities" consists of those designed to hygienically separate excreta from human contact. To meet the criteria for having a safely managed sanitation service people should not share facilities with other households, and the

excreta should be either treated and disposed in situ, stored temporarily and then emptied and transported to treatment off-site, or transported through a sewer with wastewater and then treated off-site. If this last requirement is not met, then people using those facilities are classified as having "basic" sanitation service.

Despite success in drinking water, access to safe sanitation remains a challenge in the region, in particular in rural areas (see Figure 17). In urban areas, while access to improved facilities reaches 90 percent, more than two-thirds of these households use basic services only. In rural areas, all of the 70 percent of households with access to improved sanitation rely on basic services that have no access to safe treatment of feces.

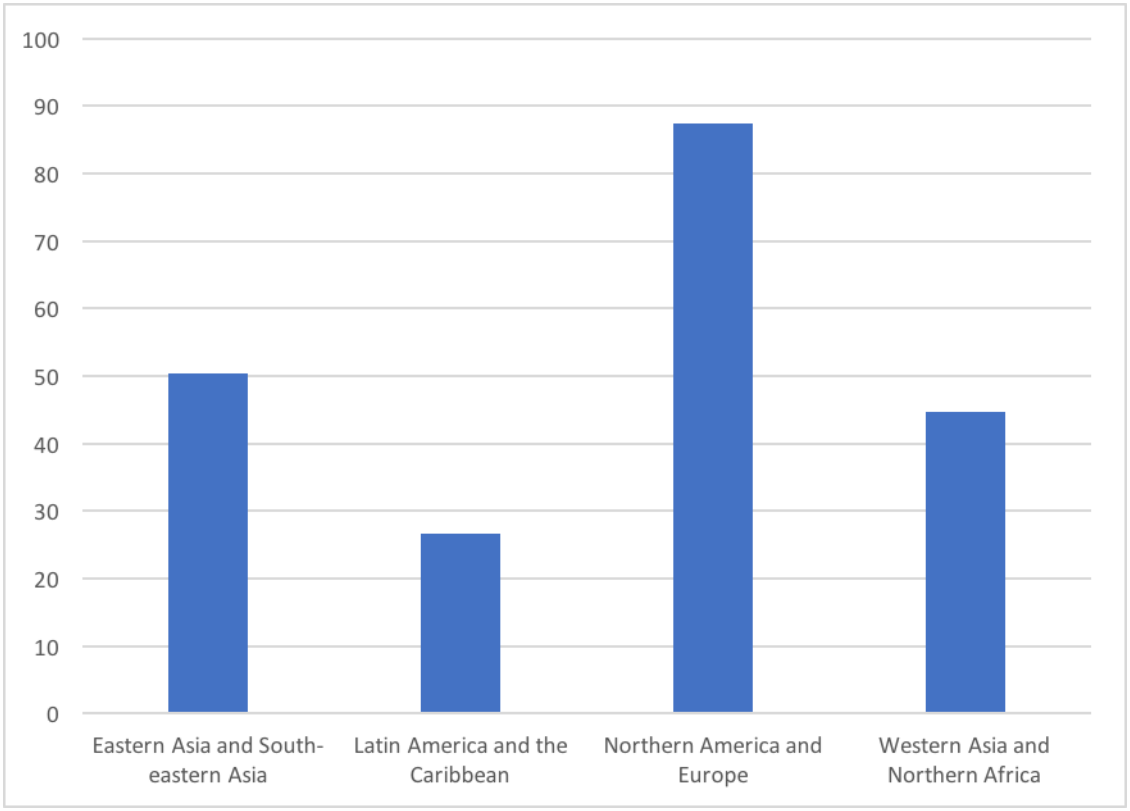
Figure 17. Access to Improved Sanitation Facilities by Region in 2015 (%)



Source: Authors' calculation using WHO/Unicef Joint Monitoring Program data available at https://washdata.org/data.

Figure 18 compares access to safely managed sanitation across regions. LAC underperforms when compared to other regions such as Eastern and Southeastern Asia or West Asia and North Africa, where 40 to 50 percent of the urban population has access. In the developed world, safely managed sanitation covers more than 87 percent of the urban population.

Figure 18. Safely Managed Sanitation in Urban Areas in 2015 (%)



Source: Authors' calculation using WHO/Unicef Joint Monitoring Program data available at https://washdata.org/data.

The fact that the LAC region presents clear signs of coverage underperformance, combined with the ever-increasing international coverage requirements mentioned at the beginning of this section, means that there is likely to be a degree of social pressure for the sector to achieve the coverage required.

This type of social pressure, however, is not new. The LAC region has historically been a coverage underperformer in sanitation, and the international coverage goals have already been in place for more than two decades.

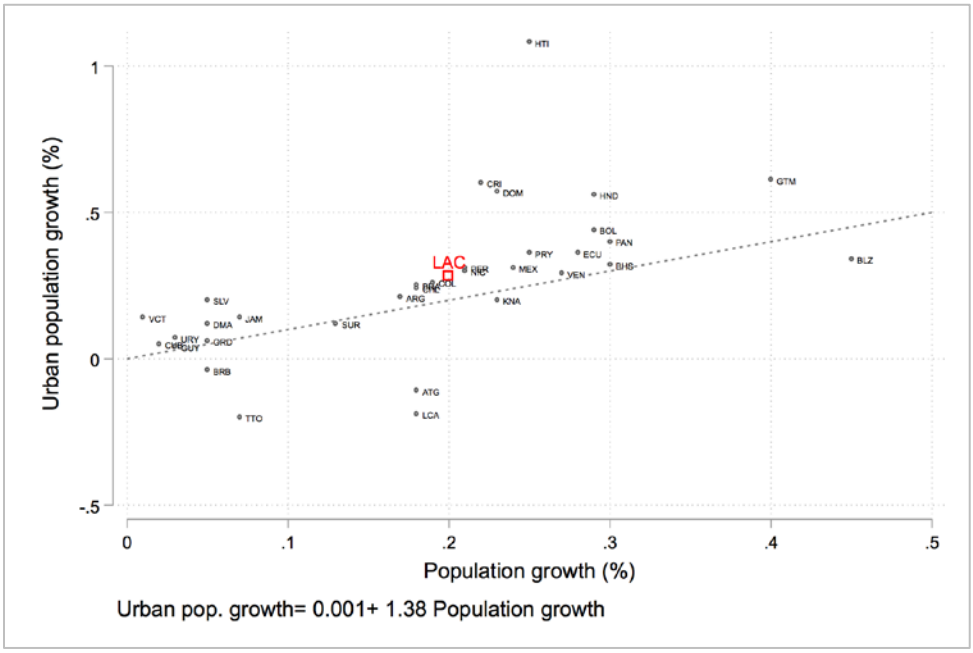
As a result, we do not envisage that the social demands resulting from exogenous coverage requirements will be a force that would change the economics of the sector.

2.6.4 Population Growth and Urbanization

Around 80 percent of the population in LAC currently lives in urban areas. Since 2000, when urbanization in the region exceeded 75 percent, and with a few exceptions (mostly in the

Caribbean), countries have experienced a deepening of urbanization. Figure 19 below shows that between 2000 and 2015, the urban population in LAC has been growing almost 40 percent faster than the total population. This trend is expected to continue and deepen over the next few decades, with urbanization rates predicted to reach almost 84 percent by 2030, 87 percent by 2050 and 91.5 percent by 2100.[8] By the end of the century, ECLAC projects that total population will grow more than 20 percent while urban population is expected to grow almost 38 percent.

Figure 19. Urban and Population Growth (LAC Countries 2000-2015)



Source: Authors' calculation using ECLAC, "Long Term Population Estimates and Projections: 1950-2100" 2017 and World Bank.
Note: Dotted line represents equality of population and urban population growth.

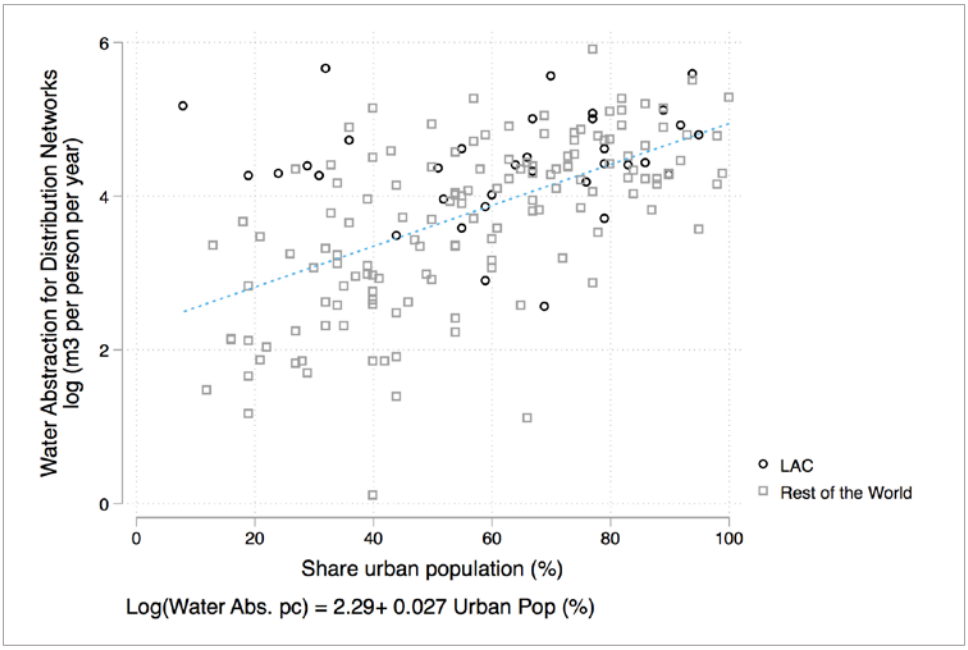
According to the United Nations, around 45 percent of the population of LAC lives in 125 cities with more than 500,000 people, and more than 15 percent in just eight cities with 5 million people or more (UN, 2016). These cities (and smaller ones) are expected to keep growing: by 2030 the UN expects that more than 150 cities with 500,000 or more people will be home to almost 50 percent of the region's population. This will most likely generate increasing demand for water and sanitation services, as more urbanized countries tend to show greater

[8] https://www.cepal.org/es/temas/proyecciones-demograficas/estimaciones-proyecciones-poblacion-total-urbana-rural-economicamente-activa.

levels of per capita water abstractions by municipalities for public network use, as shown in Figure 20. This relation, however, should be taken with care when making projections of water demand, as Latin America is already one of the most urbanized regions in the world and levels of access to safe water are high, as well as because cross-country comparisons are also picking up the fact that urbanization is strongly correlated to GDP per capita.

In any case, whether the urbanization process happens because population growth is concentrated in urban areas, because people move from rural areas to cities or because previously rural areas become urban, it will most likely result in greater consumption of network water. This projection is valid under the assumption that the region at least maintains its current level of access to safely managed drinking water in urban areas. Additionally, greater urbanization rates may also put even more pressure on the provision of safe sanitation, which currently relies on basic services and is well below the coverage of safe management of excreta that can be found in other regions.

Figure 20.[1] Urban Population and Network Water Abstraction[2] per Capita in 2015



Source: Authors' calculation using ECLAC, "Long Term Population Estimates and Projections: 1950-2100" 2017, Aquastat-FAO and World Bank.
Note: [1]The dotted line is the fitted linear correlation between urban population and water abstraction. [2]In Aquastat-FAO, Network Water Abstraction is termed Municipal Water Withdrawal, and it is usually computed as the total water withdrawn by the public distribution network. As a result, Network Water Abstraction can include water used by industries and urban agriculture connected to the distribution network.

On the other hand, greater concentration in urban areas could be expected to reduce the unit cost of networks, simply because networks are broadly fixed investments and in denser areas they are used by more people than in less dense areas. This means that it is unclear whether population growth and urbanization will generate social pressures that could materially change the economics of the sector.

There is however one aspect of an increasing urban population growth that could potentially impact on the economics of the sector. This is related to the fact that the type of consumer that lives in cities may be more demanding in terms of quality of services than the type of consumer that lives in rural areas of LAC countries. This argument, which can also be made in relation to per capita income level, is discussed in the next section.

2.6.5 Economic Growth

Aggregate network abstraction of water per capita is also associated with greater levels of income per capita, as shown in Figure 21. This cross-country relationship is slightly stronger when looking only at countries in LAC (the elasticity moves from 0.67 to 0.77), suggesting that as countries get richer the household demand for water also increases.

Our elasticity estimates are rough approximations to the (average) income elasticity at the household level, and are only meant to be illustrative and facilitate back-of-the-envelope calculations, but it is worth noting that those estimates are in line with the existing evidence: the distribution of income elasticities in the meta-sample of Dalhuisen et al. (2013) has a mean of 0.43 and a median of 0.24 (with a standard deviation of 0.79). As expected, water demand appears to be inelastic in terms of income changes.

While there are no long-term projections of economic growth, using current short-term IMF projections of 1.7 annual per capita growth (that is in line with the growth for the last 25 years), implies that household water consumption in LAC should increase around 18-20 percent by 2030. This means that there is likely to be an increase in water and sanitation demand in the LAC region because of the expected increase in GDP per capita, which could pose a challenge to the sector.

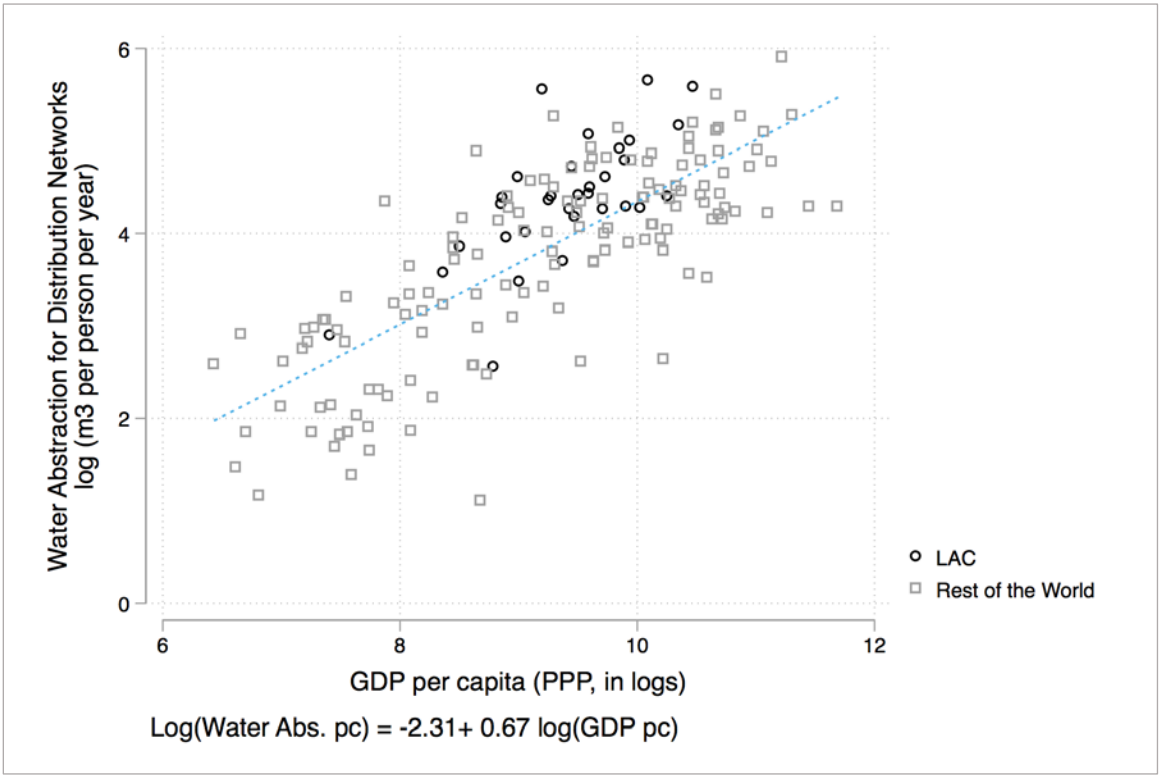
However, our view is that, as in the higher urbanization case, the impact on the economics of the sector is not likely to happen due to the higher water demand (even though

countries will need to cater for additional network connections and consumption), but due to the emergence of wealthier clients who demand a higher level of quality.

