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Change Processes in Policy Development for Integrated Water and Wastewater Management

Regulatory and economic mechanism to incorporate environmental and management aspects related to wastewater reuse in the next Colombian water and sanitation tariff framework

Figure: 1 Oxidation lagoon for wastewater treatment in San Antero de Córdoba, Colombia. Photo: ©GIZ/Diana García

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Background information

Due to the economic characteristics, as well as the social and environmental externalities derived from its operation, the drinking water and basic sanitation sector is a sector that, for its proper functioning, has required the design of regulatory frameworks that enable the provision of drinking water and sanitation, complying with defined quality criteria and at "efficient" prices that allow the financial sufficiency of service providers.

In Colombia, Law 142 of 1994 ordered domestic public water and sewerage service companies to join the regulatory regime (which may include the modalities of regulated liberty and probation), the criteria of economic efficiency and financial sufficiency were defined as the guiding principles of the relationship between the costs and the rates of the companies providing domestic public services and the Commission for the Regulation of Drinking Water and Basic Sanitation (CRA)[1] was created, the entity responsible for designing the regulatory framework for the sector in relation to the tariff regime and the administration and control of the efficiency of domestic public services.

In the development and application of this regulated freedom regime, the commission has initiated and completed two regulatory stages – the first materialized in Resolutions 08 and 09 of 1995; and the second materialized in Resolution CRA 287 of 2004 – from which it has defined the general structure of reference costs (ACM, AOC, AIC and ACEF) and have defined signals and incentives to achieve financial sufficiency and economic efficiency of the companies providing drinking water and basic sanitation services.

Currently, the sector is going through the third regulatory stage that began with the issuance of Resolutions CRA 688 and 825 of 2014 and 2017, respectively, which define the tariff methodologies to be applied by large and small providers of domestic public services of water pipeline and sewerage. In this regulatory stage, the cost structure was maintained, and incentives were introduced to achieve 100% coverage in PHC, improve the continuity of home public services – establishing a maximum of six days without service per year –, guarantee the supply of drinking water in compliance with the standards established by the competent health authority and reduce the number of commercial claims for billing.

In turn, the CRA established a system of incentives to improve the planning and management of investments by providers, by strengthening the monitoring and control system for the provision of public services at home. To this end, it determined that the providers had to structure a Regulated Works and Investment Plan (POIR by its acronym in Spanish), which would support the fulfillment of the goals established in terms of coverage, continuity and quality of drinking water (in the case of the domestic public water pipeline service) and quality of the water discharged (in the case of the domestic public sewerage service). For the latter, it allowed the inclusion of investments related to wastewater quality, contained in the Sanitation and Discharge Management Plan (PSMV by its acronym in Spanish) approved by the corresponding environmental authority.

Despite the important advances in the regulation of the sector in Colombia and the advances in the management capacity of the agencies providing the service in the country, there is still the challenge of addressing the management of water resources from the introduction of topics such as circular economy, where the main objective is to reduce the use of finite resources as inputs for production, which implies minimizing, efficiently using or avoiding the use of water whenever possible and maximum reuse to overcome the negative externalities generated by its scarcity or poor quality, thus minimizing the impact on natural sources and promoting the restoration of watersheds and ecosystems.

In this sense, it is feasible and necessary to develop regulatory and normative entities to enable the reuse of wastewater, under specific criteria, as well as it is necessary to develop a series of signals and incentives that allow the progressive increase in the use of municipal wastewater – which is composed of 99.8% water (López et al., 2017) –, in uses such as irrigation, industrial processes, among others.

[1] Article 69 of Law 142 of 1994.

The challenge

The action of reuse configures one of the key principles of the circular economy, since it enables to substitute the exploitation of natural resources to introduce inputs to the production chain by reusing by-products along the production chain.

The adoption of the principles of circular economy to the drinking water and sanitation sector implies recognizing water as a finite resource, and in that sense, rationalizing the use as a raw material and promoting its reuse and recirculation, so that progress can be made in overcoming the negative externalities generated by irrational and inefficient consumption that leads to scarcity or degradation of environmental quality due to wastewater discharge.

Aligned with the above, in 2020 the CONPES 4004 document was formulated and establishes the circular-economy policy in the management of drinking water and wastewater management services, and proposes to implement a model that manages water resources in an integral manner, considering efficient use, sustainability and protection of the resource, which contributes to guaranteeing the supply of water in the long term under conditions of quality and continuity and integrates aspects such as the control of discharges and the treatment and reuse of wastewater (Departamento Nacional de Planeación, 2020).

In this sense, although applying policies for promoting the rational use of water by consumers is needed, it also requires the adoption of policies to foster the efficient use of the resource from the perspective of the wastewater (treated or not) reuse in primary or secondary activities, whose quality demands allow it. This would yield positive returns that would materialize in a lower demand for water extracted directly from the natural source, to be connoted as replacement water, with its chain effects, such as greater availability for other economic activities, greater soil retention capacity, higher flows in times of low water and/or aquifer recharge.

For this reason, Colombia is currently in a process of regulatory adjustment to implement reuse and circularity in wastewater management. In November 2021, Resolution 1256 of the Ministry of Environment and Sustainable Development was approved which regulated the reuse of wastewater. This standard defines reuse as the use of wastewater by a receiving user, for a use other than that which generated it, and defines the following permitted uses of reuse: agricultural and industrial, although it excludes the recharge of aquifers as a permitted use of reuse.

For this reason, this document aims to establish what the possible effects of wastewater reuse are in the components of the tariff structure of the domestic public sewerage service in force (AAC, AOC, AIC and ACEF) established by the CRA in Colombia, in addition to presenting proposals to deliver signals and incentives to the reuse activity from the competences of the CRA.

The document focuses on the tariff components of the domestic public sewerage service, since they are the components that could have some effect derived from the reuse activity.

Relevance to development

With the 2030 Agenda for Sustainable Development, countries have committed to ensuring respect for the human right to drinking water and safely managed sanitation based on the fulfillment of Sustainable Development Goals (SDGs) 6.1[2], 6.2[3] and 6.3[4]. The achievements of the SGG 6 objectives would impact the fulfillment of SDG 1 (zero poverty), SDG 2 (eradication of hunger and sustainable food production) and indirectly SDG 8 (decent work and economic growth), SDG 14 (life below water) and SDG 15 (life on land). (Schröder, Anggraeni, & Weber, 2019; Velenturf & Purnell, 2021).

Additionally, adopting an approach aligned with the provisions of the National Circular Economy Strategy defined by CONPES 4004 for the drinking water and sanitation sector, and specifically the promotion of wastewater reuse, would contribute directly to waste reduction and contribute to the achievement of SDG 12 (responsible production and consumption) and the achievement of food

[2] By 2030, achieve universal and equitable access to safe drinking water, at an affordable price for all.
[3] By 2030, achieve equitable access to adequate sanitation and hygiene services for all and end open defecation, paying particular attention to the needs of women and girls and people in vulnerable situations.
[4] By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing the discharge of hazardous materials and chemicals, halving the percentage of untreated wastewater, and substantially increasing recycling and safe reuse globally.

security (SDG 2) if wastewater, sludge and nutrients derived from wastewater are used, in food production systems. Finally, the industrial symbiosis created from clustering activities around the use of energy and waste discarded by others will support the achievement of goals 3.9, 6.3, 7.3, 8.2, 12.4, 9.4 and 17.7. (Montesinos & Martín, 2020).

In this sense and considering that the CRA will seek in the fourth tariff period to contribute to adopting the circular-economy approach, based on incentives that promote the investment and operation of wastewater treatment plants (WWTP) and the increase in the reuse of wastewater and recovery of by-products derived from it, the following chapter presents some considerations for the design of a regulatory framework to promote the reuse of wastewater. It identifies the different effects of reuse on the tariff structure of providers and, finally, proposes some signals and incentives from the perspective of the regulator.

