



# Best Practices

## in the design of financing policies for wastewater reuse in Colombia



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# Financing Policy for Wastewater Reuse

## Establishing criteria for investment financing



Figure 1: Wastewater in San Antero de Córdoba, Colombia. Photo: ©GIZ/Diana García

### 1. Background information

Financing the initial investment is one of the main constraints for wastewater reuse (Morris et al. 2021). In a systematic review of studies in the region, show that there is consensus regarding the need for a framework for promoting and boosting the circular use of water that goes beyond technological solutions and that addresses aspects of policies, regulations, socio-environmental issues, and, fundamentally, economic-financial aspects. The latter establish that access to financing for initial investment is critical and may be impractical and even dissuasive, especially when continuing to use fresh water sources is significantly cheaper than reusing wastewater.

On the other hand, the countries of Latin America and the Caribbean lack clear public and private financing policies for reuse infrastructure, so the realization of projects aimed at this objective is based on specific initiatives, postponed and often unfeasible.

Unlike countries like Israel (Marin, Tal, Yeres, & Ringskog, 2017) or regions such as the European Union (Martínez et al., 2017), where there are clear public financing or co-financing policies that complement private initiative when market conditions require it, in Latin America and the Caribbean - with the exception of Mexico (Ramirez, 2022) - the main relevant reuse projects have not responded to a general policy but, mainly, to particular situations with very favorable conditions as in the cases of Mendoza in Argentina (Lorenzo, 2022), Ica in Peru (Moscoso, 2022) or Sao Paulo in Brazil (Gomes da Silva, 2016), where, apart from serious scarcity conditions, large-scale profitable reuse activities are available.

Considering that in Latin America and the Caribbean only between 30% and 40% of wastewater receives treatment (Rodríguez, Serrano, Delgado, Nolasco, & Satiel, 2020), the financing policy for reuse also needs to be directly related to the financing of the treatment itself, since, when planning its investment, it is essential to analyze the possibilities and relevance of including the standard required for reuse.

## 2. The challenge

The problem to be solved is that there are no policies or clear criteria for financing investment in wastewater treatment infrastructure in Latin America and the Caribbean and this delays or makes impossible the development of initiatives that could contribute to water security and generate great benefits at the economic, environmental and social levels.

Funding can come from private or public sources. In the case of private sources (mainly wastewater users), if the reuse activity is profitable, and the additional availability of the resource generates sufficient benefits, private stakeholders can directly finance the investment and the operation and maintenance of the infrastructure or make financing viable by covering the remuneration (for the service or for the resource) that makes the financing possible. When this is possible, which occurs only in certain situations such as severe shortages and large-scale reuse, it is mainly necessary to establish the mechanisms and procedures required to make private financing a reality and take the necessary provisions to properly value the resource.

If, however, the reuse activity does not generate sufficient private profitability, but is profitable for society, that is, there is a net benefit generated to society by implementing reuse, the project should be promoted, as the contribution of the State is justified at its different levels of government, in financing.

**The determination of the profitability of reuse for society is methodologically and operationally complex. However, there are many situations and scenarios, particularly in cases of permanent or seasonal scarcity of water resources, in which the social profitability is evident due to the great benefits represented by the additional supply.**

The definition of financing policy also requires regarding the different situations that arise on the supply side. For example, it is relevant to consider both the situation where there is already wastewater treatment, which requires a certain type and level of additional treatment, and the situation where there is still no wastewater treatment system. In the latter case, the financing of reuse is related to the financing of the wastewater treatment itself, since, when planning the investment in the treatment infrastructure, it is essential to analyze the possibilities and relevance of including the standard required for reuse when making the investment.

Considering all the region can establish simple criteria that facilitate investment financing decisions, without the need to carry out rigorous evaluations, particularly in cases where wastewater treatment systems do not yet exist and it is possible to include reuse standards, adequately determined, when designing and financing the investment, when it is foreseeable that the economic benefits to society outweigh the costs.

## 3. Relevance to development

In a context of population growth, increased pollution of water sources, climate change and recurrence of natural and man-made disasters, introducing the circular economy approach in the management of water resources through the reuse of wastewater is an unavoidable alternative to increase efficiency in the use of resources, water security and environmental sustainability.