For example, it is reasonable to imagine that LAC wealthier clients now for the first time start consuming mobile phone services, taking taxis using apps in their phones and banking on-line would require from water companies the same level of customer services quality that they receive from all the other companies they deal with. Having this new type of more demanding and empowered client could in our perspective lead to an impact on the economics of the sector.

However, this impact is likely to be very focused. In terms of the value chain structure discussed in Figure 3, this change could be represented as an enlargement of the retail element of the value chain, which incorporates the customer service dimensions of the water and sanitation industry.

Figure 21.[1] GDP Per Capita and Network Water Abstraction[2] per Capita in 2015



Source: Authors' calculation using Aquastat-FAO and World Bank.
Note: [1]The dotted line is the fitted linear correlation between GDP per capita and water abstraction. [2]In Aquastat-FAO, Network Water Abstraction is termed Municipal Water Withdrawal; and it is usually computed as the total water withdrawn by the public distribution network. As a result, Network Water Abstraction can include water used by industries and urban agriculture connected to the distribution network.

2.6.6 Negative Perception of Private Operators and Reversion to Public Ownership

The privatization of water services in Latin America is deemed to have brought about increases in access and efficiencies that many times translated into lower prices and greater quality of service (McKenzie and Mookherjee, 2003). In some cases, this has been associated with improvements in health outcomes, particularly among children. For example, Galiani, Gertler and Schargrodsky (2005) find that child mortality due to waterborne diseases has fallen due to the privatization of water services in Argentina, while Galiani, González-Rozada and Schargrodsky (2009) find lower incidence and severity of diarrhea episodes among children and greater savings in water expenditure after the privatized company expanded access to the water network in slums in Buenos Aires. Despite this, negative perceptions about the extent to which privatization has led to improvements in household welfare have prevailed in the region (McKenzie and Mookherjee, 2003). Even households that have benefited from greater access and lower prices, while having a slightly more positive perception of the privatization of water services than those who did not, still hold negative opinions (Di Tella, Galiani and Schargrodsky, 2012).

This general dissatisfaction with the private provision of water led some countries—like Uruguay in 2004, Argentina in 2006 and Bolivia in 2007—to re-nationalize water services. In the case of Uruguay, this has resulted in improvements in access to sanitation for poorer households and an increase in water quality, as measured by chemical tests (Borraz et al., 2013).

The general negative perception of private operators poses a challenge for the regulation of the sector, as it is increasingly difficult to work with systems that are based on private ownership of companies. Today it has become difficult to implement a sector reform that involves outright privatization of companies in LAC. In addition, in countries where private operators are already in place the negative perception of private operators has provided the grounds for policies that have shifted the original regulatory regimes envisaged at privatization into much more interventionist arrangements.

Interestingly, this is not a challenge limited to the LAC region. In E&W, a financing outperformance sharing mechanism (see Section 3.3.6) has been recently added as a response to the public unease with private companies. Note this is just a very mild version of an interventionist regulatory measure, especially compared to the open proposals of full

nationalization that the United Kingdom's main opposition party (the Labour Party) has been putting forward for more than five years.

In summary, the negative perception of private operators may not have the potential to impact on the economics of the sector, but it certainly limits policy options available.

3 England and Wales (E&W) Benchmark Case Study

In this section, we discuss in detail the E&W case study, which we use as an international benchmark for the water and sanitation sector. The rationale for our election of this benchmark is that the United Kingdom has traditionally been considered a leader in infrastructure regulation. In particular, there is consensus among regulation experts that the water and sanitation regulatory system in E&W can be regarded as international best practice. In addition, in E&W the regulation of the water and sanitation sector is constantly being reviewed and modified to resolve problems and to keep addressing future challenges,[9] which makes this benchmark particularly useful for the purposes of our study.

3.1 Where Is the Sector, and How Did It Get There?

Today E&W benefits from an efficient and effective water and sanitation industry. Virtually every household has a continuous supply of piped water of very high quality and connection to a mains sewerage system. Environmental standards are very high as well, and the sector is arguably perceived as being broadly en route to achieving resilience to tackle future challenges.

Significant steps to achieve a high coverage were taken during the second half of the nineteenth century and the beginning of the twentieth century as a result of the industrial revolution, urbanization and economic development. Thus, as opposed to the LAC case discussed in Section 2, the last hundred years of the history of the industry were more focused on restructuring and achieving efficiencies and quality than on achieving coverage. A stylized description of this recent history involves three phases: Early consolidation (1930s to 1960s); Restructuring (1973-1989); and Privatization (1989 onwards).[10] Key characteristics of each of these phases are outlined in the box below.

[9] See for example NIC (2018).
[10] See Ofwat (2006).

Box 3. Three Key Phases in the Recent History of the Water and Sanitation Sector in E&W

Early consolidation (1930s to 1960s)

By the mid-twentieth century, E&W were already notable for providing water and sanitation services to a high proportion of the population. For example, by 1944, 70 percent of rural households and nearly 100 percent of urban households in E&W had piped water supplies. The origin of this unusually high coverage can be traced to the early nineteenth century and was shaped by the industrial revolution, urbanization, and increasing demand driven by economic development. However, in the period up to and after the Second World War the water industry was highly fragmented. In 1945, there were more than 1,000 bodies involved in the supply of water and around 1,400 bodies responsible for sewerage and sewage disposal. Most of these were local authorities.

The two key drivers for reform during this period were: to consolidate the numerous local authority undertakings; and to make provision for public investment to extend the water and sanitation services to rural communities.

At the end of 1973 there were:

- 198 statutory water undertakings;
- 1,393 sewerage and sewage disposal authorities; and
- 29 River Authorities.

Restructuring (1973-1989)

In the late 1960s and early 1970s the continued problems with planning of water resources and forecasts of future demands prompted a more far reaching restructuring of the industry. The Water Act 1973 established 10 new regional water authorities that would manage water resources and the supply of water and sanitation services on a fully integrated basis.

Central government set financial constraints and performance aims for each authority, which in a context of instability in the wider economy and high levels of debt inherited by the water authorities, led to insufficient expenditure to meet the capital maintenance and investment requirements of the industry.

Privatization (1989 onwards)

With the government unwilling to provide any additional public finance to meet the demand for capital investment, and with the privatization of other public services underway, government concluded that privatization of the industry was a viable outcome.

Privatization involved the transfer of assets and personnel of the 10 water authorities into limited companies. This was accompanied by: the raising of capital by floating the companies on the London Stock Exchange; a one-off injection of public capital; the write-off of significant government debt; and the provision of capital tax allowances.

To ensure the interests of customers and the environment were secured, privatization led to further restructuring by separating the roles of regulation and provision of water and sanitation services.

Source: Ofwat (2006).

Today the sector is served by 17 privately-owned regional monopolies: 10 water and sewerage companies (WaSCs) and seven water-only companies (WoCs).[11] As WoCs provide water in relatively small areas within WaSCs' territories, WaSCs cannot provide water in those areas within their own regions.

Since the industry was privatized a regulatory framework has been in place to ensure there is investment in the sector to achieve high standards of service at a fair price. In almost 30 years of history, this framework has allowed the companies to invest more than £130 billion in maintaining and improving assets and services, achieving high quality and environmental standards. It is worth noting here that the investment in water and sanitation sector in E&W, as well as the operating expenses, have been privately funded in full by the 17 appointed monopolies, so there have not been any subsidies from the government going into the sector since privatization.

A fundamental governance feature of the sector is the separation between policy and regulation. A government office, the Department for Environment, Food and Rural Affairs (Defra), establishes sector policy objectives in legislation, and a number of regulators ensure the sector achieves those objectives:

- Ofwat, the economic regulator who runs the regulatory framework and sets tariffs based on it;
- Drinking Water Inspectorate (DWI), the quality regulator;
- Environment Agency (EA), the environmental regulator; and
- Competition Markets Authority (CMA), the appealing body.

In the following sections, we provide a description of the regulatory framework run by Ofwat. We start by describing the base regulatory regime, and then focus on a few quite significant changes to the regime that have happened in the last five years.

[11] This excludes smaller appointed water and sanitation companies for whom Ofwat does not set full price controls.

3.2 Regulatory Regime

The basic regulatory regime run by Ofwat since privatization, depicted in Figure 22 below, is a tuned down (or balanced) RPI – X regime.

Figure 22. Ofwat's Basic Regulatory Regime

Source: Authors' compilation.

There is a price / revenue cap set in real terms and adjusted by an inflation index.[12] This cap provides the basic incentives for companies to achieve efficiency savings. This cap is combined with several mechanisms that ensure that the power of incentives and the allocation of risks are appropriately balanced:

- Regular price control reviews, undertaken every five years. This ensures that there is a regular point in time at which the regulator decides how the efficiency gains are shared between companies and consumers.
- A set of quality regulation mechanisms to ensure that efficiency savings are not achieved at the expense of quality. An example of quality regulation in E&W has been the Guaranteed Standards Scheme (GGS) whereby, if a company fails to meet any of the guaranteed standards, it must automatically pay a pre-set penalty to the affected customers.
- Comparative competition methodology to ensure companies do not assume that efficiency targets will be set purely based on their own costs and thus do not lose incentives to cut costs. An example of this is the use of econometric cost modelling for assessing expected costs.

[12] Over the course of its history Ofwat has moved from capping prices to capping revenues.

- Pass-through mechanisms of certain costs to ensure that companies are not penalized for changes in costs they cannot control. An example of these mechanisms is the interim determination of price limits (IDoKs), whereby companies can apply to Ofwat for a recalculation of the price cap in the middle of the regulatory period if they can show that certain pre-agreed costs have exceeded certain pre-set thresholds.

This regime has remained very stable since privatization until around 10 years ago, when many quite significant changes started being considered and introduced. We discuss these changes in detail in the next section.

3.3 Regulatory Innovations

Since the 2014 price control review (PR14),[13] Ofwat has been introducing the following regulatory policies aimed at improving its basic regulatory regime:

- Competition
- Menu regulation
- Totex approach
- Outcomes approach
- Customer engagement
- Financing outperformance sharing mechanism
- Risk-based review (known also as Fast-tracking)

Although these changes do not modify the basic nature of Ofwat's existing regime, they are quite innovative and Ofwat has decided to pursue them in response to perceived sector problems or challenges that do not differ significantly from the challenges posed by the changes described in Section 2 of this paper. As a result, understanding these policies is fundamental if this case is to be used as inspiration for designing future regulatory regimes in LAC countries.

[13] Ofwat names price control reviews using the acronym PR (for price review) followed by the year in which the new price comes into effect.

Table 6 outlines the rationale for each one of these regulatory innovations highlighting in bold the problems or challenges that are also found in LAC. The subsections that follow discuss each one of the innovative regulatory policies in detail.

Table 6. Rationale of Regulatory Innovations in E&W

Regulatory policy	Rationale
Competition	**Ensure that the regulatory system enables the development of innovations** **Ensure that the regulatory system is able to respond to future more demanding and empowered customers** **Ensure the sector is resilient to deal with the challenges posed by climate change**
Menu regulation	Incentivize the submission of more realistic and accurate business plans from utilities
Totex approach	Minimize the perceived capex bias existing in the water and sanitation sector
Outcomes approach	**Provide resilience to address future challenges** **Ensure the sector satisfies customer needs**
Customer engagement	**Ensure the sector satisfies customer needs**
Financing outperformance sharing mechanism	**Tackle general perception from the public that some companies are profiting from financial engineering at the expense of consumers**
Risk-based review (known also as Fast-tracking)	Reduce regulatory burden

Source: Authors' compilation based on Ofwat documents.
Note: Rationales that appear relevant to LAC are highlighted in bold.

The content in Table 6 is useful for highlighting that the E&W case is not free of problems or challenges. Each of the elements in the "Rationale" column represents a problem or challenge. The usefulness of the E&W case study stems from the fact that something is being done to address these challenges, so what is being done can be used as inspiration to resolve similar challenges arising in the LAC region.

Unfortunately, it may be still too early to reach a definitive judgment on how effective E&W policies have been in resolving the targeted problems or challenges, but more work could be done on this area at least to reach some preliminary messages. This type of analysis is another

of the areas bulleted in Section 1.3 where the content of this paper could be expanded in the future.

3.3.1 Competition

There were attempts to promote competition in the water sector during PR04 and PR09 with the Water Supply Licensing (WSL) regime. However, these attempts failed categorically. In Ofwat's words:

> "No customers have yet switched supplier, few wholesale master agreements (WMAs) have been signed between licensees and appointed water companies, most WMA negotiations are taking too long to complete, and not even half of licensees appear to be actively engaging in WSL negotiations" (Ofwat, 2007).

From PR14, however, Ofwat embarked on a much broader competition involving the following elements:

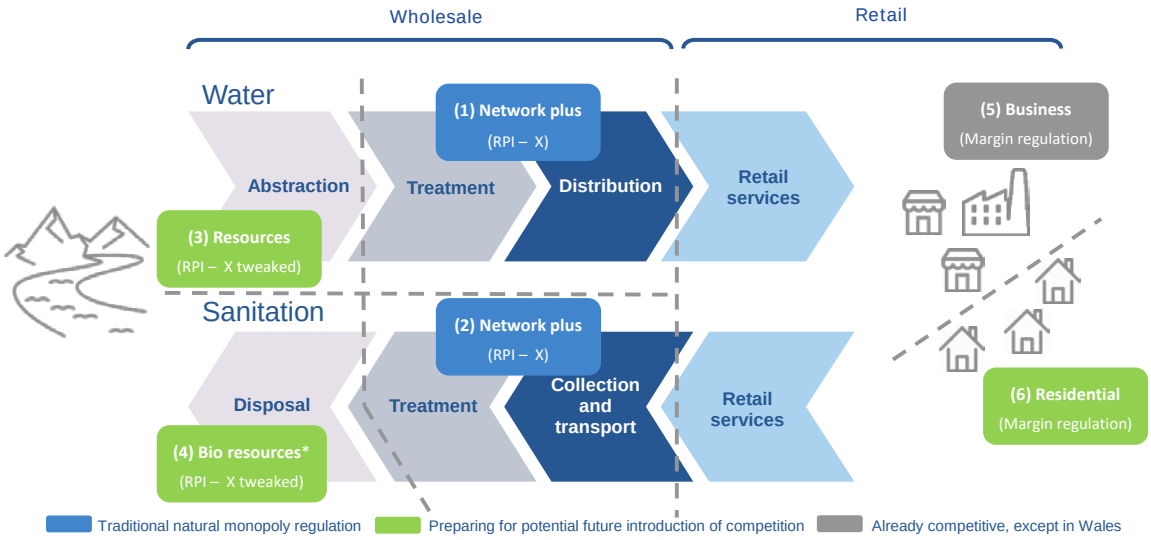
- Separated price controls, tailored to degree of expected competition.
- Business retail legally separated and open to competition in England.
- The rest of the retail market, water abstraction, and wastewater disposal (including sludge treatment) regulated to facilitate future introduction of competition.
- New criteria for access pricing (replacement of the old and perceived as flawed "retail-minus" access pricing principle).
- Increased emphasis on greater use of markets in the financing, design and delivery of new water assets by third parties, rather than incumbent water companies.

This reform is quite radical and was undertaken in cooperation with Defra, which introduced the required legal changes in the Water Act 2014. For example, in the past the sector was regulated as a vertically integrated monopoly. With the current competition reform, the sector is split into the following six subsectors and a separate price control is run for each of the following subsectors:

1. Water network plus
2. Wastewater network plus
3. Water resources
4. Wastewater bio resources
5. Retail business
6. Retail residential

Retail business has already been separated legally and the sector has been open to competition in the market since 2017. Retail residential could follow suit. Water resources and wastewater bio resources are still being regulated as natural monopolies but with certain tweaks that hint Ofwat's intention to introduce competition and depart from the traditional RPI – X system of regulation. The only elements of the value chain that will remain being regulated as natural monopolies are the network plus elements. This split of the water industry is depicted in the figure below.

Figure 23. The Six Separate Price Controls of PR19



Source: Authors' compilation.
Note: * Bio resources includes sludge treatment, transport, recycling and disposal.