The CReW+ approach

Possible impacts on tariff regulation because of wastewater reuse and proposal of signals and incentives for wastewater reuse

Considerations for wastewater reuse

Resolution 1256 of the Ministry of Environment and Sustainable Development issued in November 2021 presents an important advance with respect to Resolution 1207 of 2014, while the latter explicitly established that "in no case may the Generating User charge for the quantities (volumes) of Treated Wastewater delivered to the Receiving User", thus creating a barrier and legal risks for generators to assume and recover the costs that may arise to make wastewater available to third parties.

The new resolution leaves the door open to a commercialization of the services of collection, conduction and treatment of wastewater, which must be subsequently regulated, to give legal certainty to the agents of this new market, such as the type of contracts that can be established, the times in which the requests must be met by the generating users and the environmental authorities and the possibility of charging for the service of delivering wastewater to the receiving user, however, the above is beyond the scope of this document.

Additionally, it establishes provisions regarding the uses that can be granted to wastewater and the quality criteria to be met, and clearly defines who is configured as users generators and receivers of wastewater.

In this sense, some considerations to consider for the analysis of the regulatory implications of wastewater reuse are presented below, related to the type of receiving user, the place where the wastewater is delivered (from the generator to the receiver), volumes and the required frequency of wastewater delivery.

Who is the receiving user of the wastewater?

According to the Colombian regulatory framework[5], wastewater can – from reuse – be destined to be consumed in the agricultural sector or in the industrial sector, if fulfilling a series of requirements applicable to each of these uses.

Thus, the agricultural user receiving wastewater is any user who gives a use to said wastewater oriented to the irrigation of crops and related and complementary activities, but also for the irrigation of green areas and gardens.

On the other hand, a receiving industrial user is any user who uses wastewater in manufacturing or transformation processes, and in related and complementary activities.

How and at what point in the sewer system is wastewater delivery required?

Another factor to regard around the existing alternatives for the reuse of wastewater are to the characteristics desired by the user who demands them.

[5] Resolution 1256 of 2021 of the Ministry of Environment and Sustainable Development.

Namely, there are three possibilities:

1. Untreated wastewater.
2. Treated wastewater complying with the standard of discharges at the point of discharge.
3. Wastewater treated with additional treatment to meet the quality requirements of the receiving user.

The first, untreated wastewater, can be delivered by the generating person (service provider) in the wastewater collection and transport subsystems.

This form of wastewater delivery would require the receiving user to make the investments and assume the operation and maintenance costs for the treatment and reuse of the wastewater, in compliance with the provisions of article 2.2.3.3.5.20 of Decree 1076 of 2015.

The second form, treated wastewater, would be delivered to the receiving user once the wastewater leaves the WWTP.

The third possibility refers to cases where the receiving user requires additional wastewater treatment to meet the quality requirements of the receiving user. In these cases, it is possible for the receiving users to request the generating user (companies providing the service) to carry out additional treatment. It is also possible that these users make the investments and assume the costs incurred for the treatment (both traditional and additional) and reuse of wastewater.

When is wastewater delivery required?

Finally, it is necessary to consider that there are two types of demand for wastewater for reuse, in terms of volume:

- In principle, there are receiving users who, due to quality characteristics associated with the use they give to wastewater, require a demand throughout the year, that is, stable volumes and qualities.

- There are also receiving users who only require wastewater at certain times of the year and present a demand for fluctuating volumes of wastewater.

Thus, the possible effects of reuse on the tariff framework are presented below, taking into account the considerations presented in this chapter on who, how, when and where wastewater is delivered and received.

Possible impacts on tariff regulation because of wastewater reuse

This section will examine the possible impacts on tariff regulation by including costs associated with the activity of wastewater reuse, regulated by resolution 1256 of 2021.

The document focuses on the domestic public sewerage service since they are the components that could have some effect derived from the reuse activity. In addition, Resolution 1256 of 2021 does not allow aquifer recharge as a permitted use of reuse, so one could not think of an effect on the components of AAC and APC.

For this analysis, the provider of the domestic public sewerage service must be regarded as the user generating the wastewater and those interested in obtaining the wastewater as the receiving user who may or may not be a user of the domestic public sewerage service. The possible impacts on the components of the current tariff framework will be analyzed: Average Administration Cost of the domestic public sewerage service, Average Operating Cost of the domestic public sewerage service, Average Investment Cost of the domestic public sewerage service and Average Cost of Environmental Fees of the domestic public sewerage service.

Impacts on the Average Administration Cost component

The Average Administration Cost-AAC of the domestic public sewerage service, as shown in the annex to this document, is calculated in simple terms, such as the quotient of administrative and commercial costs (numerator) and billed subscribers (denominator).

If a reuse scenario is considered, the provider of the domestic public sewerage service – generator of wastewater – will most likely have to incur new administrative costs to develop this activity and deliver the wastewater to the recipient. Such costs range from legal advice, documentation costs, meeting and negotiation costs, billing costs, etc.

From tariff-formula perspective, such costs would increase the numerator of the formula. Now, should users pay these costs?

As it is an activity that is not part of the public domestic sewerage service, these costs should not be transferred to the tariff.

If we review the current tariff framework, in principle these costs could not be passed on to users, due to the following aspects:

1. The current regulation would prevent the pass-through of costs in the base year by using comparative efficiency standards and scores.
2. The current regulation would avoid the transfer of these costs in years after the base year, since a pass-through scheme for administrative costs (excluding fees and taxes) is not contemplated in the regulation, as if it is allowed for the private costs of the Average Operating Cost.

However, it is possible that with what is contained in the current regulation, the transfer of costs in a new tariff framework (fourth tariff period) will not be avoided. Let's think of a provider whose efficiency score (DEA) was 100 in the current tariff framework and who before the entry of the new tariff framework becomes a user generating the reuse activity. This provider incurs administrative costs and accounts for them in the public home sewerage service. At the time of granting a new efficiency score, this provider, who is efficient, obtains again a score of 100, even though they have included in their costs of the domestic public sewerage service, the costs related to the reuse activity.

To prevent this from happening, the issue of reuse in the tariff component of the AAC must be made explicit through the following regulatory statements:

1. Regulate that providers of the domestic public sewerage service must exclude the administrative costs of reuse from the AAC.
2. Regulate that the administrative costs related to the reuse activity must be made transparent in accounting and have a separate accounting record.

Impacts on the Average Operating Cost component

The Average Operating Cost of the domestic public sewerage service (AOC), as shown in the annex to this document, is calculated in simple terms, such as the quotient of operating costs (numerator) and loss-corrected consumption (denominator). If we think of a reuse scenario, there would be the following alternatives that would generate impacts on this component:

1. **If treatment is required in addition to the one needed to meet the standards set forth in the discharge regulation or the discharge permit at the expense of the generator:** If the receiver of the wastewater requires that the water be delivered in a higher quality than the generator can currently deliver and also requires that this treatment be carried out by the generator, then the operating costs of additional treatment could cause an increase in the numerator of the AOC.

As in the case of the AAC, in principle, these higher costs should not be passed on to sewerage subscribers, so the CRA must, in the following tariff framework, declare that no additional treatment costs (due to reuse effect) may be carried over to the private cost component of the sewerage AOC.

However, if the additional quality requested by the receiver is within the parameters required by the environmental authorities at the point of discharge into the water source, these costs could be passed on to sewer users.

2. **If wastewater is delivered to the receiver before the WWTP:** In this second scenario, in which the generator delivers wastewater to the receiver in the collection or transport subsystem with the existence of a WWTP in operation, the treatment operation costs could be permanently or stationarily decreased, since part of the volume and quality of the wastewater determines the energy/chemical dosages, and therefore, the costs to be incurred by the generator.