The benefits it generates for society are multiple: saving of water resources from natural sources by constituting an alternative supply, reduction of pollution and preservation of the environmental quality of the water bodies receiving the discharges, investment and operating costs avoided for wastewater treatment (when the user receives raw wastewater and assumes responsibility for its treatment up to the required quality level), reduction of soil fertilization costs, increase in the permanent availability and reliability of the water supply for the activities in which reuse occurs (agriculture, industry, in some countries for human consumption), benefits of these activities, etc. In addition, as a result of the avoided costs and the income that could be

obtained in situations of scarcity in which the value of the resource is very high, reuse has a high potential to contribute to the financial sustainability of wastewater treatment, a segment of services that is intensive in technology and investment and has high operating and maintenance costs.

Materializing these benefits implies removing the barriers that prevent the massive development of wastewater reuse projects, one of the main ones being access to financing for initial investment. Clear public and private financing policies can help lift this barrier.

From a future perspective of reuse in human consumption, this contributes to increasing the supply to achieve universal and equitable access to drinking water (SDG target 6.1). Also, as indicated, it improves water quality by eliminating dumping and increases the efficient use of water resources. Therefore, it also contributes to achieving SDG targets 6.3 and 6.4.

Beyond this, increasing the supply of water resources through the reuse of wastewater contributes to the SDGs in a transversal way: SDG 2 by contributing agricultural reuse to the production of safe and nutritious food, SDG 3 for health benefits, SDG 13 for contributing to action against climate change, etc.



## The CReW+ approach

### 4. Change process supported by CReW+

The practice described is part of the consultancy contracted by GIZ, within the scope of the GEF CReW+ project and in the framework of the “Sanitation for Millions” initiative, to contribute to the development of a regulatory and economic mechanism to incorporate environmental and management aspects, with emphasis on wastewater reuse, in the new tariff framework of water pipeline and sewerage for large providers whose establishment is currently underway in Colombia.

The main counterpart of this consultancy was the Commission of Drinking Water and Basic Sanitation, CRA, that is analyzing the relevance of including or not environmental signals associated with the reuse of treated wastewater within the framework of the objectives established in the circular-economy policy and the urban-wastewater management commitments defined by the national government.

Likewise, an inter-institutional working group was formed, also composed of the Directorate of Integrated Water Resources Management (DGIRH) and other areas of the Ministry of Environment and Sustainable Development (MADS) and the Ministry of Housing, City and Territory (MVCT), to accompany the process and promote an articulated action to encourage reuse.

The following were carried out: i) identification and mapping of policies and standards related to the reuse of treated wastewater; ii) analysis of the tariff framework; (iii) analysis of international and regional experiences; (iv) analysis of the potential for reuse; v) feasibility analysis of the reuse project in the town of San Antero.

This paper focuses on the aspect of financing infrastructure for reuse and takes the relevant information and elements of the consultancy that contribute to better presenting learning.

#### San Antero Project

The evaluation of the San Antero pilot project, which will initially reuse 5 l/s of treated wastewater in the irrigation of 3.5 hectares for fodder cultivation, allows us to determine that in areas with a shortage (even if only seasonal) of water resources, even small reuse projects in which there are no economies of scale, They are socially profitable, that is, they generate net benefits for society, being foreseeable that the results will be even more favorable in larger projects.

Therefore, in these areas, governments should promote and contribute to the financing of all wastewater reuse projects, when they do not have private profitability. In cases where there is no wastewater treatment system or it requires rehabilitation, it is essential to include the reuse standard when making the investment required for wastewater treatment.



Figure 2: Forage pastures that can be produced by reusing treated wastewater. Photo: GIZ/Diana García

#### 4.1 Financing for reuse: international and national experience and problems

Financing wastewater reuse remains an international challenge. However, there are countries and regions that have clearly defined policies to contribute public financing to the realization of wastewater reuse projects. To cite some examples:

- Israel's policy is to promote wastewater reuse by contributing investment subsidies when required. (Marin, Tal, Yeres, & Ringskog, 2017).
- In Spain, in accordance with article 110 of Royal Legislative Decree 1/2001, the State determines by regulation the aid it offers to those who proceed to the implementation of wastewater reuse systems.

- The European Union (Martinez, y otros, 2017) has public financing or co-financing policies for reuse projects.