This split of the industry is expected to set the basis for some stronger method of separation going forward. It is worth noting here that Ofwat sees competition reform as a long, step-by-step process, not a one-off massive reform.

As an example, Box 4 shows how Ofwat's regime is changing to introduce competition in the resources element of the value chain.

Box 4. Ofwat's Approach to Encouraging Competition in Resources

Approach

Markets for water resources are targeted at new rather than existing water resources. There are two main markets in resources that Ofwat is actively encouraging: bidding markets and bilateral markets. These markets, alongside the features that Ofwat uses to introduce them, are discussed below.

Bidding markets

In the bidding market, third party providers submit bids to an incumbent to provide solutions to help it meet its future needs, as set out in their water resources management plan. Options provided by a third party, can either be supply side, such as a water trade, or demand side, such as a water efficiency scheme.

The bidding market is being supported by set requirements on incumbent companies including market information requirements, to increase the transparency of the opportunities available to third party providers; and bid assessment framework requirements, to create more clarity and confidence to third party providers that their bids will be assessed fairly.

Bilateral markets

In the bilateral market, third party providers, who can be independent or incumbents operating out of area, contract directly with retailers in the business market to supply them water resources. This involves the payment of access prices to incumbents for use of their distribution system and, if needed, treatment facilities.

Bilateral markets are envisaged only for England and cannot start until Defra brings into force the relevant provisions of the Water Act 2014. Ofwat's working assumption is that 2022 is a likely implementation date. Note here that Defra has been separately consulting on undertaking a broad water abstraction reform that goes beyond the boundaries of Ofwat's and that includes abstractions for all other uses (e.g. agriculture or electricity generation).

Bilateral markets are implemented using an automatic, in-period adjustment mechanism that adjusts incumbent's revenue allowances when there is market entry. The aim of these mechanisms is to ensure incumbents and not customers face the risk from bilateral market entry.

Source: Ofwat (2017).

3.3.2 Menu Regulation

Until the introduction of menu regulation Ofwat's basic regulatory regime was a tuned-down RPI – X regime in that it had several mechanisms that ensured there was a balanced degree of sharing of outperformance or underperformance between companies and consumers. For example, the fixed five-year period after which prices were reset considering efficiency gains or losses meant that cost outperformance or underperformance was shared in a given way between customers and companies. This sharing happened because companies kept outperformance gains or paid underperformance losses for a fixed period of time, after which potential gains or losses

would be transferred to consumers. This sharing provided incentives of certain power for companies to save costs.

It is worth noting that the power of the incentives was a direct result of the design of the regulatory regime. This power was thus somehow tuned exogenously by Ofwat when it made decisions on the design of the regulatory regime. The precise level of the power of incentives was not explicit, although there was some sharing (or incentive) rates that could be inferred or calculated, which could provide an indication. These rates were different for different cost categories.

Menu regulation changed Ofwat's basic regulatory regime by providing companies with a menu of optional potential regulatory contracts involving alternative explicitly pre-set incentive rates that companies could choose from. This is a fundamental change to the basic regulatory regime, as with the application of menu regulation the power of incentives of the regulatory regime became endogenous (i.e., determined by the choice of a company) and explicit (clearly laid out so companies can make a choice).

Another important change is that, for menu regulation to work, Ofwat must undertake an ex post check of actual expenditure during the price control period. This ex post check is required so that the actual rewards the companies receive during the regulatory period are adjusted at the end of the period (and compensated in the following period), ensuring that companies eventually are rewarded as intended in the menu system.

Interestingly, the companies make the menu decision by submitting a business plan with a given expenditure level. Expenditure levels that are below Ofwat's view of expenditure are regulated with a higher incentive rate, while expenditure levels above Ofwat's view of expenditure are regulated with lower incentive rates.

Menu regulation is a practical application of a theory developed by Laffont and Tirole (1993), which proves that regulators can determine the optimum regulatory contract by offering companies a menu of appropriately designed contracts with different efficiency incentives.

The application of menu regulation in water has evolved: it was first tried in PR09 only for capex, under the name of "capex incentive mechanism" (CIS); in PR14 it applied to the sum of capex and opex (totex), under the name of "totex menu;" and in PR19 a presumably simplified version of the totex menu, named "cost sharing mechanism" is being used. All the applications maintain the same essence.

3.3.3 Totex Approach

In PR14 Ofwat introduced the totex (from total expenditure) approach to assess regulated companies' expenditure needs and then calculate revenue requirements.[14] As Table 7 shows, this approach is very different from the traditional capex and opex approach previously used by Ofwat.

Table 7. Capex and Opex Approach Compared to Totex Approach

	Traditional approach	Totex approach
Timeline	From privatization until PR09	PR14 and PR19
Philosophy	Capex needs are separate from opex needs.	Capex and opex needs can be merged into the encompassing concept of totex needs.
Modelling of costs needs	Results of models used indirectly (via efficiency targets applied to previous cost levels) to predict expenditure needs. For capex, targets were calculated using a variety[15] of ad-hoc models such as unit cost models; and for opex, targets were calculated using econometric models based on well-established methods such as Corrected OLS. A glide path to reach efficiency targets was assumed.	Results of models used directly to predict expenditure without considering previous levels of expenditure. Capex and opex modelled jointly based on a new set of totex models. (Only in PR19) Efficient operation assumed to be achieved in first year of price control period.
Calculation of required revenues	Building blocks approach	Building blocks approach, applying a notional capex / opex split to the totex figure
Financial incentives	Different for capex and opex (e.g. in PR09 incentive rates were 30 percent for capex and between 35 percent and 57 percent for opex)[16]	Equalized for capex and opex via application of totex menu

Source: Authors' compilation.

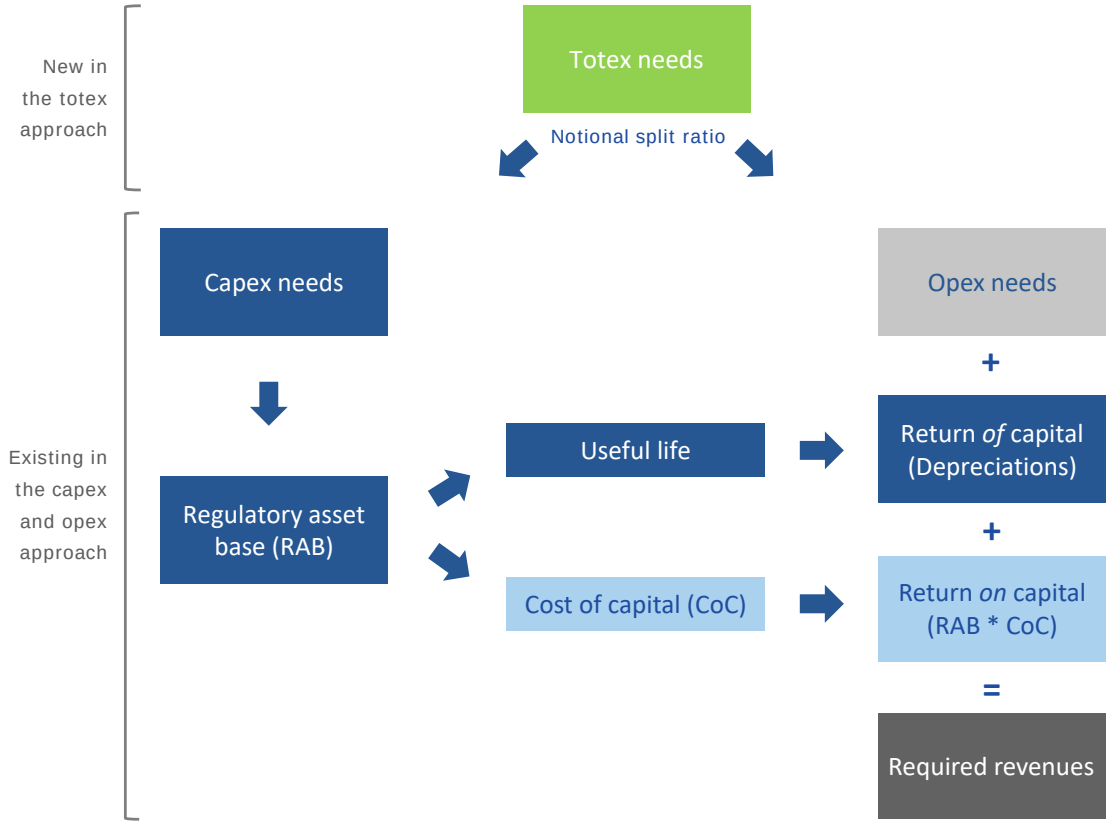
[14] Note that the assessment of expenditure needs is a different (often previous) process than the calculation of the revenue requirements.
[15] Capex was in fact split into four sub-categories: Below-ground maintenance; Above-ground maintenance; Below-ground enhancement; and Above-ground enhancement. Each sub-category was modelled differently.
[16] See CEPA (2012).

The key difference between the approaches is how Ofwat assesses expenditure needs:

- In the traditional approach this was done separately for capex and opex, taking heavily into consideration existing levels of expenditure at the time of the price control. Existing levels of expenditure were used as part of the data considered to create a set of models that were mostly cross-sectional models, and as the starting point of an assumed glide path.
- In the totex approach only totex needs are calculated and there is a much more limited use of existing levels of expenditure at the price control. Existing levels of expenditure are simply used as part of the data considered to create a set of models, which are both cross-sectional and time series models. Existing levels of expenditure are not used as the starting point of an assumed glide path because no glide path is assumed. Ofwat directly assesses totex by forecasting the cost drivers and applying those forecasts to the modelling suit.

Interestingly, for calculating required revenues the totex approach maintains almost intact the previous method known as the "building blocks approach," which remunerates opex instantly as it is spent; and capex with a delay via a return *on* capital and a return *of* capital. The novelty in the totex approach is that the amount of opex and capex is determined by applying a notional split ratio to the overall totex figure. This is depicted in the figure below.

Figure 24. The "Building Blocks Approach" with a Tweak



Source: Authors' compilation.

This new tweak of the building blocks approach means that companies are no longer able to influence the amount of money that is remunerated via the capex route or via the opex route by making capex versus opex spending decisions, as they were in the past.

Ofwat expectation is that this aspect of the totex approach, in conjunction with the unified incentive rates of the totex menu, will work towards removing a perceived capex bias existing in the water and sanitation sector. Box 5 defines capex bias and summarizes its key

Box 5. Capex Bias Definition and Key Drivers at the Time of Introducing the Totex Approach

Definition of capex bias

There is a capex bias when the regulated companies prefer to incur capex rather than opex when it is inappropriate for them to do so, or when it does not offer the best solutions for customers or the environment.

Key drivers of capex bias in the water and sanitation industry

1) Strength of financial incentives

If the companies out- or underperforms the assumptions Ofwat makes about capex and opex when it sets price limits, they receive some financial benefit (or penalty). There is a perception in the industry that the incentives to reduce opex are stronger than incentives to reduce capex. In some cases, this is perceived to limit opex, which introduces a bias.

2) Return on capex

Ofwat allows a rate of return on capex that is remunerated over the regulatory asset base (RAB), while opex is recovered from customers in the year in which it is incurred and earns no such return. The extent to which a company can secure finance at a rate below the allowed cost of capital, may create an incentive for companies to bid up capex in their business plans and deliver capex rather than opex solutions where they may expect that expenditure to be remunerated in the RAB in the future.

3) Financing and ownership

Companies and investors may focus on RAB growth as a metric that symbolizes company growth. While RAB growth must be financed, the extent to which a company and its investors may focus on this metric could influence a preference for capex.

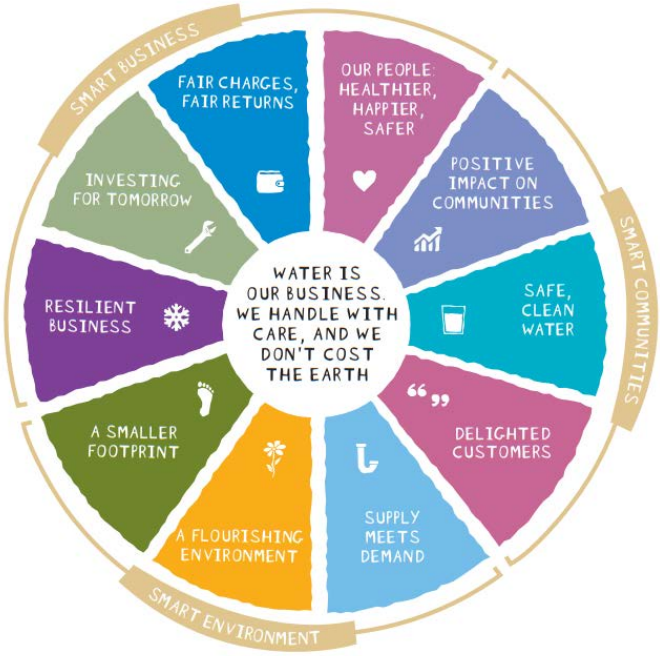
Source: Ofwat (2011).

3.3.4 Outcomes Approach

In each price determination Ofwat agrees with the companies on a number of targets that companies commit to achieve, along with associated incentive schemes to incentivize the achievement of those targets. In the past, those targets and associated incentive schemes were designed, proposed and set almost unilaterally by Ofwat.

The outcomes approach, introduced in PR14, changed this logic. A new set of high-level explicit objectives, known as outcomes, became part of what companies commit to achieve. For example, Figure 25 shows the outcomes proposed by one WaSC in its PR19 business plan submission.

Figure 25. Outcomes Proposed by Anglian Water in PR19



Source: Anglian Water (2018).
Note: The original formatting of the business plan has been maintained.

The outcomes approach also encompasses associated performance commitments (i.e., promises made in a measurable way) and associated incentive schemes (i.e., rewards and penalties for achieving or not achieving those promises). Outcomes, associated performance commitments and associated incentive schemes are all decided jointly by companies, customers and Ofwat:

- Ofwat provides guidance on potential outcomes, performance commitments and incentive outcomes, performance commitments and incentive schemes that Ofwat pushes more strongly to the point of establishing them as common and compulsory for all companies. In PR19, for example, Ofwat established 14 common and compulsory performance commitments (Ofwat, 2017).
- Companies engage with customers to establish preferred outcomes, performance commitments and incentive schemes. More detail on the process of customer engagement is provided in Section 3.3.5.

- Companies propose outcomes, performance commitments and incentive schemes to Ofwat via the business plan submission process. More details on the business plan process are provided in Section 3.3.6.
- Ofwat provides views on companies' schemes. There are some proposals during the business plan submission process, and Ofwat accepts or rejects companies' final proposals in the final price determination.

One particularly interesting performance commitment and incentive scheme that is not compulsory but that Ofwat has recommended companies to include in their PR19 proposals is the Abstraction Incentive Mechanism (AIM). The AIM is interesting because it is an innovative way of setting incentives for companies to deal with future scenarios of more water scarcity resulting from climate change, which complements other existing tools to reduce abstraction from sensitive sites, such as abstraction license changes or license conditions which require abstractions to cease during periods of low flows. Box 6 shows how the AIM works, according to the latest guideline from Ofwat.

Box 6. The Abstraction Incentive Mechanism (AIM)

Objective

The AIM has the objective of encouraging water companies to reduce the environmental impact of abstracting water at environmentally sensitive sites when water is scarce.

How does it work?

For water companies to operate the AIM they need to:

- **Identify the abstractions sites to which the AIM applies. The identification is done based on some pre-conditions set by Ofwat and additional conditions set by companies.**
- **Identify the trigger points for each AIM site to be considered "switched on." The AIM will generally switch on, subject to a hydrological trigger, when a reduction in abstraction from the abstraction site would be, or is likely to be, environmentally beneficial. Typically, this will be a river flow condition, but equally it might be a groundwater level condition, drought trigger or other appropriate measure.**
- **Identify the abstraction baseline for each AIM site. The company identifies its historical abstraction at times when the AIM would have been switched on had it applied in the past (e.g., the times when river flows were below the trigger threshold).**
- **Capture abstraction data at each AIM site and calculate performance. In general, to calculate performance on the AIM for a particular abstraction site the following formula applies:**
  - **AIM performance in Ml = (average daily abstraction during period when flows are at or below the trigger threshold - baseline average daily abstraction during period when flows are at or below the trigger threshold) * length of period when flows are at or below the trigger threshold.**
- **Report results through their annual performance report**

Source: Ofwat (2016).