   In this case, as the current tariff framework stands, in which treatment costs are pass-through, the numerator of the AOC would decrease, specifically of the private costs for both sewer users and existing interconnection contracts. However, this

could discourage reuse activity, from the point of view of the generator. In the chapter: *Proposal of signals and incentives for the reuse of wastewater*, this scenario will be addressed.

Additionally, if the generator delivers the wastewater without any treatment and there is no WWTP, there would be no tariff effect on the AOC of the domestic public sewerage service.

Impacts on the Average Investment Cost component

The Average Investment Cost of the domestic public sewerage service (AIC), as shown in the annex to this document, is calculated in simple terms, such as the ratio of depreciation costs and capital remuneration of realized and future investments (numerator), and loss-corrected consumption (denominator). If we think about a reuse scenario, there would be two alternatives that would generate impacts on this component:

1. **If additional treatment is required to comply with the discharge standard or the discharge permit at the expense of the generator:** If the recipient of the wastewater requires for such water to have a higher quality than that which, in compliance with current regulations, can be delivered by the generator at present, and also requests that this additional treatment be carried out by generator, then the costs of possible additional investments, if not regulated, would generate an increase in the numerator of the AIC.

As in the case of the AAC and AOC, in principle, these higher costs should not be passed on to sewerage subscribers, so the CRA must declare in the following tariff framework that no additional treatment costs (due to reuse effect) may be carried over to the AIC component of sewerage.

2. **If wastewater is delivered to the receiver in the collection or transport subsystem:** In this second scenario, in which the generator delivers wastewater to the receiver before an existing WWTP or a planned WWTP, treatment investment costs could be reduced, as capacity expansion may not be required, or lower future treatment capacity may be defined.

Impacts on the Average Cost of Environmental Fees component

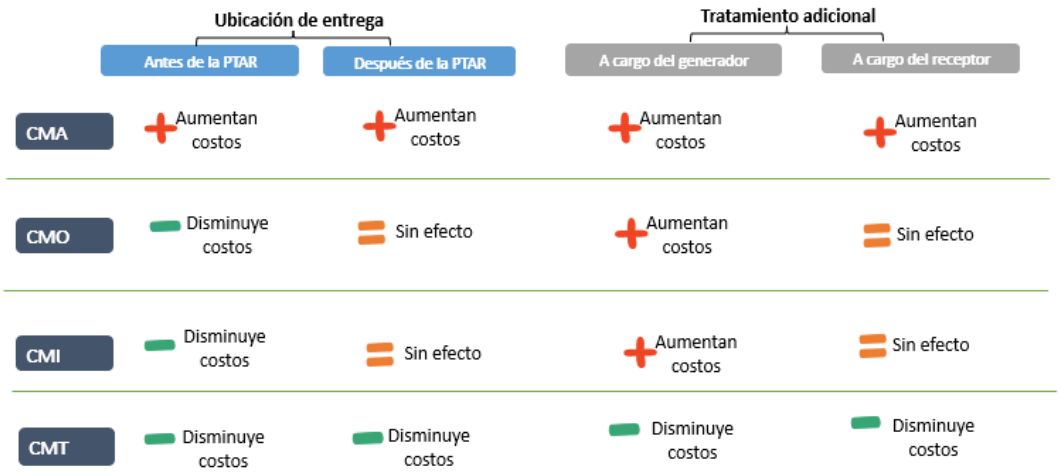
The Average Cost of Environmental Fees of the domestic public sewerage service (ACEF), as shown in the annex to this document, is calculated in simple terms, such as the quotient of the fees paid to the environmental authority with regional factor one (numerator) and the invoiced volume of sewerage (denominator).

If a reuse scenario is considered, the fees paid to the environmental authorities could be decreased, if the authorities recognize the decrease in discharges to the receiving sources. In this sense, the numerator of the formula would decrease. As the current tariff framework is conceived, which must be maintained for the next tariff period, this reduction in environmental charges will be reflected in a lower user tariff.

Summary of possible impacts on tariff regulation

The following figure presents a summary of the possible tariff impacts on tariff regulation because of wastewater reuse, exposed in the previous sections.

Figure 2: Possible tariff impacts on tariff regulation due to the effect of wastewater reuse



Source: Own preparation

In the impacts indicated with a plus (+), the CRA must give regulatory signals to prevent the higher costs resulting from the reuse activity from being transferred to sewer users, while the impacts indicated with a minus (-), the CRA could make modifications to the current tariff framework to establish that the benefits of the reduction of costs in the domestic public sewerage service product of the reuse activity, are transferred to both the provider and the users (incentives).

Given that the proposed signs and incentives are within the tariff framework of the domestic public sewerage service, this regulation is the responsibility of the CRA, which is based on the following:

- Article 68 of Law 142 of 1994 establishes that the indication of the policies referred to in article 370 of the Political Constitution of Colombia may be delegated to the Regulatory Commissions.
- The President of the Republic, by Decree 1524 of 1994, delegated the Presidential functions of indicating general policies of administration and control of efficiency in domestic public services to the Regulatory Commissions.
- Article 73 of Law 142 of 1994 establishes the general functions and powers of the Regulatory Commissions, and the same norm provides that these Special Administrative Units: *"(...) have the function of regulating monopolies in the provision of public services, when competition is not, in fact, possible; and, in other cases, to promote competition among those who provide public services, so that the operations of monopolists or competitors are economically efficient, do not involve abuse of dominant position, and produce quality services. (...)".*
- Te tariff regime applicable to domestic public services, in accordance with number 86.4 of article 86 Ibidem, is composed of rules relating to procedures, methodologies, formulas, structures, strata, billing, options, values and, in general, all aspects that determine the collection of rates.
- By virtue of the principle of economic efficiency, established in number 87.1 of article 87 of Law 142 of 1994, *"(...) The tariff system shall ensure that tariffs approximate what would be the prices of a competitive market (...) that tariff formulas cannot pass on to users the costs of inefficient management, nor allow companies to appropriate the profits from practices restricting competition (...)".*
- According to the provisions of number 88.1 of article 88 Ibidem, *"(...) The Regulatory Commission may establish maximum and minimum tariff ceilings, which must be complied with by companies (...)".*
- Article 91 of the aforementioned law states that *"In order to establish tariff formulas, a formula shall be calculated separately, whenever possible, for each of the various stages of the service."*

- Article 92 ibidem provides that: *"In the tariff formulas, the Regulatory Commissions will guarantee users over time the benefits of the average cost reduction in the companies that provide the service; and, at the same time, they will give incentives to companies to be more efficient than average and to appropriate the benefits of greater efficiency."*

Signals required for the tariff framework regarding the reuse of wastewater

The impacts marked with the sign (+) in Figure 1 warn of the possibility that, in the absence of complementary regulation, costs of the reuse activity are passed on to sewer users. To avoid such a transfer, the regulator must give certain signals that are set out below.

As the current reuse regulations are conceived, there is the possibility that a provider of the domestic public sewerage service, which is constituted as a generator of wastewater for reuse, incurs additional costs of administration, operation and even investment, when delivering wastewater to a receiver.

It is clear that from the point of view of the CRA these costs should not be passed on to sewerage users, since they are not part of the costs of the service. However, it is highly likely that generators record these costs in the accounting of the domestic public sewerage service, without their distinction being visible in many cases. This could materialize in a market failure known as incomplete information.

To avoid such market failure, the regulator should require providers to disaggregate cost information related to reuse activity. That is, it must establish in the next tariff framework, that providers must have a separate accounting/registration of the additional costs of reuse and make them visible. Such accounts may be subject to review by the Superintendence of Domestic Public Services.