Likewise, at regional level, there are interesting experiences of financing:

- Mexico is promoting reuse by co-financing large-scale projects such as Atotonilco, which includes the standard required for reuse. (Ramirez, 2022), (De la Peña, Ducci, & Zamora, 2013). This project is in operation, although it faces social problems.
- Argentina has the most important experience of agricultural reuse in the region, in Mendoza, thanks to the fact that the production activity allows financing reuse. (Rauek, 2017), (Lorenzo, 2022).
- Brazil developed the large reuse project in petrochemical Aquapolo, in which the conditions of the industry allowed to finance the reuse. (Gomes da Silva, 2016).
- In Chile, until the recent change of government, the possibility of developing concession schemes was analyzed (Diagua Consultores, 2019) in whose structuring and execution the need for some type of co-financing and its magnitude would be determined.
- In the Peruvian case, the regulations allow sanitation service providers to provide services to third parties, with the corresponding consideration: "in terms of marketing treated wastewater, wastewater treatment and marketing of untreated wastewater, for reuse purposes". This enables private financing of reuse, in cases where the nature and profitability of the demand allows it. (Moscoso, 2022), (Mendoza, 2021).

In general, except perhaps Mexico, regional experiences are isolated and are due to specific conditions of severe scarcity and existence of demand for large-scale reuse and high profitability.

In addition, the analysis and working visits at the level of Colombia, the country under study, made it possible to identify the following experiences:

- Research of the Institute of Research and Development in Water Supply, Environmental Sanitation and Conservation of Water Resources – CINARA of the Universidad del Valle, which has developed numerous research studies on the reuse of treated water on a pilot scale in Valle del Cauca.
- In Geneva, Valle del Cauca, there is an experience of reusing treated wastewater from a stabilization lagoon system that has operated for more than 20 years. Reuse has also been promoted by CINARA and consists of the irrigation of sugarcane crops.
- The experience of forest irrigation with domestic wastewater from Ecopetrol's oil fields. [Efecto del uso de aguas provenientes de la producción petrolera en actividades agrícolas y pecuarias \(redalyc.org\)](https://redalyc.org/urn:lsid:redalyc.org/urn:lui:10.11161/2019010100001)
- Serena del Mar Project, in Cartagena, integral urban development of 1,000 ha located north of Cartagena that borders a large area of beaches, and that will receive raw water from ACUACAR to treat it in compact plants, assuming the integral financing of the reuse, mainly for the irrigation of the green areas and the golf courses that are included in the real estate development.
- Reuse in irrigation of sports fields such as the Golf Club in Caribana, in Cartagena, where the provider Acucar derives the wastewater that only received primary treatment before being discharged to the submarine emissary, so that the receiving private entity treats it until achieving the quality required for irrigating the golf course.
- The indirect reuse of wastewater in the rice fields of Ibagué, whose viability was evaluated by the University Corporation of Ibagué.
- Informal cases of agricultural reuse in the municipalities of Galapa, Luruaco and Caravaca of the Atlántico Department, reported by the Regional Autonomous Corporation of Atlántico.

Colombia has a well-developed general framework of environmental policies and specifically water resource management with several elements incorporated even before they become global trends because of climate change and the intensification of its effects.

These policies have been reinforced and updated in recent years and have been complemented with environmental and sectoral regulatory development and with the establishment of national goals consistent with the needs of the country and international commitments, which shows an unequivocal and express political will in favor of circular economy, water security, productivity in the use of water resources and the reuse of wastewater.

This is consistent with the vision and expectations of the competent CRA officials, the DGIRH and other areas of MADS and the MVCT, which have been expressed both in the meetings held and in the sessions of the Inter-institutional Working Group constituted to accompany the process of developing the regulatory and economic mechanism to incorporate environmental and management aspects in water and sanitation tariff reform in Colombia. In these meetings, the consensus on the need and desirability of promoting wastewater reuse has become tangible.

Regarding the regulations on reuse, the applicable environmental and sectoral laws and the approval of Resolution 1256 of 2021 that repeals Resolution 1207 of 2014, constitute an improved reference framework that allows reuse to be carried out safely and legally for agricultural and industrial purposes. This resolution may be further improved in the future. However, it is still in force for a short time and there is consensus among the stakeholders that the tariff framework being developed by the CRA should be considered in terms of the current rules, so that it is immediately applicable.