3.3.5 Customer Engagement

Until PR14 Ofwat's regime lacked explicit principles, processes or incentives to incorporate the views of customers into companies' decisions. There was an implicit requirement to support every line of companies' business plans with CBA, which was particularly emphasized in PR09. This implicitly meant that customer views would have to be considered, as a key building block of quantifying costs and especially benefits within CBA are customer preferences.

However, it was only in PR14 that the views of customers explicitly became a key input in the decision-making process, with clear principles, processes and incentives for companies to incorporate those views. This involved the creation of independent company Customer Challenge Groups (CCGs), which each company had to put in place and support. Table 8 shows the explicit roles of the key players in customer engagement.

Table 8. Roles of Key Players in Customer Engagement

Player	Role
Companies	Are responsible for carrying out direct local engagement with their customers to understand their priorities, needs and requirements, which should then drive decision-making and the development of the company's business plan.
CCGs	Provide independent challenge to companies and provide independent assurance to Ofwat on the quality of a company's customer engagement and the degree to which this is reflected in its business plan.
Ofwat	Informs, enables and incentivizes good customer engagement; facilitates more CCG collaboration; and continues to provide information and clarity (not detailed or prescriptive guidance) about its expectations.

Source: Ofwat (2017).

This new customer engagement framework directly affects the tariff level and structure in two ways:

- The level of general price increase (and the specific areas where expenditure is focused) proposed in the business plans by the companies must be endorsed by the clients based on analysis of willingness to pay, etc. This was required before, but now it is only validated if clients themselves, via CCGs, approve it.
- Companies that show more and better customer engagement (among other things) are selected and receive additional remuneration. This is part of the risk-based review discussed in Section 3.3.7.

It is worth noting that the rationale for the need to incorporate the customers' views has always existed, as in natural monopoly sectors there is not a market whereby consumers reveal their preferences, so some second-best method must be used to ensure customers get what they want. However, the latest emphasis on making the customer engagement framework more explicit and adding clear financial incentives into it may have been driven by a change in customers' expectations along the lines of the discussion in Section 2.6.

3.3.6 Financing Outperformance Sharing Mechanism

In PR19 Ofwat introduced a new requirement for companies with gearing levels above 70 percent to propose a financing outperformance sharing mechanism (i.e., a mechanism that shares with customers potential gains obtained out of leveraging at rates significantly higher than the notional gearing rate). These companies are free to propose their own sharing mechanism, but Ofwat has put forward the following "illustrative" scheme:[17]

- There is a 5 percent deadband above the notional gearing level of 60 percent.
- The mechanism would share 50 percent of the difference between notional nominal cost of equity to actual nominal cost of debt for the proportion of gearing that is above the deadband.

[17] See Ofwat (2018a,b).

Ofwat assess each company's proposed mechanisms as part of its business plans assessment. If the proposed sharing mechanisms do not share adequate benefits with customers, Ofwat intervenes to introduce a mechanism at draft determinations. Interestingly, this new financing incentive mechanism has been introduced in conjunction with other changes that could be branded as "more intrusive than usual practice" such as the new requirements for companies to set out in their business plans their policies for performance-related executive pay and dividend distribution.

The rationale for introducing these new financing incentive mechanisms, as well as the new requirements on information regarding executive pay and dividends, seems to be based on a general perception from the public that some companies are profiting at their expense from financial engineering. In the words of Ofwat's chairman:

> "Corporate behavior of some water companies has diminished trust in the delivery of this most vital service. Some companies are seen as focused on financial engineering at the expense of public service" (Cox, 2018).

The lack of trust problem, which is not uncommon in LAC countries, has been discussed in the LAC context in Section 2.6.

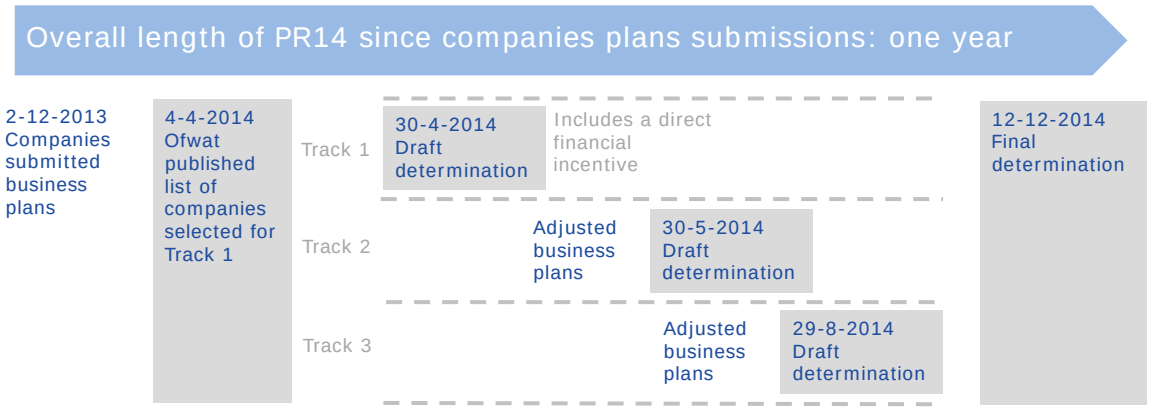
3.3.7 Risk-Based Review (also known as Fast-tracking)

Since PR14 Ofwat has adopted a risk-based approach to assessing companies' business plans. Under this approach Ofwat differentiates among issues and companies, focusing the regulatory effort on the issues and companies that could have the biggest impact on customers.

During price controls companies are categorized in different groups based on their business plan submissions and a parallel price control with different regulatory treatment (e.g., timelines, scrutiny, rewards, etc.) is undertaken for each group. Note that some selected companies (those with the best plans) receive direct financial benefits, as well as a procedural benefit of agreeing a plan early and the reputational benefit of being top in a league table.

The figure below shows the three tracks that Ofwat has used in PR14.

Figure 26. PR14 Timeline since Draft Business Plans Submission



Source: Authors' compilation.

In PR19 Ofwat has streamlined the approach used in PR14 and uses four tracks instead of three (Ofwat, 2017):

- **Exceptional:** companies receive an amount equivalent to a 20 basis points (bp) to 35bp addition to the return on regulated equity (RoRE) over the whole price review period, based on the notional gearing of 60 percent, and procedural incentives through an early determination.
- **Fast-track:** companies receive an amount equivalent to a 10 bp addition to the RoRE, and procedural incentives through an early determination.
- **Slow-track:** companies receive standard incentives and price control timings.
- **Significant scrutiny:** companies receive reduced cost sharing rates in the menu system and potentially capped outcome delivery incentive outperformance payments.

The assessment of companies' plans is a broad exercise that reviews the business plans following a preset method. In PR19 companies' plans are assessed against three key characteristics (quality, ambition, and innovation) and nine key test areas that reflect Ofwat PR19 themes (engaging customers; addressing affordability and vulnerability; delivering outcomes for customers; securing long-term resilience; targeted controls, markets and innovation; securing cost efficiency; aligning risk and return; accounting for past delivery; and securing confidence and assurance).

Note that the risk-based review is the main mechanism whereby Ofwat incentivizes companies to follow what it requires in several of the regulatory changes discussed in the previous sections of this paper, such as the outcomes approach, customer engagement or the financing outperformance sharing mechanism. Therefore, the risk-based review can be understood as a key addition to Ofwat's regulatory regime, without which many of the other additions could not have been implemented successfully.

4 LAC Gap Analysis

4.1 Where Is the Sector, and How Did It Get There?

A stylized description of the evolution of the water and sanitation sector around the world involves three phases: i) expansion in coverage, ii) demand management and cost efficiency and iii) quality and environmental concerns (see Ferro and Lentini, 2010). This was mirrored in the UN Development Goals. As discussed in Section 2.6, while the MDGs called for reducing gaps in access (coverage) by 2015, the new Sustainable Development Goals (SDGs) have shifted attention towards quality and the environment, in addition to finally closing access gaps.

The water sector in LAC has evolved over time with a similar logic. The region underwent the first phase after the Great Depression, and especially in the 1960s and 1970s, with significant increases in coverage but with little regard to the efficiency and financial sustainability of the operators (Jouravlev, 2004). In the 1980s, the debt crisis put countries all over the region under financial stress and led them to balance their fiscal budgets—including cuts in investments and operating expenses in the water and sanitation sector. This resulted in declines in quantity and quality of services (ECLAC, 1994), and paved the way for the deep structural reforms of the 1990s that marked phase 2 (for more on these reforms see, among others, Jouravlev, 2004; Solanes and Jouravlev, 2005; Hantke-Domas and Jouravlev, 2011; Lentini and Ferro, 2014; and Rojas Ortuste, 2014).

In this period, though there were differences across countries, most reforms shared several features (Jouravlev, 2004):

- changes to the institutional structure of the sector (separation of policy formulation, regulation, and operation);
- changes to the industrial structure of the sector (decentralization and horizontal disintegration);

- private sector participation;
- new regulatory frameworks; and
- cost-recovery prices coupled with subsidy schemes targeting the poor.

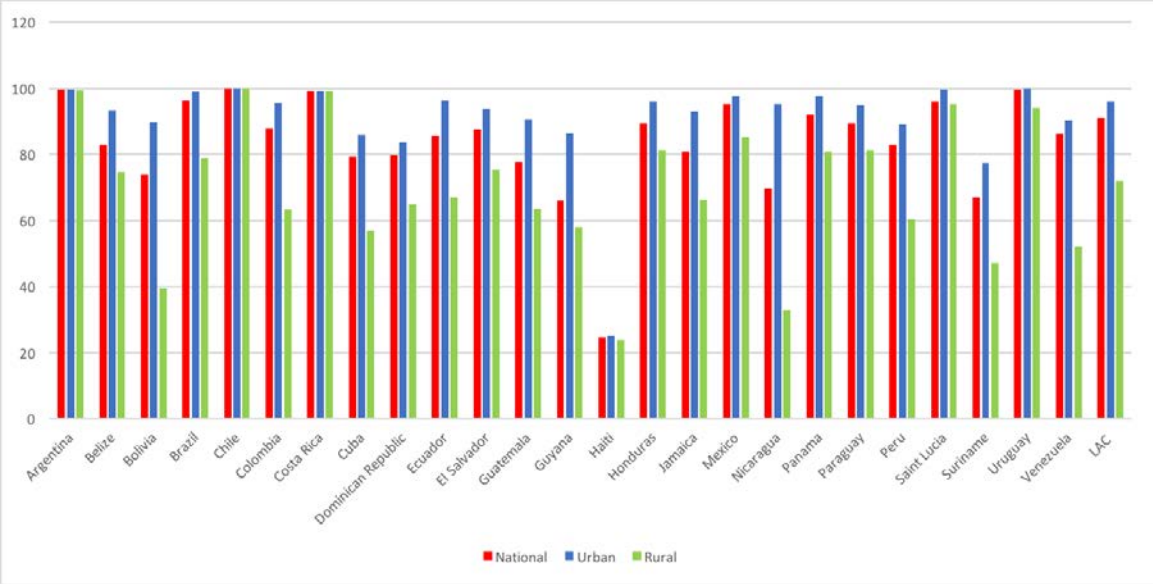
The SDGs should mark the beginning of phase 3 for LAC countries, but it must be noted that phases 1 and 2 are far from being complete in the region (see Section 4.4), as opposed to more developed parts of the world.

In the rest of Section 4.1 we take stock of where the region currently stands in terms of water infrastructure and governance. Section 4.2 takes a closer look at the prevailing regulatory frameworks in LAC countries and Section 4.3 discusses a number of regulatory innovations in the region. In Section 4.4 we perform a gap analysis in infrastructure, institutions and innovative practices.

4.1.1 Infrastructure

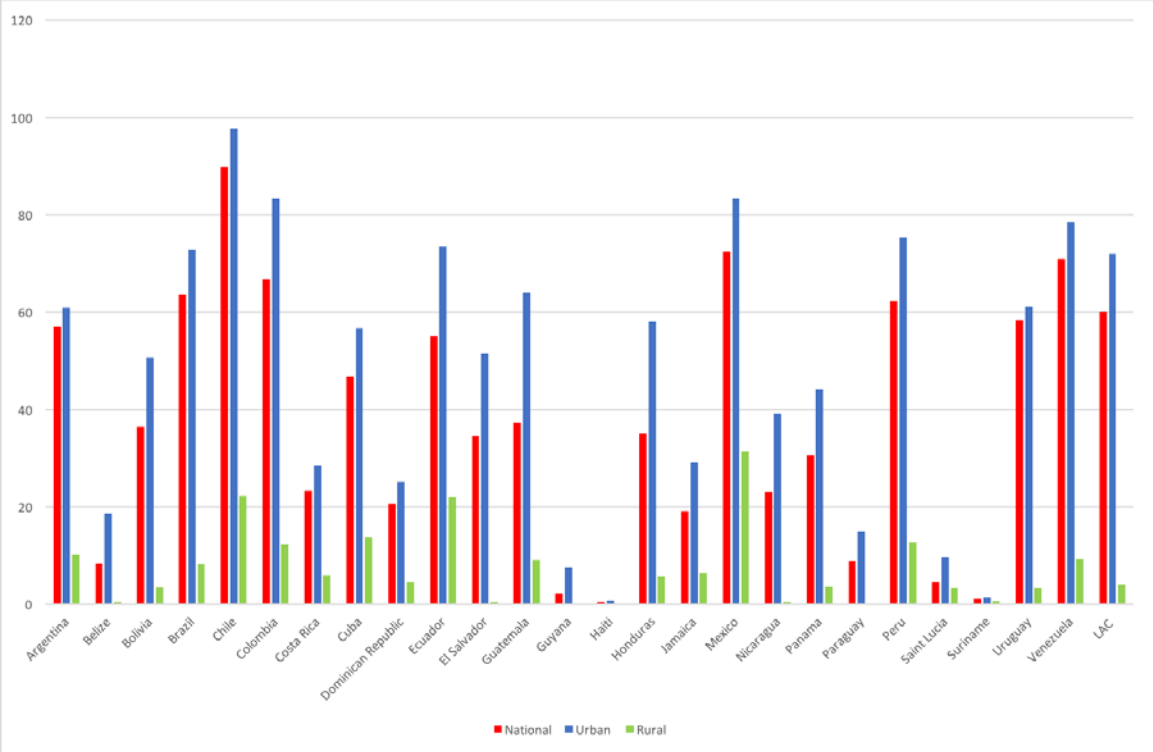
Important efforts have been made to improve water supply and sanitation coverage. Even though the region has achieved relatively high rates of coverage of water and sanitation services (see Figures 16 and 17), meeting the MDGs (with few exceptions, most notably in sanitation), Figures 27 and 28 show that regional numbers mask important access gaps between and within countries—mainly in informal urban settlements and rural areas, usually the poorest segments of the population. The contrast across and within countries is particularly stark in sanitation and wastewater treatment.

Figure 27. Population Connected to Piped Water in 2015 (%)



Source: Authors' calculation using WHO/Unicef Joint Monitoring Program data available at https://washdata.org/data.

Figure 28. Population Connected to Sewerage Network in 2015 (%)



Source: Authors' calculation using WHO/Unicef Joint Monitoring Program data available at https://washdata.org/data.