Although the current regulation does not allow the inclusion of costs not affected by the service, it is convenient that the CRA in the following tariff framework make an explicit regulatory statement indicating to the providers of the domestic public sewerage service that they cannot transfer costs related to the reuse activity to the sewerage rate.

Incentives for wastewater reuse

The impacts marked with the sign (-) in Figure 1 mean that the reuse activity generates a reduction in the costs of providing the sewerage service. The following are the signals and incentives that the CRA, within the framework of its competences, could include in the next tariff framework to take these benefits into account and encourage the reuse of wastewater.

Distribution of the benefits of reuse

Lower charges for environmental fees

In a reuse scenario, the fees paid to environmental authorities by sewerage service providers could decrease, if those authorities recognize the decrease in discharges to receiving sources produced by reuse. In this regard, it should be noted that those environmental authorities that calculate pollutant loads from population served and per-capita load and that do not accept the self-declaration presented by the provider, may not recognize the decrease in pollutant loads because of reuse.

As the current tariff framework is conceived in this regard, and which seems to be maintained for the next tariff period, the reduction in payments to environmental authorities for polluting loads generated by any cause, including reuse, should be reflected in a reduction in the average cost of environmental tax and therefore in a lower user rate. In this context, no modification to the current tariff rule related to the subject seems necessary.

Lower operating costs

As explained in the previous sections, the reuse activity could reduce operating costs to the provider of the domestic public sewerage service (as generator of the reuse), if it delivers the wastewater before the WWTP. These savings would be mainly in energy and chemicals.

Paragraph 4 of Article 2.1.2.1.4.2. of Resolution CRA 943 defines that, in the event of variations of more than 5% in the private costs of wastewater treatment in a period of no less than 12 months, the provider must adjust the rates.

To encourage reuse activity from generator point of view, a tariff rule could be thought of that allows the provider to retain part of the cost savings generated by the reuse.

In accordance with Article 92 of Law 142 of 1994, the commissions may allow the tariff formulas for the recovery of operating costs and expenses to distribute the benefits generated by the increase in productivity among companies and users.

For this, the regulator could define that in the calculation of the sewerage AOC, the provider must transfer to the rates at least 50% of the negative variations of the private costs that are generated by the effect of reuse.

Use of income from reuse

Until now, our first recommendation, in protection of users of the public domestic sewerage service, is to avoid that costs generated by the activity of commercialization (of services) of wastewater eventually mimic as costs of the public domestic sewerage service and therefore are transferred totally or partially to said users.

Secondly, to encourage the providers of the domestic public sewerage service, we propose that any savings in the costs of the public domestic sewerage service, which are generated by the effect of the activity of commercialization of the wastewater, are distributed between the company and the users.

Now, let's consider the case in which a provider of the domestic public sewerage service, as a generator of the wastewater, can receive revenues for the provision of the service of collection, conduction, delivery and even treatment (basic and/or additional) of the wastewater that they deliver for reuse (use of shared infrastructure).

Clearly, these are revenues from an activity not regulated by Law 142 of 1994 and are therefore outside the regulatory scope of the CRA, to which companies can give the use and destination that they freely define.

However, it should be borne in mind that the current tariff regulations are based on the "costs of providing services" and do not explicitly contemplate that companies can reduce the costs to be carried out in the tariff calculation because of external revenues.

Additionally, although under the "price ceiling" regulation, which explicitly applies to providers with more than 5,000 subscribers, they can establish costs/rates lower than those resulting from the tariff methodology "as long as they do not jeopardize the financial viability of the company", it is not explicit that external income can be considered in this feasibility analysis.

Although for private providers there is no risk or limitation to reduce their rates or reference costs taking into account other income, such as those generated by the reuse activity, in the case of public providers, subject to the rules and surveillance of attorneys and comptrollers, it is convenient, and even necessary, to make this possibility explicit in the tariff regulations of the sector and thus avoid that the officials of these companies can reduce the rate of sewerage due to the effect of the economic benefit generated by the reuse activity, without being the subject of investigations for possible "patrimonial detriment".

Regulation of another cause for modification of the POIR

The Regulated Works and Investment Plan is, by definition of the CRA:

"(...) the set of projects that the provider considers necessary to carry out to reduce the differences compared to the standards of the service required during the period of analysis, in the SPA of each of the municipalities it serves. The provider must consider in the definition of each of the projects included in the POIR the technical, environmental management and risk management components."

Resolution CRA 943 of 2021 defines in its article 2.1.2.1.4.3.10 the conditions for providers to modify *ex officio* (without procedure before the CRA) their Regulated Works and Investment Plan, which we summarize below:

1. Modify the POIR of the water pipeline and/or sewerage services, without alternating its initial Net Present Value per service, considering that the projects to be modified allow the provider to meet the service goals initially defined.

2. Modify the POIR of the water pipeline and/or sewerage services, in a percentage less than or equal to 10% of the NPV of the original POIR of each service, supported by changes in urban regulations.
3. Modify the POIR due to changes in the Sanitation and Discharge Management Plan-PSMV.

We consider that the reuse activity makes it relevant for there to be an additional alternative for providers to modify the POIR of the domestic public sewerage service, conditioned to negative variations (reductions) in the future investment amounts originated by the total or partial destination of wastewater to the reuse activity.

As explained above, a possible effect of the reuse activity for the sewerage service provider (as generator of these waters) and that delivers wastewater before the existing or projected WWTP is that it must resize/adjust the future investments that were going to be made in treatment, due to a lower volume of wastewater that will reach the WWTP.

In this case, the cause "Modification of the POIR due to changes in the Sanitation and Discharge Management Plan-PSMV" could not necessarily be used since there could be changes in the POIR, which would not necessarily lead to a modification of the PSMV or whose processing before the environmental authority takes a long term.

Thus, it would be convenient to include as an additional possibility to modify the POIR *ex officio*, the reduction in the value of the sewerage POIR because of wastewater reuse contracts, which reduce or displace in time the planned investments in treatment.

It should be specified that the sunk costs of the installed capacity that will be idle due to the reuse activity would have to continue to recognize their remuneration in the tariff.

Creation of the category "domestic public service providers of wastewater treatment and final disposal" or sewerage service providers that only provide the activity of treatment or disposal of wastewater

In a Domestic Public Sewerage Service Provision Area where no wastewater treatment is yet being carried out, an economic agent interested in making use of that wastewater (for the reuse activities allowed in Resolution 1256) could find the opportunity to make treatment investments.

In this case, this agent could generate a profit for both the provider of the domestic public sewerage service and the sewerage users, by assuming the investments and carrying out the treatment of the wastewater to achieve the qualities required for planned use.

This agent will incur investment and operating costs for treatment, which they may not be able to fully assume with the reuse activity but which, if shared with sewer users, could make the project viable. In this context, it seems desirable from the point of view of the sewerage sector, that users assume a part of the treatment costs and said agent the remaining costs, that is, as if they were costs by stages of the treatment train.

This model would encourage not only the reuse activity but also the treatment of wastewater in municipalities where there is no treatment of any kind. The National Municipal Wastewater Management Plan 2020-2050 (PMAR by its acronym in Spanish) prioritized 58 municipalities that need a solution for discharge management, for some of which this model could contribute to solving the problem.

This proposal would be framed in the "Green Growth Policy", contained in document CONPES 3934 of 2018, which included as part of the actions of the CRA, the policy of vertical disintegration in the public sewerage service, to allow the development of regional markets for wastewater treatment and final disposal systems.

For the CRA to regulate the costs that this agent can pass on to users of the sewerage service, they would have to be qualified as a "provider of the domestic public service of treatment and final disposal of wastewater" or "provider of the sewerage service that only provides the activity of treatment and disposal of wastewater".