Some aspects still to be developed were recommended and are included in the Policy Analysis Document that was one of the products of the consultancy.

As for the existing public financing policies in Colombia, these are mainly related to wastewater treatment. Thus, document CONPES 3177 of 2002 already included in its lines of action the "Articulation of the sources of resources for the financing of the Wastewater Management Program", establishing that the National Government would develop a financial strategy based on the following instruments: "*Contributions from the Nation, National Royalties Fund, resources from the municipalities from the General System of Participations-SGP with specific destination to the drinking water sector and basic sanitation, resources from credits, own resources of the Regional Autonomous Corporations and resources from tariffs charged to users*". In addition, the Departmental Water and Sanitation Plans for the Business Management of Drinking Water and Basic Sanitation Services-PDA, created in 2007, included among their actions: "iv) to articulate the different sources of resources and facilitate the sector's access to credit; (v) to exercise better control over resources and regulatory compliance; and vi) to have comprehensive investment plans with a regional, short, medium and long-term perspective." The Strategic Investment Plans – PEI, which are part of the PDAs, are part of this last action.

At the same time, the Sanitation and Discharge Management Program, created in 2007 with the main objective of promoting compliance with the treatment goals in the basins and municipalities prioritized in the PMAR, included within the actions to be carried out by the MVCT, for the ten prioritized basins due to the high levels of pollution by discharges in the receiving sources, the co-financing of treatment systems by the Nation. However, the inclusion of the standards required for reuse in these systems is not defined, an aspect that is also the responsibility of the regional environmental authorities.

Regarding private financing policies for reuse, there are some limitations, given that according to Colombian regulations, water is a good for public use, that is, a natural resource that is not tradable, regardless of its characteristics. This does not prevent a charge for the services necessary to supply it, such as storage, transport and treatment. This charge, in any case, should contribute to the financing of the reuse infrastructure and its operation.

All the above shows that, in Colombia, as in Latin America and the Caribbean, in terms of financing, the main reuse projects are responding mainly to specific initiatives and special conditions and it is necessary to establish general policies of public and private financing to promote the massive development of wastewater reuse.

## 4.2 Addressing the problem

Financing for investment in reuse infrastructure can be private or public. The existence of private financing for wastewater reuse will depend, among other things, on the existence of a market for wastewater, the profitability of such markets and the level of water scarcity they face.

When there is a situation of serious scarcity and profitable demand for reuse, the latter must directly assume the financing of the investment and operation associated with reuse or make it viable through some remuneration mechanism. Moreover, this demand can contribute to the financing and financial sustainability of wastewater treatment (in addition to the reuse itself). This is possible if the wastewater can be "commercialized", or the rights of use assigned, at "prices" that reflect the value of the resource in a situation of scarcity, or, in the Colombian case where this is not possible, if the receiving user can be imputed the investment and operation costs upstream, that is, typical of the drinking water system, sewerage and wastewater treatment.

For these cases, the World Bank (2020) recommends establishing innovative business and financial models that take advantage, as far as possible, of the additional sources of income that arise from water reuse.

On the other hand, the relevance of public financing of wastewater reuse depends on social profitability, that is, on the existence of a net benefit for society.

Wastewater reuse generates a number of benefits for society (Seguí, 2004), (Winpenny, Heinz, & Koo-Oshima, 2013): (i) environmental benefits; (ii) benefits for the release of fresh water (in areas of scarcity they are very high due to avoided costs in dams, transfers or groundwater extraction); (iii) savings in the cost of fertilizer (nutrients); (iv) savings in wastewater treatment; (v) benefits associated with new production (increase in crop areas, increase in production in general); (vi) improved reliability of wastewater supply (constant and permanent year-round supply); (vii) health benefits; (viii) benefits from the use of by-products (sludge, gas), etc. Projects where these benefits are greater than the costs demanded by reuse for society are socially profitable and should be promoted and concretized.

As indicated, there are privately profitable reuse projects, which do not require public co-financing, and several examples from the region have been referenced. However, even when there is a shortage situation (permanent or seasonal) and there is demand for reuse, in many cases, at least with the information available at the time of the evaluation, private profitability is not achieved.