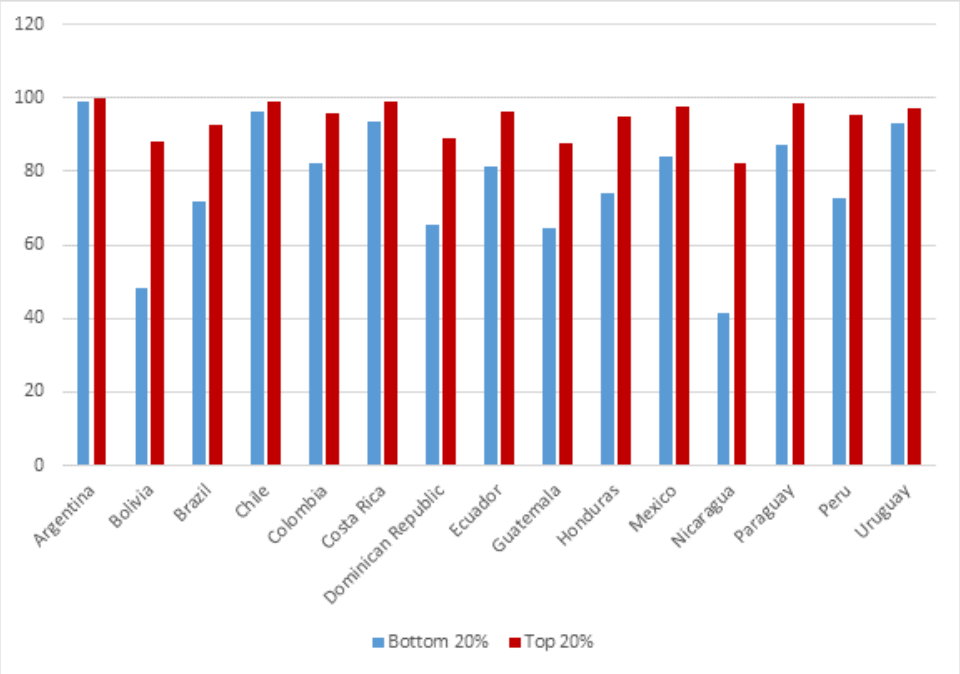
Coverage in rural areas is much lower than in cities. Rural access in water is lowest in countries like Haiti, Nicaragua, Bolivia and Suriname (Figure 27), but around 66 percent of the people without service live in just five countries: Brazil, Colombia, Mexico, Haiti, Guatemala and Peru. In sanitation, large rural gaps (above 95 percent) are observed in Haiti, Guyana, Suriname, Uruguay, Panama, Saint Lucia, Belize, Bolivia and Dominican Republic (Figure 28). Again, Brazil, Mexico, Colombia, Guatemala, Peru, and Ecuador account for 67 percent of the uncovered rural population.

Service quality (intermittency, water quality control, customer service, water pressure, etc.) is poor, and infrastructure is often in bad condition, which is illustrated by high water losses that are usually above 40 percent (Canales, 2011; and Rojas Ortuste, 2014). One of the reasons for this is that governments often opt for highly visible infrastructure projects with fewer resources for maintaining service quality (Flores Uijtewaal, Goksu and Saltiel, 2018).

According to the global data on Water Supply, Sanitation and Hygiene (WASH), as of 2015 more than 75 percent of sewage collected is discharged into the nearest water bodies (especially close to large urban centers) without any treatment—causing alarming water pollution problems (Canales, 2011, and Lentini, 2015). The quality of underground water has also deteriorated thanks to inadequate wastewater management, sewage leaks, overexploitation, and unplanned urban expansion (Rojas Ortuste, 2014).

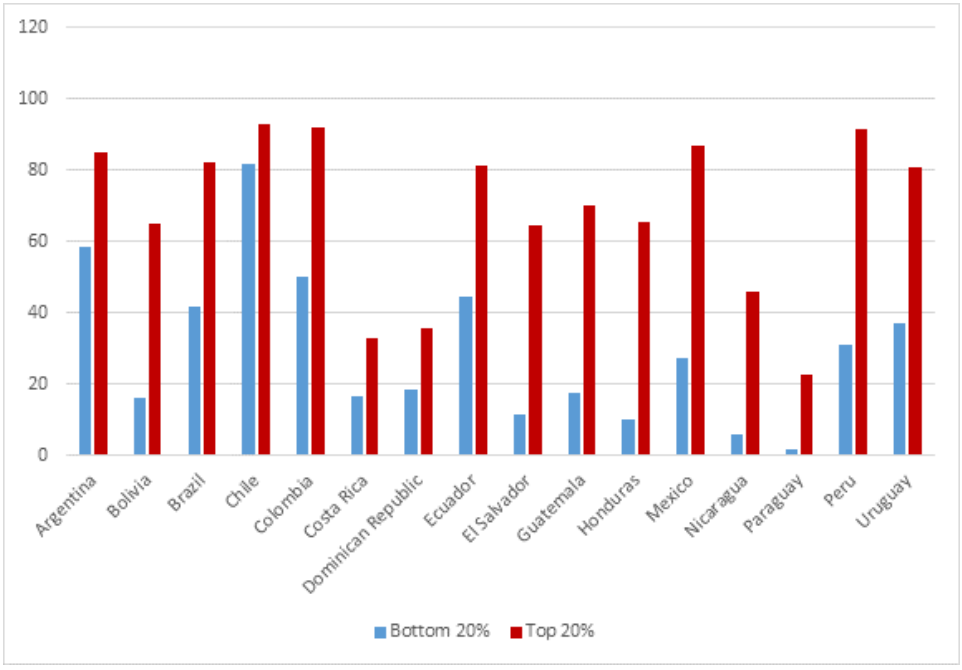
Access gaps within countries reflect drastic inequalities between income and ethnic groups, as well as primary language and education level (see Flores Uijtewaal, Goksu and Saltiel, 2018) beyond the urban-rural divide. Figures 29 and 30 (water and sanitation, respectively) focus on access inequality among income groups in LAC countries and show large disparities in virtually every country, especially in access to safe sanitation.

Figure 29. Access to Drinking Water in Top and Bottom Income Quintiles by country between 2014 and 2017 (%)



Source: Authors' calculations with data from the Socio-Economic Database for Latin America and the Caribbean (Centro de Estudios Distributivos, Laborales y Sociales—CEDLAS—and World Bank).

Figure 30. Access to Sewerage Network in Top and Bottom Income Quintiles by country between 2014 and 2017 (%)



Source: Authors' calculations with data from the Socio-Economic Database for Latin America and the Caribbean (Centro de Estudios Distributivos, Laborales y Sociales—CEDLAS—and World Bank).

Efficiency in service provision is also low (CAF, 2012), as evidenced by water losses around 40-50 percent, nonpayment above 15 percent, intermittent water provision in almost 30 percent of systems, micro-metering below 65 percent, overconsumption (e.g., more than 300 liters per capita per day in Argentina, Panama, and Honduras; see Lentini, 2015), and overemployment in water companies (3.8 employees per 1,000 connections, according to ADERASA, 2010).

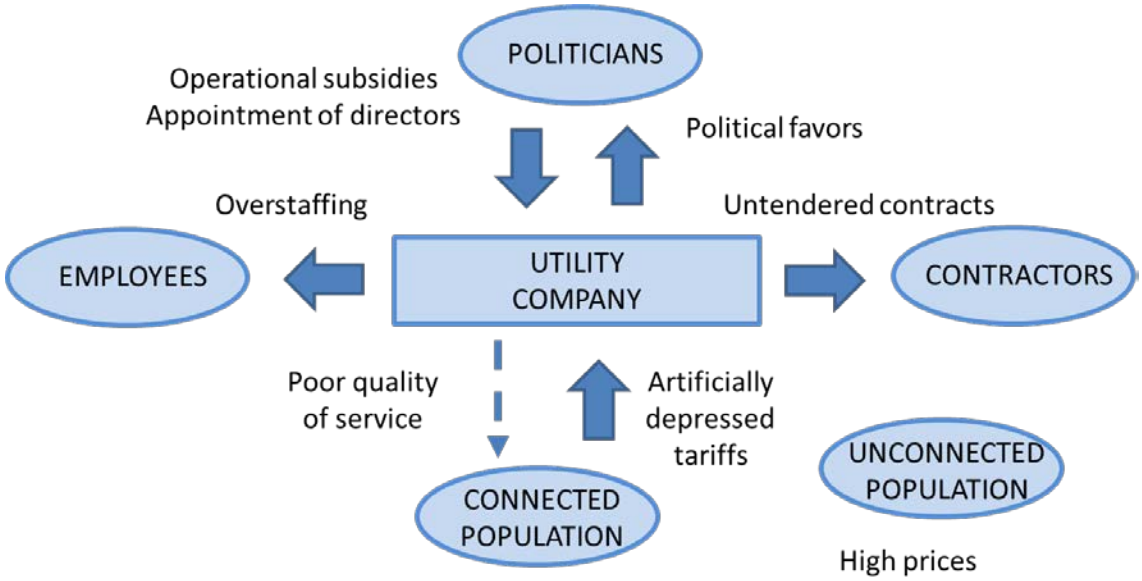
4.1.2 Governance

Water governance has been defined as "the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society."[18] Governance thus involves the explicit or implicit sharing of policymaking authority, responsibility, development and implementation at different administrative and territorial levels (Akhmouch, 2012). It is widely believed that water governance and infrastructure interact, and governance improvement is deemed crucial to achieving sector goals—even more so for goals that go beyond universal coverage (see, e.g., CAF, 2012; Ferro, 2017; and Flores Uijtewaal, Goksu and Saltiel, 2018).

At the turn of the century, almost every country in LAC had already achieved some degree of sector governance reform or was seriously considering such reforms. But the depth of reform varied substantially across countries and bore no relationship with how broad the reform process was (Foster, 2005). Two generic models of water service provision can be distinguished (Foster, 2005; CAF, 2012). First, there is the *traditional* model (see Figure 31), in which state-owned, over-staffed water companies are part of the political apparatus, investments are financed through public subsidies and politically targeted, and tariffs are artificially depressed. In this model, planning, sector policy, regulation, and provision are usually in the hands of the state-owned provider.

[18] www.un.org/waterforlifedecade/waterandsustainabledevelopment2015/governance_frameworks.shtml.

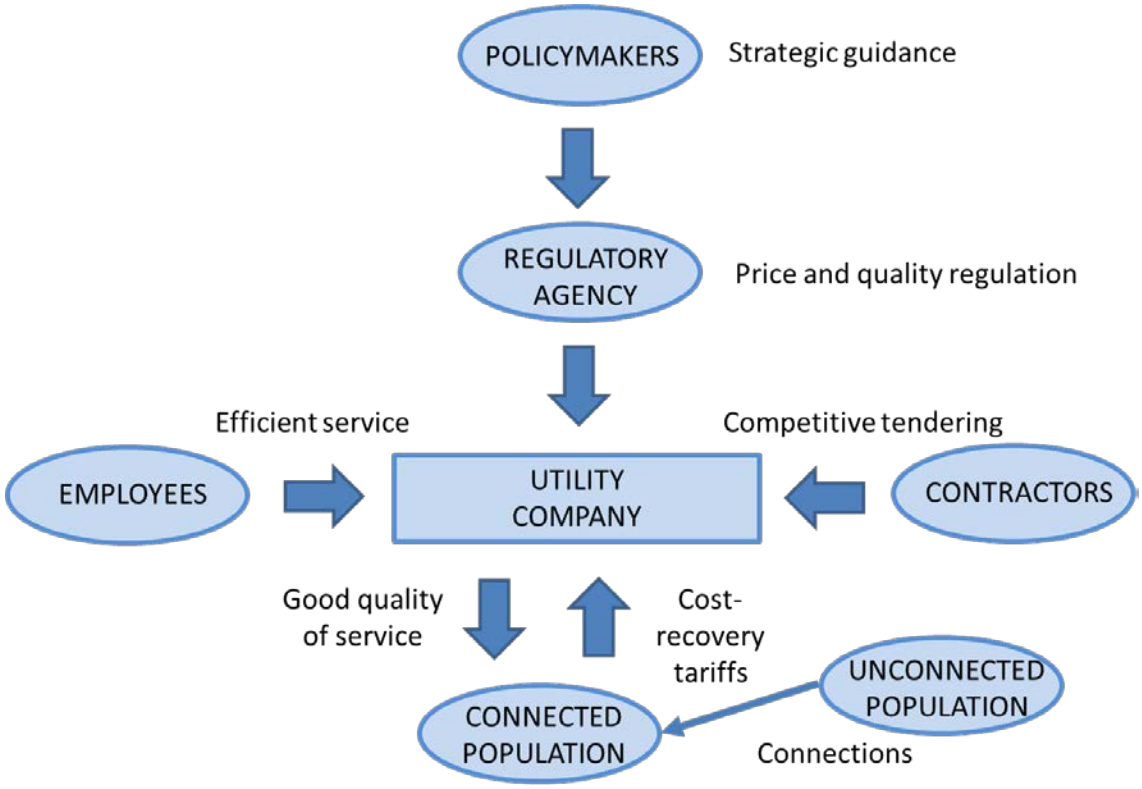
Figure 31. The Traditional Model of Water Provision



Source: Foster (2005).

The other polar case is the *modern* model of water provision (see Figure 32), in which planning, sector policy, regulation, and provision are separated. In such a model, rules are enforced, and deviations bring about consequences. To insulate the provider from political interference, a regulatory agency is created, and actual provision is delegated to the private sector or a corporatized public company. Business principles are introduced into the provision of the service, and tariffs are set to recover costs (including the cost of capital).

Figure 32. The Modern Model of Water Provision



Source: Foster (2005).

Countries in LAC are still transitioning from the traditional to the modern model, although at different paces. Colombia, Peru, and especially Chile, are leading cases in this respect. Table 9, taken from Ferro (2017), summarizes the institutional evolution of the sector.

Table 9. Institutional Evolution of the Water and Sanitation Sector in LAC

Country	Creation of national company	Decentralization to local level	Regulation	Legislation
Small unitary countries				
Costa Rica	1961	Limited	1961	1942
Cuba	1962	2001	--	2001
Dominican Rep.	1962	1973	--	Pending
Ecuador	1965	1992	2001	2014
El Salvador	1961	Limited	--	Pending
Guatemala	--	Limited	--	Pending
Haiti	1977	2010	--	2009
Honduras	1961	1991	2003	2003
Nicaragua	1998	Limited	1998	2007
Panama	1961	Limited	1996	1997
Paraguay	1966	2000	2000	2000
Uruguay	1952	--	2002	1952
Large unitary countries				
Bolivia	--	--	1997	2007
Chile	1977	--	1990	1988-90
Colombia	--	1974	1992	1994
Peru	1981	1994	1992	1993
Federal countries				
Argentina	1912	--	1992	Pending
Brazil	--	1988	2007	2007
Mexico	--	1983	--	Pending
Venezuela	1943	--	--	2001

Source: Ferro (2017).

Despite the great diversity in the assignment of competences across ministries and levels of government in the water sector, Akhmouch (2012) identifies some common trends in water governance across countries in LAC:

- In all cases, there is a significant decentralization of some functions, with service delivery most often devolved to the local level, while higher-tier local governments (e.g., regions, provinces) are responsible for resource management (see Table 10).