Since it is not clear that in the current regulations, there is the figure of the treatment provider independent of the sewerage provider, and in fact previous concepts of the CRA and the SSPD that this activity, carried out independently of the sewerage provider, is not a public service, to make this model viable, the following aspects must be regarded:

Regulate the possibility of existence of "public service providers of wastewater treatment and disposal" or "sewerage service provider that only provide the activity of treatment and disposal of wastewater"

In accordance with the provisions of Law 142 of 1994[6] in its article 18, a public service company has as its object "(...) the provision of one or more of the public services to which this Law applies, or to carry out one or more of the complementary activities, or both (...)".

In accordance with the above, Decree 1077 of 2015 in its article 2.3.1.1.1, included the definition of domestic public sewerage service as *"(...) The municipal collection of waste, mainly liquids and/or rainwater, through pipes and conduits. This service includes the complementary activities of transport, treatment and final disposal of such waste (...)"*.

Decree 1745 of 2021, which adds to Decree 1077 of 2015, establishes the general conditions for the connection by the providers of the complementary activity of wastewater treatment to the collection networks of the other providers of the domestic public sewerage service, and Resolution CRA 759[7] of 2016 establishes, among other things, the general requirements of the interconnection contracts and the remuneration and/or toll for the interconnection to the wastewater treatment and/or final disposal subsystems.

In this sense, in light of the current regulatory framework, it is feasible to form providers only of the activity of treatment and final disposal of wastewater or sewerage service providers that only provide the activity of treatment or disposal of wastewater, defined by the CRA, in article 2 of Resolution 759 of 2016, as the set of infrastructure, networks, equipment and accessories used by the provider for treatment and/or final disposal of wastewater, located from the point where the transport subsystem ends.

Define tariff formulas for the remuneration of wastewater treatment and disposal costs

According to the analysis of the previous section, it is possible, within the legal framework, to make viable the existence of the "public service of treatment and disposal of wastewater" or of sewerage service providers that only provide the activity of treatment or disposal of wastewater. Consequently, the CRA must define specific tariff formulas that allow the remuneration of the costs of providing this service, taking at least the following considerations into account:

1. For the recovery of the costs (administration, operation and investment) of the treatment service, different options of tariff formulas could be chosen, such as:
    a. Use the same components of the public sewerage service (AAC, AIC, AOC) but recovering the costs associated with the treatment and final disposal of wastewater.
    b. A specific tariff component for the treatment and final disposal of wastewater, similar to the existing scheme for the final disposal activity in the case of the domestic public cleaning service. The CRA could determine a ceiling price scheme for this component, which would encourage providers to use efficient technologies for wastewater treatment.
    c. On the other hand, it is necessary to regulate the joint billing mechanism that allows and obliges the provider of the domestic public water and/or sewerage service to charge and collect the wastewater treatment fee and guarantee the transfer of these resources, thus giving the "public service of treatment and disposal of wastewater", the same qualification that is given, in the cleaning service, to the activity of final disposal.

Regulate the type of contracts between providers

It is also important to discuss the type of contract that public sewerage service providers could have with providers of the "public service of treatment and disposal of wastewater".

[6] By means of which the regime of domestic public services is established, and other provisions are dictated.

[7] By which the general requirements applicable to the contracts signed by the providers of domestic public services of water pipeline and/or sewerage, for the use and interconnection of networks and for contracts of drinking water supply and interconnection are established; The methodology for determining the corresponding remuneration and/or toll is indicated and the rules for the imposition of interconnection easements are established.

Number 39.4 of article 39 of Law 142 of 1994 establishes that, for the purposes of the management of public services, it is authorized, among others, to make contracts through which two or more entities providing public services or these entities with large suppliers or users, regulate the shared access or interconnection of goods essential for the provision of public services, by payment of reasonable remuneration or toll. This is something that the CRA has regulated for the public household cleaning service and for interconnection contracts in the domestic public services of water pipeline and sewerage.

This type of contracts could be made under the modalities "Take and Pay" and "Take or Pay" contracts. The latter would eliminate the risk of demand for the providers of the "domestic public service of treatment and disposal of wastewater since it would ensure a demand and remuneration to these providers.

Lessons learned and synthesis of proposed signals and incentives for wastewater reuse

In summary, below are the proposals to deliver signals and incentives to the activity of reuse (from the competences of the CRA), which are derived from the diagnosis made in this document.

1. **Regulatory Statements.** The regulator must make an explicit regulatory statement indicating to the providers of the domestic public sewerage service that they cannot transfer costs related to the reuse activity to the sewerage tariff.
2. **Regulation of adjustment of private costs.** To encourage the reuse activity from the point of view of the generator, a tariff rule should be thought of that allows the provider to retain part of the cost savings generated by the reuse. For this, the regulator could define that in the calculation of the sewerage AOC, the provider must transfer to the rates at least 50% of the negative variations of the private costs that are generated by the effect of reuse.
3. **Use of income from reuse.** To provide incentives to the providers of the domestic public sewerage service, we propose that any savings in the costs of the domestic public sewerage service, which are generated by the effect of the activity of commercialization of wastewater are shared between the company and the users.
4. **Regulation of a new cause for modification of the POIR.** We consider that the reuse activity makes it relevant for there to be an additional alternative for providers to modify the POIR of the domestic public sewerage service, conditioned to negative variations (reductions) in the future investment amounts originated by the total or partial destination of wastewater to the reuse activity.
5. **Creation of the category "providers of the domestic public service of treatment and final disposal of wastewater" or sewerage service providers that only render the activity of treatment or disposal of wastewater.** In a Domestic Public Sewerage Service Provision Area where no wastewater treatment is yet being carried out, an economic agent interested in using that wastewater (for the reuse activities allowed in Resolution 1256) could find the opportunity to make treatment investments. This agent will incur investment and operating costs for treatment, which they may not be able to fully bear with the reuse activity but which, if shared with sewer users, could make the project viable. To this end, it is necessary to:
    - Define a scheme for the recovery of costs (administration, operation and investment) of the treatment service, for which the same components of the public sewerage service (AAC, AIC, AOC) can be used but to recover the costs associated with the treatment and final disposal of wastewater; or a specific tariff component for the treatment and final disposal of wastewater, similar to the existing scheme for the final disposal activity in the case of the public domestic cleaning service.
    - Establish the type of contracts to be signed between the providers of the public sewerage service with the providers of the "public service of treatment and disposal of wastewater". The modalities "Take and Pay" or Pay the Required and "Take or Pay" or Pay the Contracted Contracts are put to consideration.
    - Regulate the joint billing mechanism that allows and obliges the provider of the domestic public service of drinking water and/or sewerage to charge and collect the wastewater treatment fee and guarantee the transfer of these resources.

Sustainability, improvement, and downscaling

This consultancy establishes the beginning of the path for the adoption of signals and incentives for the reuse of wastewater in the next regulatory framework of the sector in Colombia.

The great challenge identified for the adoption of the proposals presented in this document lies in the development of consultancies and additional studies, for the maturation of proposals that revolve around the "use of reuse income", because in the next regulatory framework, the CRA should, in case the proposal is accepted, define clear rules to distribute the savings in the costs of the domestic public sewerage service, which are generated by effect of wastewater marketing activity, between the company and users.

There is also this challenge around the materialization of the "creation of the category of providers of the domestic public service of treatment and final disposal of wastewater or sewerage service providers that only provide the activity of treatment or disposal of wastewater". Therefore, in the context of the vertical disintegration of the market, studies should be developed to define the mechanism for the remuneration of the costs incurred by potential providers that fall into this category.