According to the analysis carried out, reuse should continue to be promoted since, because there is scarcity, the economic benefits (from the perspective of society) should outweigh the costs, focusing the problem on the existence of resources for financing, which could even come from external sources. And, particularly, if there is no wastewater treatment system or it is precarious, and the State, through any of its levels of government, were to finance and/or subsidize the investment, it should decide to include in the design the quality levels necessary for reuse.

However, in a regional context where reuse faces different barriers, conducting social assessments for each specific reuse project can be dissuasive and would further slow down the effort to introduce the circular economy to wastewater.

The pilot case of San Antero was interesting, as it represented a special situation with non-ideal conditions, of scale, market and scarcity of water resources, which could shed light on the desirability of adopting general policies.

Indeed, since Colombia has diverse and abundant sources of water (positive water balance), regardless of territorial and seasonal differences, and a project size that prevents achieving economies of scale (25 l/s) and requires extreme design forecasts to ensure safe sanitary and environmental conditions, the project could present border conditions, so it was decided to carry out a confirmatory evaluation in order to analyze the contribution that its implementation would have on the well-being of the population in its sphere of influence, and therefore, support the relevance of including the reuse standard in the investment to be made with public financing, international cooperation or another type of entity.

## 4.3 Social profitability evaluation of San Antero project

### 4.3.1 Overview

The project was evaluated to analyze the contribution that its implementation would have in the well-being of the population in its sphere of influence, for which it was necessary to establish, from society point of view, whether the benefits that would be obtained outweigh the costs that would be incurred, measured through the economic profitability indicators of the project (NPV, IRR).

For this purpose, the information on conceptualization, design, investments, operation and maintenance costs to optimize the San Antero WWTP and implement the respective reuse and irrigation system, provided by ACUAMEUNIER (design consulting company) and CReW+ on the Final Report of the "Project of Reuse of the Treated Water by the Optimized WWTP in the Municipality of San Antero, Department of Córdoba, Colombia", were taken as a reference. Additionally, as a methodological reference document for economic and social evaluation, the Guide for the Formulation of Environmental Projects, prepared by the National Planning Department of Colombia, DNP, has been used as a methodological reference document for economic and social evaluation.

The Wastewater Reuse Pilot Project of the San Antero WWTP is in the Municipality of San Antero, Department of Córdoba, Bajo Sinú Region, Colombia. The WWTP consists of 3 facultative lagoons, with a design flow of 25 lps, built between 1998 and 2005. The investments required to optimize the operation of the WWTP and ensure a discharge complying with environmental standards basically contemplate recovering and/or replacing the deteriorated infrastructure.

The pilot project contemplates deriving a flow of 5 lps of effluents from the existing lagoons, for reuse in the irrigation of 3.5 hectares for forage cultivation on land owned by the Mayor's Office. For this purpose, it is contemplated to implement a reuse and technified irrigation system that includes pen-type pumps, filtration batteries, photovoltaic equipment, matrix network for the transport of treated wastewater, flat hoses and sprinklers. The project also considers signing an operating agreement that allows the community to enjoy and benefit from its operation.

### 4.3.2 Conceptual and methodological framework of evaluation

A fundamental aspect in determining the benefits generated by a wastewater reuse project for society is the "price" of water that must be understood, in a context of formal or informal markets, as the monetary compensation associated with a water exchange (water exchange value).

Economic theory indicates that, under ideal conditions, market forces determine the prices, and these will be optimal for society (maximization of well-being). An approximation to the price (value) of water is obtained by analyzing the transactions of rights of use in "relatively" competitive markets, where there are no important information asymmetries.

However, in the case of water resources in general, there are no formal (and efficient) markets; in very few countries the legislation allows a free transaction of water (among the exceptions is Chile) and this is expressly prohibited in Colombia. Regarding this limitation, it is necessary to use other approaches to economic valuation of water.

A first approach to the valuation of treated wastewater is to associate it with the valuation of water as an environmental resource. Although these concepts basically apply to water in its natural or purified state, this association is considered justified, taking into account: i) the use value of the treated wastewater; (ii) its character as a substitute for water from natural sources or drinking water in certain productive activities; (iii) its favorable impact on the preservation of the environmental quality of the respective receiving bodies, when compared to the discharge of untreated wastewater and (iv) its potential for increasing use over time, in the context of water stress and climate change.