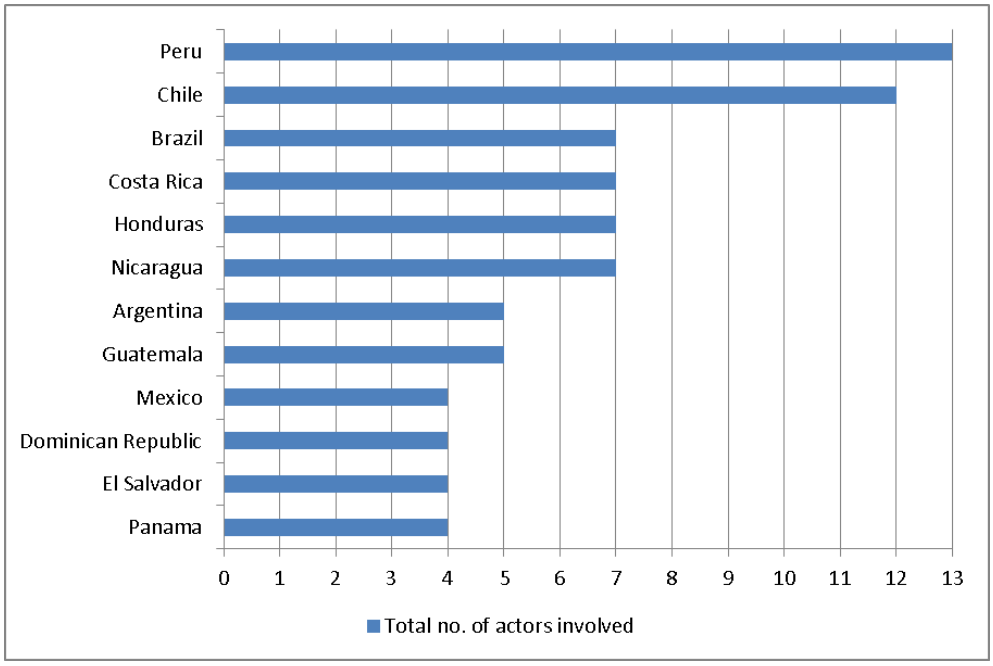
- There is no systematic relationship between a country's constitutional structure and the institutional mapping of water policy, but central governments in federal countries tend to play a larger role than their OECD counterparts. Some federal countries (Argentina, Brazil, Mexico) have delegated many water responsibilities to lower levels of government, while the Caribbean islands and Costa Rica still retain significant water responsibilities at central government level with highly centralized water policy making (Costa Rica, Cuba, Dominican Republic). Most LAC unitary states (Chile, Peru, Guatemala, Nicaragua), on the other hand, have de facto delegated many responsibilities to lower levels of government.
- The number of central authorities (ministries, departments, public agencies) involved in water policy making ranges from four in Mexico to 13 in Peru, and the number of authorities in charge of regulatory issues ranges from three in Argentina to 10 in Peru—indicating a fragmentation of roles and responsibilities (see Figures 33 and 34).
- River basin organizations have been set up in half of the countries (both federal and unitary).
- In almost all countries, the allocation of roles and responsibilities in water policy at central government level is primarily (but not only) defined by a specific law on water (see Figure 35).
- Regulatory frameworks inspired in international best practice are in place in most countries, and most countries have introduced a specific water regulatory agency.

Table 10. Separation of Functions

Country	Policy	Planning	Regulation & control	Provision
Argentina	Local governments	Local	Local	Municipal and local firms – Cooperatives
Belize	Central	Central	Central	National firms
Bolivia	Central	Central & local	Central	Local firms – Cooperatives
Brazil	Central	Central & local	Municipalities	Regional, state and municipal firms
Chile	Central	Central	Central	Regional and municipal firms
Colombia	Central & department	Central & department	Central	Municipal firms
Costa Rica	Central	Central	Central	National firm – Municipalities – Administrative committees
Dominican Rep.	Central	Central	Central	National and regional firms – Communal water boards
Ecuador	Central	Central	Guayaquil & Agencia de Regulación y Control del Agua	Municipal firms
El Salvador	Central	Central	Central	National firm – Municipalities – Rural cooperatives
Guatemala	Central	Central	--	Municipal firms – Rural communities
Honduras	Central	Central	Central & local	National firm – Municipalities – Private firm
Mexico	Central	Central & state	--	State and municipal firms – Water boards
Nicaragua	Central	--	Central	National firm – Municipalities – Communal organizations
Panama	Central	Central & local	National agency	National firm – Rural boards
Paraguay	Central	Central	National agency	National firm
Peru	Central & local	--	National agency	Municipal firms
Uruguay	Central	Central	National agency	National firm
Venezuela	Central	Central	Central	National firm

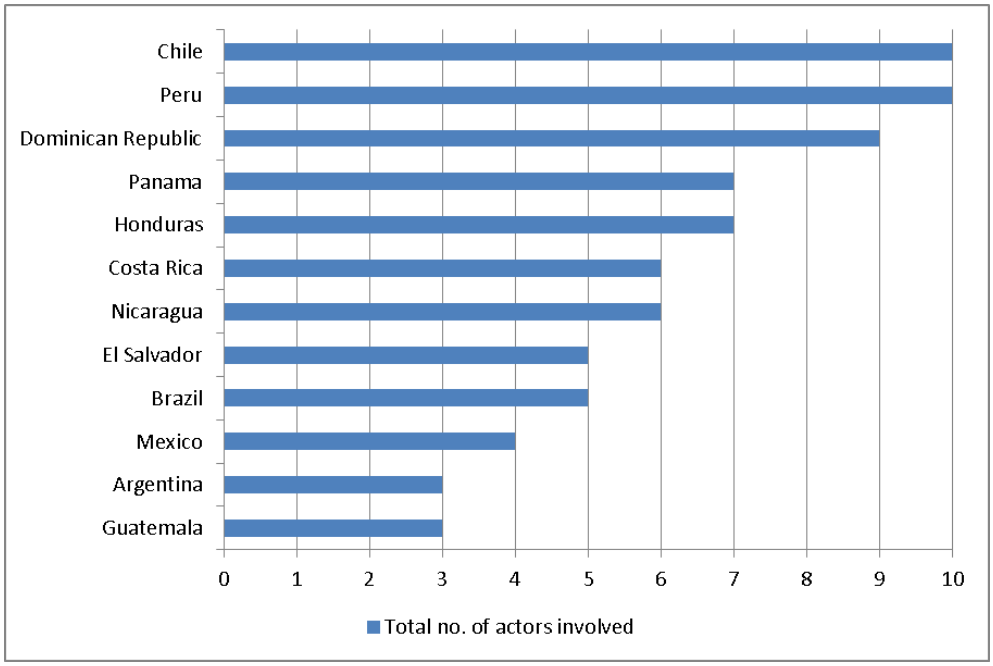
Source: Ballestero et al. (2015).

Figure 33. Number of Authorities Involved in Water Policymaking at Central Government Level



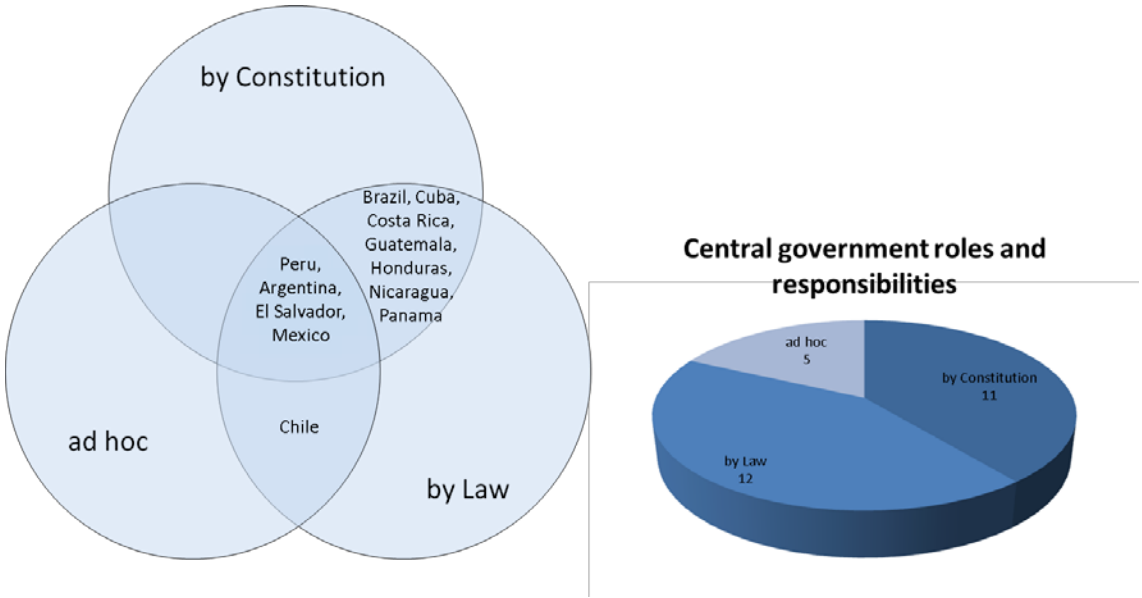
Source: Akhmouch (2012).

Figure 34. Number of Authorities Involved in Water Regulation at Central Government Level



Source: Akhmouch (2012).

Figure 35. How Central Governments' Roles and Responsibilities in Water Policy Are Defined



Source: Akhmouch (2012).

4.2 Regulatory Regimes

As discussed in the previous subsection, most countries in LAC are still transitioning to the modern model of water governance, which entails a separation of planning, sector policy, regulation, and provision. A key element of this model is the creation of a specific water regulatory agency.

Most LAC countries have created such an agency. CAF (2012) counted 28 regulatory agencies in 16 LAC countries in 2012. The oldest agency is the *Superintendencia de Servicios Sanitarios* (SISS), created in 1990 in Chile. Note that the Chilean experience is the one that sector analysts often regard as the most successful within LAC countries, with its success based on a solid governance structure, of which the independent regulatory agency SISS is key part. Other cases that are sometimes mentioned as local good examples are the *Comisión de Regulación de Agua Potable y Saneamiento* Básico (CRA) in Colombia and the *Superintendencia Nacional de Servicios y Saneamiento* (SUNASS) in Peru. The reasons why the Chilean case can be regarded as the local benchmark are outlined in the box below.

Box 7. Why Can Chile Be Regarded as a Regional Benchmark?

Chile has established modern model of sector regulation akin the one depicted in Figure 31. This model can be regarded as successful because it has enabled the achievement of several desirable outcomes, which are discussed below.

Outcome 1: Coverage without reliance on public investment

At the time of privatization in 1989 water and sewerage coverage were already above 90 percent. Most of the necessary investment to achieve full coverage had been undertaken in an earlier period with public funds. However, the coverage of urban wastewater treatment was merely 21 percent. The Chilean regulatory regime enabled the mobilization of private investment to close the urban wastewater treatment gap and achieve full coverage in urban wastewater treatment by 2012 (SISS, 2015, and Bruna Villena, 2017).

Outcome 2: Cost reflective price signals (i.e., allocative efficiency)

Chile uses a system of regulation known as "efficient model firm," whereby the SISS sets tariffs based on efficient cost levels of a notional company. The tariffs determined by SISS using this system of regulation are the tariffs charged to consumers. The independence of the SISS from the government does not permit any type of government intervention in relation to tariff levels or structures. This results in tariffs that reflect the costs of providing the services. A more detailed discussion of the "efficient model firm approach" is provided in Section 4.3.2.

Outcome 3: Social equity without distorting price signals

Since 1990, there has been in place a system of direct subsidies for low income consumers to help them pay for water and sanitation services. This system does not require a change in the level or structure of tariffs (i.e., tariffs paid by the subsidized consumers are the same as tariffs paid by non-subsidized consumers). Therefore, it could be argued that the system has achieved social equity without distorting price signals. A more detailed discussion of this direct subsidy system is provided in Section 4.3.3.

Source: Authors' compilation.

Most regulatory agencies in the region still do not enjoy as much independence and autonomy in decision-making as the agencies in Chile, Colombia and Peru, and they have certainly not been able to achieve the sort of regulatory outcomes that Chile has achieved.

Establishing a regulatory regime also entails setting the rules of the game in legal norms such as legislation, regulations, decrees, concessions and licenses (Foster, 2005). Some countries, like Chile, Panama, and Peru, began with water sector legislation and then proceeded with the details of the regulatory framework. At the other extreme, countries like Argentina, El Salvador, or Guatemala, have yet to introduce water legislation, and the Dominican Republic, El Salvador, and Guatemala still lack a regulatory framework (see Table 9).

Regulatory frameworks inspired in international best practice are in place in most countries.[19] These frameworks have embraced (at least nominally) some basic tariff principles like allocative efficiency, productive efficiency, financial sustainability, social equity, and administrative simplicity, with price-cap regulation with regular tariff revisions (like in E&W) being the most common choice (Foster, 2005). Experience, however, has shown that these concepts have been difficult to translate into reality.[20]

While some countries, like Chile, have implemented cost-recovery tariffs coupled with effective subsidy schemes for the poor, water utilities in many other LAC countries still face tariffs that are set too low for noneconomic reasons and that hence do not cover basic operating expenditures, let alone investment needs (see Lentini, 2015).[21] Therefore, most operators are not financially sustainable and must rely on government transfers (Ballestero et al., 2015), and tariffs send the wrong signals for consumption, distorting allocative efficiency.[22] Productive efficiency is also low in the region: employees per 1,000 connections average 3.3, but many operators show figures between 4.5 and 7.4 (see Lentini, 2015, and Section 4.5 below).

Figure 36 shows the relationship between network water abstraction (which can be used as a proxy for consumption) per capita and average water tariffs in LAC countries. For the sake of comparison, the figure also plots the United Kingdom (in red). Average network abstraction in LAC is roughly 93 m^3 per person per year (around 255 liters per person per day), similar to the UK average of 91, but tariffs (and income per capita) are much lower: 0.52 USD per m^3 in LAC versus almost 2 USD in the United Kingdom.

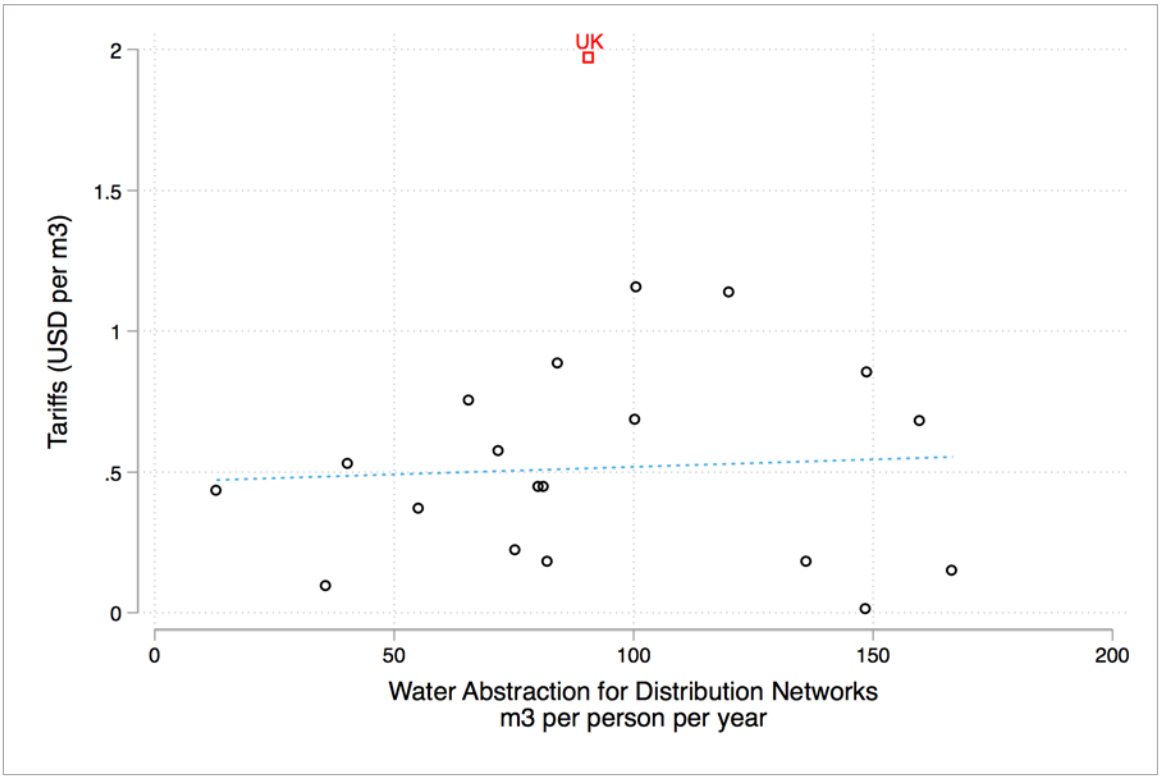
[19] See, for instance, *Ley General de Servicios Sanitarios* (1988, Chile), *Lei Federal do Saneamento Básico* (2007, Brazil), and *Ley de Servicios Públicos Domiciliarios* (1994, Colombia).

[20] Widespread poverty, lack of human resources, lack of information, lack of control and monitoring systems, and the ease of regulatory capture, all constitute impediments to the fulfillment of the declaimed regulatory objectives (Canales, 2011).

[21] According to Lentini (2015), revenues in 16 percent of LAC operators do not cover operating expenditures, and only a small fraction of water utilities would be covering their investment needs. In Panama, for instance, the tariff has not been modified since 1982. The price level has almost doubled since (retrieved from https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?end=2017&locations=PA&start=1960&view=chart on November 20, 2018).