At the same time, to ensure the sustainability of this process and the materialization and maturation of the regulatory proposals proposed in this document, instances for dialogue and discussion are to be held to identify the different perceptions about the proposals presented by the sectoral actors and the agents interested in the reuse of wastewater.

In the same way, the application of the provisions regarding reuse, which will be contained in the next regulatory framework of the sector, will depend on the development of the technical capacities and prior knowledge that sewerage service providers have with respect to these regulatory provisions. For this reason, it is necessary to socialize and hold training sessions prior to approving the next tariff framework, which allow providers to know in detail the purpose of the provisions and the way in which they should be applied in companies.

Finally, the signals and incentives that are introduced in the next regulatory framework are to be constantly reviewed to ensure they respond to the new challenges imposed by the context, since it is known that climate change and environmental phenomena, as well as changes in the demand for water for different uses, impose variable conditions over time, which require regulatory adjustments.

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Annexes

Annex 1. Structure of the current tariff framework for the domestic public sewerage service of large providers

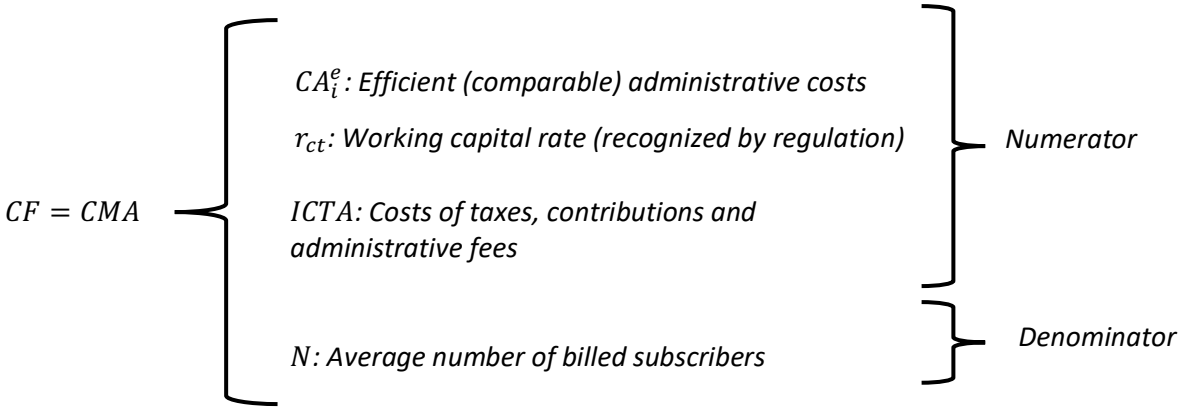
Next, the structure of the current tariff framework for the domestic public sewerage service for large providers will be presented.

Through Resolution CRA 688 of 2014, the CRA defined the tariff methodology for providers with Service Provision Areas (SPA) greater than 5,000 subscribers in the urban area. In this resolution, 2 segments were defined according to the size of the market served:

(i) Providers that served (as of December 2014) urban PHCs of more than 100,000 subscribers or department capitals, are classified in the first segment.
(ii) Providers serving urban PHC with subscribers between 5,000 and 100,000 are classified in the second segment.

These rules, now compiled in Resolution CRA 943 of 2021, established the current tariff formulas, which are composed of 2 charges: the fixed charge and the consumption charge. The fixed charge corresponds to the Average Administration Cost (AAC), while the consumption charge is determined based on the sum of the Average Operating Costs (AOC), the Average Investment Cost (AIC) and the Average Cost of Environmental Fees (ACEF).

Figure 3: Composition of the fixed charge

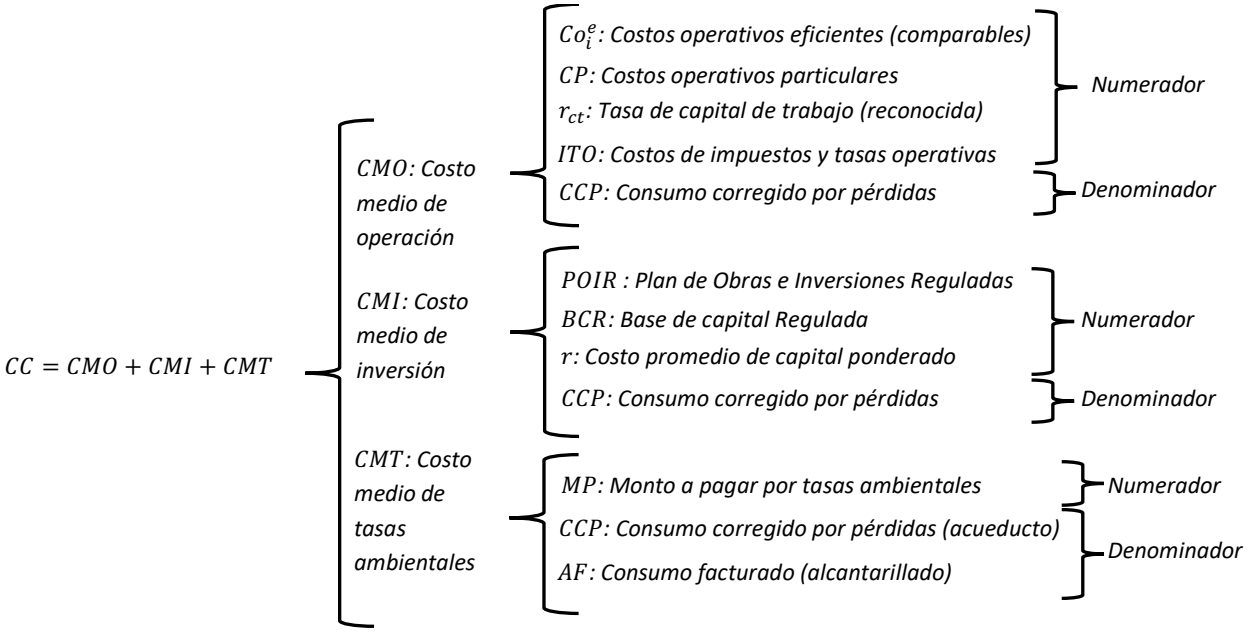


Source: own production

The Average Administration Cost (AAC) is determined from the Comparable Administrative Costs, administrative taxes and fees, and administrative working capital cost, while the Average Operating Cost is determined from the Comparable Operating Costs, Private Costs (energy and wastewater treatment cost), operating taxes and fees, the cost of operating working capital and total payments for interconnection contracts (the latter, also divided into private costs and comparable costs).

These Comparable Administrative and Operating Costs had to be projected in a linear manner, so that within a period of five years and gradually, they would go from the value defined in the base period, to an efficient value.

Figure 4: Composition of the consumption charge



Source: own production based on Res. CRA-688 of 2014

This efficient value, in the first segment, was defined from the efficiency factor resulting from the application of the DEA methodology "Data Envelopment Analysis"[8]; while for the second segment the CRA directly determined the efficient values.

[8]Data Envelopment Analysis (DEA) methodology in which efficiency parameters are defined from the comparison of companies.

The Working Capital Costs, both Administrative and Operating, as well as the discount rate (which, in turn, is the recognized cost of capital rate) were also determined directly by the CRA and are established in CRA Resolution 943 of 2021.

The Private Costs (energy, wastewater treatment and the private cost portion of interconnection contracts) were to be projected over five years, starting from the values of the first year (considering efficient use of energy and chemicals) and keeping the unit costs of the base year constant for the entire projection period.

The Average Cost of Investment (AIC) is determined based on the depreciation and cost of capital (at the regulated discount rate) of the Regulated Capital Base (RCB). The Regulated Capital Base is composed of the value of current assets and the value of the assets that are incorporated in a period of ten years on behalf of the Regulated Works and Investment Plan (POIR).