[22] Average consumption per capita is 159 liters per day, but in some countries it exceeds 360 liters per day. Unmetered consumption also plays its part: on average, 20 percent of consumption is unmetered, but nonmetering can reach as much as 80 percent of users. See Lentini (2015).

Figure 36. Average Water Tariffs and Network Water Abstraction[1] per Capita (2015)



Source: Authors' calculation using Global Water Intelligence Water Tariff Survey, Aquastat-FAO and World Bank.
Note: [1]In Aquastat-FAO, Network Water Abstraction is termed Municipal Water Withdrawal, and it is usually computed as the total water withdrawn by the public distribution network. As a result, Network Water Abstraction can include water used by industries and urban agriculture connected to the distribution network.

To deal with service affordability, most countries rely extensively on cross-subsidies (include a rising block tariff structure) and on surcharges to industrial tariffs (Foster, 2005). The inclusion and exclusion errors of such subsidy schemes are well known—see, e.g., Komives et al. (2005).[23] Chile and Colombia provide interesting exceptions dealing with social equity, with well-developed focusing schemes for their subsidies, based on socioeconomic characteristics of the household (Chile) or of the neighborhoods (Colombia).

The new regulatory regimes often sought to increase private sector participation (PSP). The record shows that PSP has evolved at a slower pace than regulatory frameworks, and it has

[23] For one thing, since the poorest households are usually unconnected households (recall Figure 24), usage-based subsidies cannot benefit them.

also experienced some serious drawbacks.[24] Success stories in PSP involve Chile, some Colombian cities (Barranquilla, Cartagena, Montería, Santa Marta), Guayaquil (Ecuador), Cuba, Brazil (Manaos and numerous other small cities), Córdoba (Argentina), and Saltillo (México); see CAF (2012).

Overall, private operators served around 8 percent of the urban population of LAC as of 2012 (CAF, 2012). This means that, unlike in E&W (or Chile, to consider the regional benchmark), the vast majority of the population is still served by public providers. Adapting regulation to deal with the peculiarities of public enterprises is still a daunting challenge in many LAC countries.

Rather than moving from public to private provision, countries in LAC have moved from unregulated centralized public provision to regulated decentralized public provision—what Foster (2005: 23) has dubbed the Anglo-French hybrid:

> "On the one hand, it takes from the British model the creation of a centralized regulatory agency relying on incentive-based regulatory instruments, but rejects the equally British notion of regionally consolidated and fully privatized water operators. On the other hand, it takes from the French model the notion of a decentralized, municipally based industry relying on concession contracts as the primary vehicle for PSP, but rejects the equally French notion that regulation can be confined to municipal monitoring of contracts."[25]

4.3 Regulatory Innovations

In this subsection, we describe a few innovative regulatory practices that have been introduced in the water and sanitation sector in LAC countries.

[24] Several privatization processes were undone in Argentina, Bolivia, and Uruguay. Bolivia, Ecuador, Nicaragua, and Uruguay have gone as far as including an explicit prohibition of water provision privatization in their constitutions (Ferro, 2017).

[25] The British model of regulation is described in detail in Section 3. The French model of regulation, which is not discussed in this paper, is based on a contractual arrangement known as *affermage*, whereby an operator is responsible for operating and maintaining the assets that are necessary to provide services but not for financing the investment required to build those assets.

4.3.1 Raw Water Abstraction Rights Market – Chile[26]

Background

Chile has different degrees of water availability in different parts of the country. In the north there is severe scarcity, and in the center there is some scarcity. In both these areas most of the surface water has already been allocated, and there are clear signs of overexploitation problems. In addition, several basins present water quality problems. On the other hand, in the southern part of the country, there is availability of water, but not enough infrastructure for its storage to help coping with summer droughts, which are becoming more common.

The management of water resources in Chile operates on the basis of a market model regulated by the Water Code of 1981 (The Water Code). The Water Code separates water rights from land ownership and declares that water rights are private and fully tradable. Private rights over water can be granted freely by the General Directorate of Water (DGA) or purchased through the water market. Once water rights are granted or purchased, they should be recorded in the same registry where real estate transactions are recorded, the *Conservador de Bienes Raíces* (CBR).

How does it work?

This is basically a free market with minimum government intervention. Hence there is no pre-set mechanism or established trading platform to buy and sell water rights. What normally happens is that agents interested in buying or selling rights go to specialized lawyers' offices to look for buyers or sellers and obtain some reference regarding prices.

Interaction with water and sanitation regulation

Chile uses a system of regulation known as "efficient model firm", whereby efficient cost levels used as a benchmark to set tariffs are estimated by the regulator, the SISS (*Superintendencia de Servicios Sanitarios*), based on hypothetical model companies.

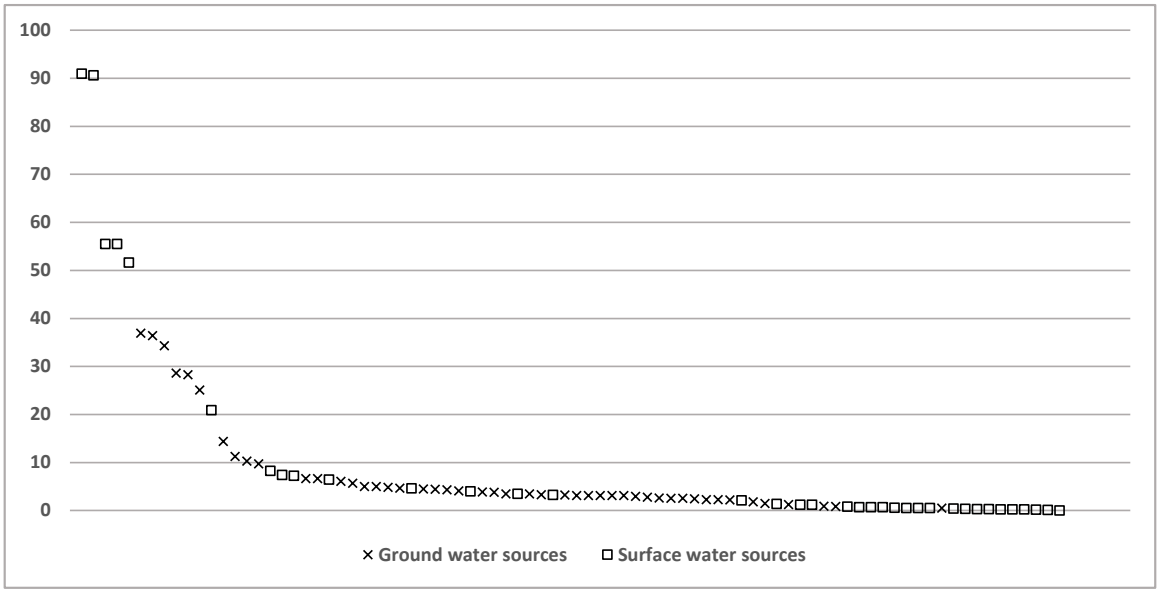
The value of raw water required to supply each system of each hypothetical model company is a key input in the assessment of the model companies' costs. The SISS establishes a value of zero in those sources where it is possible to obtain new water rights freely by request to

[26] Based on Baeza Gómez (2018) and information from the SISS.

the DGA. In other sources, the value is calculated based on the price of market transactions of water rights in those sources, which are available in the CBR.

During price controls, companies also undertake parallel calculations of the efficient model firms' costs. To do this, companies also assess the value of water in each source based on published market prices. Figure 37 shows the value of water for each source calculated by the water companies during the latest price control. This provides a very clear snapshot of the water abstraction rights trading market prices.

Figure 37. Value of Raw Water per Source (in Thousand USD per Liter per Second)



Source: Authors' calculation, based on information provided by CISS.
Note: Values have been converted into USD from UF (Chilean unit of account) at USD39.92 per UF.

Has it been successful?

It is unclear whether the water rights trading markets have been successful or not. Very large price variability by source suggests that the market is signaling scarcity in certain sources. In addition, in the sources with severe scarcity there has been a noticeable reallocation from agricultural uses to non-agricultural uses that are often considered to be more productive in the use of water.

In particular, water markets have been active in a small number of basins (e.g., Limarí and Elqui). In those basins water markets have helped to:

- facilitate the reallocation of water from lower value uses to higher value uses;

- mitigate the impact of droughts by allowing financial support for agriculture; and to
- make water resources available where all resources were already allocated.

However, water market activity has been relatively mild or limited in other basins. Among the reasons often mentioned for limited water markets are:

- inadequate existing infrastructure to increase storage, diversion and transport; and
- lack of formal registration in the CBR.

Key aspects to improve in the future

The current Government appears to believe that the market is not working appropriately. As a result, it is pushing a reform of the Water Code which gives greater powers to the regulatory bodies to intervene in the market.

The main proposed changes to the Water Code are as follows:

- **Redefining the legal nature of the abstraction rights**. Currently, the rights to use water consist of real rights over water. These real rights would be transformed into administrative concessions that allow the use and temporary enjoyment of water.
- **Making the rights time limited**. The current real rights are of a perpetual nature. The new rights would be temporary for a maximum of 30 years. This time limit is supposed to be automatically extendable, unless otherwise determined by the DGA.
- **Allowing the Government to limit the exercise of the rights**. The DGA would be able to temporarily determine a reduction in the use of water rights. It would also be able to temporarily reallocate water.
- **Categorizing the rights according to use**. The new Water Code would stablish priorities among different uses of water. These priorities must be considered when the government intervenes in the market. For example, if there were two or more abstraction requests over the same source presented within six months, and there was limited availability in that source to satisfy

the requests, the Government could directly allocate the abstraction to the user that it considers will give best use, rather than run the general auction mechanisms. Likewise, the DGA would consider uses when determining the temporary reductions mentioned above.

- **Increasing the fee for lack of use of the rights**. Currently there is a fee that rights holders must pay if abstraction rights are not being used. The new Water Code would increase that fee up to eight times.

It is worth noting that most of these measures represent a movement from a free market towards a more intervened market. We are unclear at this stage if this shift is based on real problems currently encountered in the market or simply the result of the government reluctance to apply free markets in the water sector. More analysis may be required to fully understand the strengths and weaknesses of the water abstraction rights market that may have led to the proposed reform so that this example of regulatory innovation can be best used by other countries in the LAC region.

4.3.2 Efficient Model Firm Approach – Chile

Background

Since privatization the Chileans have been using an approach to calculate regulated companies' required revenues known as "efficient model firm approach."[27,28] This approach is of a different nature than the approach used in E&W and replicated in several other countries around the world. As a result, we consider that, although it has been used for almost three decades, the efficient model firm approach could be considered a regulatory innovation.

How does it work?

The efficient model firm approach sets companies required revenues at the level of the forward-looking long term costs of an efficient hypothetical company. The forward-looking perspective means that the costs allowed do not consider investment made in the past. The efficient hypothetical company perspective means that the costs allowed are those of an efficient

[27] From the Spanish "método de la empresa modelo eficiente."
[28] This approach is also used to regulate electricity distribution networks and local telecommunication networks in Chile; and adaptations of this approach are used to regulate electricity distribution networks in Peru and Colombia.

theoretical construct, not the actual company. So, in simple terms, the efficient model firm approach only allows costs of a hypothetical efficient company that would be starting from scratch today.

Has it been successful?

The efficient model firm approach is the core of the regulatory regime run by SISS, which has enabled an annual average of USD350 million of private investment from the year 2000 (Bruna Villena, 2017). From that perspective, this approach could be considered a success.

Key aspects to improve in the future

The main problem of the efficient model firm approach is that the differences in the conditions that the forward-looking hypothetical firm and the real firm face can generate significant gains or losses to the real firm (Sánchez and Coria, 2003). For example, if in the past a company had invested efficiently in one technology that later became obsolete due to the introduction of a new cheaper technology, the model firm approach would disregard that past investment and would only allow revenues for the investment that would be required to operate with the new cheaper technology, generating a loss for the company that had already made the more expensive investment in the past.

This problem generates bitter disputes between the regulator and the firms. For example, in the Peruvian electricity distribution sector where a similar method is applied, distribution companies are currently pushing for an uplift in the cost of capital to compensate them for the fact that the efficient model firm approach does not provide a full return of and on their investment.

We believe that it would be difficult to resolve this problem, as it comes with the basic nature of the approach. As a result, we see that efforts going forward should focus more on where this method is applied than on resolving these types of issues. For example, the efficient model firm approach would be very useful to set prices in potentially competitive elements of the value chain, should governments decide to introduce competition in the water sector going forward.

4.3.3 Direct Subsidies for Low-Income Consumers – Chile[29]

Background

A system of direct subsidies for low income consumers was introduced in 1989 alongside privatization to ensure low-income consumers could afford newly set cost-reflective tariffs. Note that before that there was an implicit subsidy of a universal nature that arose from the fact that tariffs were politically set well below the economic costs of providing the services.

How does it work?

The system is run by the municipalities and financed by the ministry of finance. The subsidy covers up to 100 percent of the charges for a maximum monthly consumption of 15 cubic meters. Municipalities pay the subsidized amount to service providers, and low-income consumers apply to municipalities to be included in the system. The target population consists of those consumers that have already been included in other social benefit programs run by the Ministry of Social Development, or those consumers for which the water bill represents more than 3 percent of their monthly income. The benefit lasts 36 months.

Has it been successful?

Guernica (2017), which is the latest program evaluation available, has found that the direct subsidy system has produced a positive impact. In particular, it has effectively contributed to improving the target consumers' payment capacity and continuity of access to drinking water. This was achieved without generating consumption levels that are above those registered before the introduction of the system.

Key aspects to improve in the future

Guernica (2017) suggests that there are a few improvements that could be implemented in relation to the management of the direct subsidies system, in particular in terms of the transparency, availability and consistency of information. For example, the implementation of an information system which provides basic information (some of which could be shared via annual reports) such as number of subsidies, water consumption, amount subsidized, waiting lists,

[29] Based on Guernica (2017) and discussions with the SISS.

effective beneficiaries, permanence of beneficiaries within the program, and coverage of the potential population. Consistent and transparent information would help to protect the current system of direct subsidies against its use for political clientelism.

4.3.4 Environmental Fees – Peru[30]

Background

Improvement in access to water requires that service providers invest in maintaining and restoring their water sources. Traditionally, however, providers have focused on managing their networks rather than taking care of their key input. There is growing recognition that the use of economic incentives in environmental management programs can help in this regard.[31]

This is precisely what SUNASS (the Peruvian water regulator) has been doing since 2014 (in cooperation with the Ministry of Environment and water utilities), by allowing service providers to charge their customers an environmental fee (*mecanismos de retribución por servicios ecosistémicos*, or MRSE) to finance the conservation of water sources (river and lake basins which start in the Andes).[32] Over the past few years, water resources in Peru have been decreasing due to overpopulation, urbanization, infrastructure and climate change. With these environmental fees source basins can be rehabilitated and sustainable management programs can be introduced.

How does it work?

To implement the MRSE, SUNASS works together with water utilities, companies, stakeholders, and communities across basins. The following, borrowed from IWA (2017), is a description of the steps for the implementation of the MRSE:

1. Water utilities, with the technical assistance of SUNASS, design a proposal for the MRSE, including an assessment of the basin(s), an agreement between payers and providers; a monitoring system, and a dialogue platform between all the stakeholders of the MRSE.

[30] Based on IWA (2017) and http://www.sunass.gob.pe/websunass/index.php/eps/sunass-comprometida-con-el-cuidado-de-las-fuentes-de-agua.
[31] Environmental fees were first implemented in LAC by Costa Rica.
[32] Law No. 30215 (*Ley de Mecanismos de Retribución por Servicios Ecosistémicos*), passed in June 2014.

2. Based on this design plan, SUNASS evaluates what percentage of the water tariff will be used to implement the MRSE, and at the same time SUNASS offers the utilities recommendations for good practice.
3. SUNASS presents a proposal of the new water tariff structure and requests public recommendations by citizens in the community.
4. Based on public opinions, SUNASS creates a final document for the final tariff which includes the environmental fees.
5. A group of specialists with technical and financial knowledge is created to support and monitor the project, and a monitoring system is developed to follow up actions and initiatives taken by utilities and users.

Money collected through the fees is placed in a special account, and SUNASS ensure that funds are used for their intended purpose.

Has it been successful?

Currently, 16 regions in Peru participate in the mechanism, and will invest more than 37 million dollars over the next five years in water sources conservation. Since the MRSE were introduced, different basins, both rural and urban, are being restored and consumers are becoming more involved and aware of the need to protect water resources. Furthermore, the regions have improved rural sanitation with the construction of wastewater treatment plants and provided economic support to local sustainable practices to secure the water resources and mitigate possible droughts. Citizens in urban areas have shown support of the law by paying their fees on time.[33]

Key aspects to improve in the future

Problems related to basins are large, and the investment is still too small. However, these challenges are expected to improve as the MRSE is further introduced in the country and continues to engage users. Quintero and Pareja (2015) identify several obstacles (financial,

[33] Furthermore, they have shown increased willingness to pay: e.g., according to a study by the Universidad Nacional Mayor de San Marcos, urban and rural users are willing to pay an extra 8 percent per year for protection and rehabilitation services in the basin in Cusco.

institutional, technical, and social) to the implementation of MRSE that would need to be resolved in moving forward:

- Private sector lack of commitment and interest to sustain investments in time in MRSE.
- Lack of transparency in the use of the funds collected through the MRSE.
- Lack of understanding by all stakeholders of the environmental issues at stake.
- Lack of knowledge about the MRSE legislation.
- Lack of trust towards service providers and municipalities in local populations.

4.4 Gap Analysis

4.4.1 How Does LAC Compare to E&W?

The content described so far in Sections 3 and 4 clearly shows that there is a significant gap between LAC and E&W. In the table below we provide a snapshot of this gap disaggregated by regulatory objective. Although the assessment of the gap in this table is mostly qualitative, it is useful to orientate decisions on potential regulatory policies to be implemented in LAC in the future, which we discuss in Section 5.2.

Table 11. Achievement of Regulatory Objectives in LAC and E&W

Regulatory objective[1]	LAC	E&W
Coverage	Well below 100%, especially in wastewater	100%
Productive efficiency	Inefficient	Presumably efficient
Allocative efficiency	Inefficient, mostly due to the public subsidies aimed at maintaining low tariffs	Efficient, although with certain cross subsidies among rural and urban consumers
Social equity	Unequal, mostly due to ineffective social tariff systems and unfair access	Equal, but noting that the problem with poverty is much more acute in LAC than in E&W
Environmental sustainability	Unsustainable, in particular in terms of the amount of wastewater discharged to the environment without treatment	Broadly sustainable
Economic sustainability	Unsustainable, given the dependence on public funds and the general lack of clarity in terms of technical mechanisms to set charges	Sustainable, noting that there is a general perception from the public that some companies are profiting at their expense from financial engineering
Resilience to tackle future challenges	Non-resilient	Presumably resilient

Source: Authors' compilation.
Note: [1] All regulatory objectives are standard in economic regulation theory, except "resilience to tackle future challenges,", which has been added by the authors to take into account the extent to which regulatory regimes are prepared to deal with the changes discussed in Section 2 of this paper.

In the rest of this section we concentrate on providing a general description of the gap. We frame the analysis of the gap along the same lines used in Section 4.1: infrastructure and governance.

4.4.2 Infrastructure Gaps

In a region with the largest water reserves in the world (LAC possesses about a third of the world's freshwater resources), more than 25 million people (4 percent of the population, mostly urban poor and rural) still lack access to safe water (and 35 percent lack piped water at home).[34] Many more lack access to safe sanitation: more than 490 million people (78 percent of the population).[35] Several facts discussed in Section 4.1 reflect this situation: service quality is poor, infrastructure is often in bad condition, more than 70 percent of sewage collected is discharged without any treatment, access gaps within countries reflect drastic inequalities between income groups, and efficiency in service provision is low. On top of that, most cities lack drainage infrastructure and do little to protect their water sources (CAF, 2012).

According to estimates in Ballestero et al. (2015), as shown in Table 12, closing the infrastructure gaps by 2030 would cost about 160 billion dollars (8 billion dollars per year). Such investments would achieve 100 percent coverage in potable water, 94 percent in sewerage, and 85 percent in urban drainage. They would also allow for the renovation of the existing infrastructure. Formalizing half of the precarious connections would require an additional 1.5 billion dollars a year.

Table 12. Investments Needed to Close Infrastructure Gaps in LAC

Services	Total investment (billion USD, 2010-2030)	Average annual investment (billion USD)	2030 goal
Drinking water	45.4	2.27	100% coverage
Sewerage	79.4	3.97	94% coverage
Treatment	33.2	1.66	64% wastewater treated
Drainage	33.6	1.68	85% in urban areas
Formalization of water and sewerage connections	30.5	1.52	50% gap reduction – 20 million households
Water sources	27.1	1.35	100% of new demand

Source: Ballestero et al. (2015).

[34] At least a quarter of the declared water coverage is through precarious means, according to CAF (2012).
[35] And a third of those supposedly covered access through precarious connections (CAF, 2012).

Even with quasi-universal access, problems with service quality and wastewater treatment would remain. Achieving the SDGs will therefore require a much higher effort than that expended to meet the MDGs. Additional investments of 60 billion dollars (3 billion per year) would be needed to substantially increase wastewater treatment and develop new water sources to cover new demand. This is less than what could be saved by reducing inefficiency to comparable international best practice: according to CAF (2012), reducing current losses from 40-50 percent to 20 percent, and employment from 3.8 agents per 1,000 connections to 2 agents, would save 3.8 billion dollars per year. Reducing nonpayment would save an extra 2 billion.

The required annual investments, totaling 250 billion dollars (12.5 billion per year or 0.3 percent of the region's GDP), do not seem out of reach, but the effort required should not be underestimated: it is still about three times current investments in the sector, and twice the annual investment undertaken in E&W (see Section 3). Moreover, a consensus seems to have been reached whereby significant improvements in water governance (see next) would be required for these investments to come to fruition and deliver on their promises.

Looking forward, the challenge of closing infrastructure gaps is compounded in the region by the challenge posed by rapid population growth and urbanization (recall Figure 2.19), which will increase demand for the services and require heavy investments in infrastructure (Lentini, 2015). Setting cost-recovery prices—and, more generally, sending the right signals for consumption and investment through prices—will be a more pressing need wherever climate change increases water scarcity. This is likely to collide with the affordability of what has been explicitly recognized as a basic human right by the UN since 2010, thus making the deployment of effective subsidy schemes a more urgent matter.

4.4.3 Governance Gaps

Almost every country in LAC has achieved some degree of sector governance reform. At face value, most of these reforms have followed international best practice; implementation of the reforms, on the other hand, has proved much more difficult. While there have been advances in formulating new regulatory frameworks, creating specialized regulatory agencies, changing the institutional and industrial structure of the sector, and encouraging private sector investment, challenges remain concerning the setting of cost-recovery prices, the deployment of effective subsidy schemes, and the implementation of the new regulatory frameworks (Ferro, 2017).

The Anglo-French model of regulation (see Section 4.1) adopted in the region has added its own tensions: imposing regulation and PSP from the center on a sector that is often legally under municipal control (especially after decentralization), attracting private investment into a highly fragmented sector, regulating state-owned water utilities using incentive-based instruments, and so on (Foster, 2005). As emphasized by Solanes and Jouravlev (2005), it is precisely this lack of harmony between the pre-existing and the new institutional frameworks that are at the origin of governance problems in the region.

Akhmouch (2012) offers a good summary of governance problems in the region: "The trend towards the decentralization of water policies in LAC countries over the past decades has resulted in a dynamic and complex relationship between public actors at all levels of government. To varying degrees, LAC countries have allocated increasingly complex and resource-intensive functions to lower levels of government, often in a context of economic crisis and fiscal consolidation. Despite these greater responsibilities, sub-national actors were often not transferred the authority over the financial allocation required to meet these needs, or the capacity to generate local public revenues. Coordination failures between sub-national and national governments and of sub-national budgetary constraints have led to policy obstruction in Latin America" (Akhmouch, 2012: 15).[36]

To diagnose key coordination gaps in the water sector, Akhmouch (2012) applied the OECD Multi-level Governance Framework to a sample of LAC countries. Table 13 summarizes these gaps.

[36] At a more macro level, water governance in LAC has proved difficult because of specific socioeconomic and political characteristics of countries in the region (Solanes and Jouravlev, 2005): low income per capita, widespread poverty, important deficits in health, education and housing, and low state capacity (whether due to lack of resources, ideological prejudice about the role of the State in regulation, or regulatory capture by interest groups).

Table 13. OECD Multi-Level Governance Framework: Seven Key Coordination Gaps

Coordination gap	Description
Administrative gap	Geographical "mismatch" between hydrological and administrative boundaries. This can be at the origin of resource and supply gaps. ⇒ **Need for instruments to reach effective and appropriate scale.**
Information gap	Asymmetries of information (quantity, quality, type) between different stakeholders in water policy, either voluntary or not. ⇒ **Need for instruments for revealing and sharing information.**
Policy gap	Sectoral fragmentation of water-related tasks across ministries and agencies. ⇒ **Need for mechanisms to create multidimensional/systemic approaches, and to exercise political leadership and commitment.**
Capacity gap	Insufficient scientific, technical, infrastructural capacity of local actors to design and implement water policies (size and quality of infrastructure, etc.) as well as relevant strategies. ⇒ **Need for instruments to build local capacity.**
Funding gap	Unstable or insufficient revenues undermining effective implementation of water responsibilities at subnational level, cross-sectoral policies, and investments requested. ⇒ **Need for shared financing mechanisms.**
Objective gap	Different rationales creating obstacles for adopting convergent targets, especially in case of motivational gap (referring to the problems reducing the political will to engage substantially in organizing the water sector). ⇒ **Need for instruments to align objectives.**
Accountability gap	Difficulty ensuring the transparency of practices across the different constituencies, mainly due to insufficient users' commitment, lack of concern, awareness and participation. ⇒ **Need for institutional quality instruments.** ⇒ **Need for instruments to strengthen the integrity framework at the local level.** ⇒ **Need for instruments to enhance citizen involvement.**

Source: Akhmouch (2012).

The main obstacle ("important" or "very important" gap) mentioned by almost all LAC countries surveyed is the policy gap, followed by the accountability gap and the funding gap. Information and capacity gaps are also crucial in two-thirds of LAC countries surveyed.

The most important indicators of the policy gap are: problematic implementation of central government decisions at the local and regional levels; lack of national-level political

commitment and leadership in water policy; absence of strategic planning and sequencing decision; interference of lobbies, lack of institutional incentives for cooperation; overlapping, unclear or nonexistent allocation of responsibilities; and difficulties related to implementation of reforms.

In terms of the accountability gap, the governance challenges relate to limited citizens' participation and the absence of monitoring and evaluation of outcomes; whereas a mismatch between ministerial funding and administrative responsibilities is a key ingredient of the funding gap. The capacity gap was pointed out as a major obstacle for effective implementation of water policy in two-thirds of LAC countries surveyed. This refers not only to the technical knowledge and expertise, but also to the lack of staff (at central and sub-central levels) as well as obsolete infrastructure. Besides, capacity challenges have been exacerbated by decentralization processes in the early 1990s. Finally, the absence of a common information frame of reference was pointed out in relation to the information gap.

5 What Lies Ahead for LAC Water and Sanitation Regulation?

5.1 Key Findings of This Paper

Our analysis suggests that the water and sanitation sector in LAC is unlikely to experience a paradigm shift in the foreseeable future. We have found that changes facing the sector are likely to have a limited impact, localized either geographically or in specific parts of the value chain.

We have looked at the E&W best practice case study and found that it has achieved full coverage of exceptional quality based on a solid governance structure and regulatory framework, which are constantly being improved to provide resilience for the type of challenges that could be expected in the future.

The reality in LAC is very different. For example, more than 75 percent of sewage collected is discharged without any treatment, 40 percent of the LAC population is not connected to the sewerage network, service quality is poor, and infrastructure is often in bad condition and operated inefficiently. There are also significant gaps in terms of governance and regulatory arrangements, which could partly explain the other shortcomings. This reality shows clearly that the LAC region has not done enough to achieve basic sector objectives that have been in place for almost three decades.

5.2 What Does This Mean for the Regulation of Public Utilities of the Future?

The future changes facing the water sector are not expected to lead to a change in paradigm and therefore the old regulatory objectives, which have not been achieved so far, remain valid. In other words, the water and sanitation sector in LAC needs to ensure it keeps the focus on solving the known problems of the past.

There are, however, a number of new challenges that the future changes facing the sector could bring about, which may require some degree of regulatory reform, for example:

- New technologies such as resource recovery may have the potential to significantly impact specific parts of the value chain. As a result, regulatory frameworks of the future should be capable of maximizing the positive impact that these new technologies may have.
- Climate change is expected to bring uncertainty on the future availability of raw water. As a result, regulatory frameworks of the future should be able to allocate raw water efficiently should it become a scarce resource.
- Customers are expected to increase the level of scrutiny and requirements they place on utilities. As a result, regulatory frameworks should be able to foster utilities that are responsive to customer needs.

Table 14 outlines the sort of regulatory policies that may be pursued in the future and explains the rationales for them. We have grouped these policies into *business-as-usual* (defined as policies to solve the known problems of the past); and *beyond-business-as-usual* (defined as policies to deal with the new challenges introduced by the three changes facing the sector). The business-as-usual example policies are well known by governments and regulators. The beyond-business-as-usual example policies in the table are novel policies and have been inspired mostly by the E&W case study.

We note that these are just examples of policies to provide an idea of the type of regulatory policies that may be pursued in the future in the water and sanitation sector in LAC. These examples serve to provide an idea of the direction that sector regulatory policy may take in the future, and they could be used as a starting point to design policies that are region-specific. The exercise of deciding which regulatory policies should be implemented in each region is very complex and has not been undertaken in this paper. This exercise would weigh costs and benefits

in the light of local circumstances (e.g., institutional constraints) and may recommend, for the right reasons, policies (both business-as-usual and beyond-business-as-usual) that are different from the example policies included in the table below.

Table 14. Examples of Future Water and Sanitation Sector Regulatory Policies

Regulatory policy	Rationale
Business-as-usual (aimed at achieving coverage in an efficient, equal and sustainable manner)	
Establish economic regulators that operate at arm's length from the government	Ensure economic sustainability
Implement regulatory systems that ensure tariffs are cost reflective (including external costs) while protecting vulnerable users	Achieve allocative efficiency while maintain equity Achieve environmental sustainability
Implement regulatory rules (that can work in the context of both private and public ownership of utilities) that incentivize companies to save costs	Achieve productive efficiency
Capacity building at both ministerial and regulatory agency level	Ensure that human capacity to implement the regulations in practice is available
Beyond-business-as-usual (aimed at tackling the new challenges posed by future changes facing the sector)	
Develop water abstraction rights trading markets	Create a method to improve the allocation of raw water resources in a future context in which there will be increased uncertainty on raw water availability generated by climate change
Implement additional incentives (such as the abstraction incentive mechanism in E&W) to deal with over-abstraction	Ensure environmental sustainability in the context of increased uncertainty on raw water availability generated by climate change
Implement upstream competition	Ensure that the regulatory system enables the development of innovations in areas such as resource recovery
Implement retail competition	Ensure that the regulatory system is able to respond to future more demanding and empowered customers Retail and water upstream competition could leverage the impact of abstraction rights markets to further improve the allocation of scarce raw water resources
Develop a customer engagement framework	Ensure that the regulatory system is able to respond to future more demanding and empowered customers
Introduce a degree of discretion embedded in the regulatory regime so that both regulators and utilities are able to endogenously determine the outcomes to be pursued and the incentive schemes needed to encourage companies to achieve those outcomes	Provide resilience to tackle future challenges that are currently unknown

Source: Authors' compilation.

In summary, the key insight from this paper for future regulation is that regulatory policy should keep focusing on achieving old and well-known objectives. Innovative policies appear to be worth pursuing to tackle future challenges. However, if these innovative policies were to be implemented, that should be done without losing focus on the policies aimed at addressing the known problems of the past.

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