The Average Cost of Environmental Fees is determined based on the amounts charged by the environmental authority to the company in force for pollution, in accordance with current regulations.

In addition, the new tariff methodology included revision or updating mechanisms: for private costs, companies should review them whenever within a period of no less than 12 months, the unit cost has a variation (positive or negative) of at least 5% of the constant unit price; for taxes and fees, whenever there is a variation not included in the rates and for environmental fees each time the environmental authority issues an invoice modifying the values to be paid.

Demand projection

Resolution CRA 943 of 2021 in articles 2.1.2.1.2.1.1. to 2.1.2.1.2.1.4. establishes in the criteria to be considered to make the projection of the average number of subscribers to be billed for each of the years in a horizon of ten years, both for residential subscribers and for non-residential subscribers.

From these projections, it is possible to project the following indicators[9]: index of water supplied by billed subscriber (ISUF), index of water consumption per billed subscriber (ICUF), index of losses per billed subscriber (IPUF) and finally, of the Consumption Corrected for Losses, which configures an important component in the calculation of the AOC, the AIC.

This loss-corrected consumption was conceived as an incentive to reduce the level of losses by the lending companies, based on the punishment in income, assuming that losses greater than the IPUF* (6 m3/subscriber/month) are understood as invoiced (as will be seen in section 2.3 of this document).

However, the resolution proposes an alternative for the replacement of the IPUF* that corresponds to the calculation of the Economic Level of Losses (ELL), which, according to number 6.2.2.1.1. of title 2 of book 6 of resolution CRA 943, must be carried out applying the following methodology:

1. Identify all the projects of the different programs of the Loss Reduction Plan of the system.
2. Determine the minimum cost of investments associated with projects.
3. Determine the economic benefits of avoided costs associated with reductions in water losses.
4. Determine the benefits in economic terms of the increases in turnover associated with the reductions in commercial losses.
5. Define the ELL, as the volume of losses per subscriber greater than 75% of the difference between the current losses per user of the system and the IPUF*, where the benefit/cost ratio of all the projects of the Loss Reduction Plan is greater than 1.

This way, the current regulation offers the possibility to companies to calculate the consumption corrected for losses, from their own level of standard efficient losses.

Average Administration Cost (AAC)

The average administration cost, defined in Articles 2.1.2.1.2.2.1. to 2.1.2.1.2.2.6. of Resolution CRA 943 of 2021, for the first 5 years of application of the current tariff framework, represents the quotient between the sum of the total administrative costs admitted by the regulation between year 1 and year 5, and the sum of the number of average subscribers billed between year 1 and year 5.

These total administrative costs admitted by the regulation, to comply with the efficiency criterion established in Law 142 of 1994, represents efficient administrative costs[10], and the costs of taxes, contributions and administrative fees (ICTA), directly related to the provision of the domestic public sewerage service.[11]

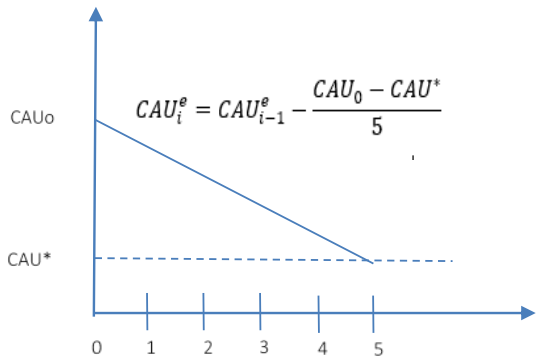
Comparable administrative costs

Efficient administrative costs regard the standard costs from the comparison with other companies in the sector, as a result of the application of the comparative efficiency model with the Data Envelopment Analysis (DEA) methodology(CA_i^e)[12].

These costs for each of the projection years are obtained by multiplying the cost per administrative efficient subscriber (CAU_i^e) projected for each year, by the number of subscribers projected for that year.

For the first five years of projection, the regulator established a transition function for costs per efficient administrative subscriber (CAU_i^e)[13], so that by the fifth year the company reaches the standard of service delivery.

Figure 5: Transition function from administrative costs per subscriber to administrative costs per efficient subscriber



Source: own production based on article 2.1.2.1.4.1.4 of Resolution CRA 943 of 2021

These transition features depend on the cost per subscriber of the base year (2014) CAU_0 and the standard cost per subscriber set by the regulator CAU^*.

[10]Multiplied in each year by the discount rate of working capital (defined in Article 2.1.2.1.3.2. of Resolution CRA 943 of 2021).
[11]According to article 2.1.2.1.4.1.7 of the Resolution CRA 943 of 2021, these are taxes such as inspection and audit fees, contributions to regulatory and control entities, fees that do not correspond to fees paid to environmental authorities, registration, notaries, sales tax (VAT), equity tax and stamp duty. The property tax and the industry and commerce tax are excepted, in addition to the fines and penalties that the company has incurred.
[12]For more detail see number 6.2.2.1.2 of Chapter 1 of Title 2 of Part 2 of Book 6 of Resolution CRA 943 of 2021.
[13]In article 2.1.2.1.4.1.4 of Resolution CRA 943 of 2021.

However, since the comparable AAC reference costs, yielded by the tariff methodology, are unique and fixed[14] for the initial 5 years of application of the tariff formulas, the regulator established that these would be calculated as a simple average of the result of each year:

$$CMA_{al} = \frac{\sum_{i=1}^{5} CAT_{i,al}}{\sum_{i=1}^{5} N_{i,al}}$$

However, Article 2.1.2.1.4.1.1. of Resolution CRA 943 of 2021 establishes that from year 6 and while the CRA does not set a new tariff formula, the AAC will take the efficient value of the last year.

Therefore, once the standard costs have been determined, and hence the transition costs per subscriber, the unit costs of administration would be determined in the time of application of this tariff framework and can only be modified through a review of the standards by the CRA.

However, because the calculation of the standards based on the new DEA scores has been subsequent to the beginning of the entry into application of the tariffs, Resolution CRA 830 of 2018, now compiled in Resolution 943 of 2021, specified how to recalculate the costs considering the definitive standard costs and those provisional ones that the company obtained with the DEA scores of the previous tariff framework (Resolution CRA 287 of 2004).

Average Operating Cost (AOC)

The average operating cost, defined in Articles 2.1.2.1.4.2.1. to 2.1.2.1.4.2.14. of Resolution CRA 943 of 2021, is the quotient between the sum of the total operating costs admitted by the regulation between year 1 and year 5, and the sum of the consumption corrected for losses between year 1 and year 5.

These total operating costs admitted by the regulation correspond to efficient operating costs, private operating costs[15], and operating taxes and fees (OTF) costs directly related to the provision of the domestic public sewerage service.[16]

Comparable operating costs

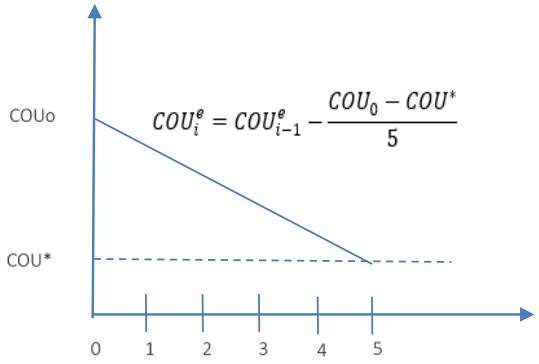
Comparable efficient operating costs (CO_i^e), as defined in Article 2.1.2.1.4.2.2. of Resolution CRA 943 of 2021, regard the standard costs from the comparison with other companies in the sector, as a result of applying the comparative efficiency model with the Data Envelopment Analysis (DEA) methodology.[17]

Efficient comparable operating costs for each of the projection years are obtained by multiplying the projected cost per operating efficient subscriber (COU_i^e) for each year by the number of subscribers projected for that year.

For the first five years of projection, the regulator established a transition function[18] for efficient costs per operating subscriber (COU_i^e) such that in the fifth year the company reaches the standard of service provision.

[14]Although once defined and applied they will have the adjustments for inflation and private costs defined in the regulation.
[15]These first two multiplied in each year, by the discount rate of working capital (defined in article 2.1.2.1.3.2. of Resol. CRA 943 of 2021).
[16]According to article 2.1.2.1.4.2.14 of Resolution CRA 943 of 2021, it corresponds to taxes such as stamps, registration, the tax on financial movements, vehicle tax (operational), tolls (operational) and other taxes paid in the operation of the service. The property tax and the industry and commerce tax are excepted, in addition to the fines and penalties that the company has incurred.
[17]For more details, see section 6.2.2.1.2 of Chapter 1 of Title 2 of Part 2 of Book 6 of Resolution CRA 943 of 2021.
[18]In article 2.1.2.1.4.2.4 of Resolution CRA 943 of 2021.

Figure 6: Transition function from operational costs per subscriber to operating costs per efficient subscriber



Source: own production based on article 2.1.2.1.4.2.4 of Resolution CRA 943 of 2021

This transition feature depends on the operating cost per subscriber of the base year (2014) COU_0 and the standard cost per subscriber set by the regulator COU^*.

However, since the comparable AOC reference costs, yielded by the tariff methodology are unique and fixed[19] for the initial 5 years of application of the tariff formulas, the regulator established that these would be calculated as a simple average of the sum of the result of each year:

$$CMO_{al} = \frac{\sum_{i=1}^{5} COT_{i,al}}{\sum_{i=1}^{5} CCP_{i,al}}$$

However, Article 2.1.2.1.4.2.1. of Resolution 943 of 2021 establishes that, as of year 6, and while the CRA does not set a new tariff formula, the AOC will take the efficient value of the last year.

Therefore, once the standard costs have been determined, and hence the transition costs per subscriber, the unit operating costs would be determined in the time of application of this tariff framework and can only be modified through a review of the standards by the CRA.

Private operating costs

The private operating costs are the costs of energy and wastewater treatment, in the domestic public sewerage service, mentioned in article 2.1.2.1.4.2.7. of Resolution CRA 943 of 2021.

To project private operating costs, private unit cost of wastewater treatment (CUP_TR)[20] is to be determined by dividing the costs of the base year by the consumption of water billed from the domestic public sewerage service.

On the other hand, although these costs respond to the particularities of each system or area of service provision, the regulator has insisted on encouraging the search for efficiency in the operation, even in activities where it is difficult to compare efficiency between providers.

In that sense, the company must seek for its private costs of wastewater treatment to be within efficient quantities and prices, so that the consumption of energy and chemical inputs must be presented according to quantities based on optimal dosage studies and competitive prices[21].

[19]Although once defined and applied they will have the adjustments for inflation and private costs defined in the regulation.
[20]In accordance with article 2.1.2.1.4.2.12 of Resolution CRA 943 of 2021.
[21]Article 2.1.2.1.4.2.13. of Resolution CRA 943 of 2021.

At regulatory level, these private operating costs present a special characteristic in the way they can be updated: in accordance with articles 2.1.2.1.4.2.7. and 2.1.2.1.4.2.13 of Resolution CRA 943 of 2021[22], each time when in a period of twelve continuous months there is an increase or decrease in constant weights of the private unit cost of wastewater treatment above 5%, the company must proceed to update it.

In accordance with the above, the costs of private operation the regulation allows to carry to the tariff are the costs in which the company indeed incurs for its normal operation, as long as it remains within the authorized limits.

Average Investment Cost (AIC)

The average investment cost, defined in Articles 2.1.2.1.4.3.1. to 2.1.2.1.4.3.11. of Resolution CRA 943 of 2021, corresponds to the quotient between the sum of the present value of investment costs between year 1 and year 10, and the sum of the present value of consumption corrected for losses between year 1 and year 10, as illustrated below:

$$CMI_{al} = \frac{VP(CI_{i,al})}{VP(CCP_{i,al})}$$

These investment costs are given by the depreciation of the regulated capital base in each of the 10 projected years, and by the financing costs that the company must incur for the execution of the projected investments.

Depreciation of the Regulated Capital Base (RCB)

According to the regulation, the Regulated Capital Base (RCB) for each of the 10 years of the projection horizon, is determined by the assets in operation of the base year, which correspond to the Regulated Capital Base of the base year (BCR_0) and the assets to be generated from the POIR projected for a horizon of 10 years. For regulation, the base year of the tariff framework is June 2016.

Thus, the depreciation to be taken to the tariff calculation is determined based on the assets of the BCR_0 (as of June 2016) and those resulting from the company's POIR, and their corresponding useful lives. That is, to determine the costs of depreciation of assets, the following aspects must be considered:

- The value of the corresponding asset or project whether it is part of the BCR_0 or of the POIR.
- The remaining useful life (RUL) of the asset, which is determined based on the useful life set by the regulator for each type of asset and the useful life that the asset has in operation.
- The depreciation method, which must be linear, in accordance with Article 2.1.2.1.4.3.6. of Resolution CRA 943 of 2021.

The assets that are included in the BCR_0, according to the regulation, come from two sources:

(i) The assets realized based on the investment plan of the tariff framework of Resolution CRA 287[23] (VI_287).
(ii) Assets in operation different from the previous ones[24] (VI_DIF287).

Financing Cost

The financing costs correspond to the costs of financial capital (own and debt) used to finance the assets that make up the regulated capital base (RCB), calculated in accordance with the formula of article 2.1.2.1.4.3.2 of Resolution CRA 943 of 2021, plus administrative and operating working capital, calculated in accordance with the formula of articles 2.1.2.1.4.1.2 and 2.1.2.1.4.2.2 of Resolution CRA 943 of 2021 respectively.

[22]Compiled in Articles 2.1.2.1.4.2.7. and 2.1.2.1.4.2.13 of CRA Resolution 943 of 2021.
[23]Which are incorporated based on the self-declaration of investments (defined in number 6.2.2.1.3. of Chapter 1 of Title 2 of Part 2 of Book 6 of Resolution CRA 943 of 2021).
[24]Which are incorporated based on the book value or its technical valuation in accordance with the provisions of number 6.2.2.1.4. of Chapter 1 of Title 2 of Part 2 of Book 6 of Resolution CRA 943 of 2021.

According to the regulation, for the first segment, the cost of capital that is applied on the RCB, and which corresponds to the discount rate, is 12.28% and the working capital rate is 2.61%; while for the second segment they are 12.76% and 2.43% respectively.

Thus, according to the tariff formulas, the BCR's financing cost is obtained by multiplying the value of the RCB of the previous year by the discount rate (12.28%); and the cost of financing administrative and operating working capital is obtained by multiplying comparable administrative and operational costs and individual costs for each year by the working capital rate (2.61%).

Average Cost by Environmental Fees (ACEF)

In accordance with Article 2.1.2.1.4.4.2. of Resolution CRA 943 of 2021, the cost the regulator recognizes for environmental fees in the public domestic sewerage service corresponds to the amount charged by the environmental authority to the company (in force) for pollution, in accordance with current regulations.

However, the regulator established only the transfer of an efficient cost that, in the case of the remuneration rate, corresponds to the cost that the company would incur if it presented full compliance with the pollutant load goal established by the competent environmental authority.

Finally, this payment of remuneration rates is divided by the billed consumption, giving rise to the Average Cost of Environmental Fees (ACEF) of the domestic public sewerage service.

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