According to one of the traditional valuation approaches (Dixon & Pagiola, 1998) the Total Economic Value (TEV) can be disaggregated into value categories:

- *Direct use value*, known as extractive, consumptive or structural use value, which is derived from goods that can be extracted, consumed or enjoyed directly. It is generally the easiest to determine, insofar as it usually involves observable quantities of products whose prices, in general, can also be observed.
- *Indirect use value*, known as non-extractive use value or functional value, which is derived from the services that the environment provides. For example, wetlands often filter water and improve water quality for downstream users. In this case the consumption of one individual does not reduce the consumption of others (non-rival consumption, characteristic of public goods). Measuring indirect use value is often more difficult than estimating direct use value. The "quantities" of the services being provided often do not enter the markets; therefore their "prices" are also extremely difficult to establish.
- *Existence or legacy value*, which, in contrast to use value, derives from the benefits that the environment can provide without involving any form of use, directly or indirectly. It is based on altruistic reasons and wishes of legacy (inheritance) to future generations. This is the most difficult to estimate, since, in most cases, and, by definition, it is not reflected in people's behavior, and, as such, completely unobservable.

In the specific case of treated and reused wastewater from the San Antero WWTP, the evaluation focused on its use value, in terms of the net value of the economic activities it would generate. According to the scope of this project, its benefits are focused on the economic impact of forage cultivation on 3.5 hectares, for which the producer surplus methodology was applied.

Additionally, for the economic evaluation of the project, principles and criteria accepted for the valuation of costs and benefits from the point of view of society have been regarded, also following the methodological guidelines and parameters of the public investment system in Colombia, as indicated below:

#### *Treatment of costs*

The costs of the project must reflect its alternative cost or real scarcity to the economy, which can be estimated through the valuation of the resources required by the project, expressed in economic prices. For this purpose, the values of the price-account ratio (RPC) calculated for the economic evaluation of projects in Colombia contained in the Methodological Guide of the National Planning Department, NDP, of Colombia were used, which allow converting the investment and operation and maintenance costs of a project from market prices to economic prices.

Regarding the allocation of costs, the requirements for replacement, expansion or optimization of infrastructure that are essentially justified to continue adequately providing the basic sanitation service, regardless of whether the effluent is destined for reuse, are not imputed to the purpose of reuse.

On the contrary, new investments and higher operating and maintenance costs attributable to the purpose of reusing effluents, due, for example, to the requirement to improve wastewater quality to meet parameters required by regulations in a specific economic activity, are attributed to reuse. Likewise, the costs of operation and maintenance of the irrigation system are imputed to the reuse.

#### *Treatment of benefits*

To value the benefits of the activities generated by the reuse of treated wastewater, the producer surplus methodology has been considered, which measures the net return to the producer for the sale of goods and services, that is, after subtracting the cost of paying for the inputs (factors) of production.

The estimate of economic benefits for the project is determined as the difference of the net return in the situations with and without project, considering in all cases values corrected with their price-account ratios.

On the other hand, there is a need to resort to a downstream market for the proper measurement of the benefits of a project, when the prices of the goods offered by the project (main market) are distorted (for example, through subsidy policies) and the market does not reflect the true value of the good to the economy, in terms of willingness to pay.

In the case of fodder production in the San Antero area, the conditions are met so that, from the point of view of economic evaluation, it is desirable that the benefits instead of being measured in the fodder market (main market) be valued in the respective derivative market (livestock market), especially considering that fodder is often distributed free of charge by the municipality to local farmers.

Based on these considerations, it has been decided to measure the economic benefits of the project in the cattle farming market, which in Colombia has competitive characteristics due to the concurrence of numerous bidders and demanders.

### 4.3.3 Results

After the evaluation, which is detailed in an independent feasibility analysis document of the San Antero project, the following was obtained:

- The total investments charged to the reuse project amount to USD 236,409 (Investment cost of the reuse system only composed of photovoltaic pumping system and irrigation system).
- The annual operation and maintenance costs of the reuse and irrigation system are initially USD 2,590 and increase to USD 4,471 at the end of the 20-year evaluation horizon.
- The annual economic benefits from livestock activity, measured through the net value of cattle production attributable to the cultivation of 3.5 hectares of forage, amount to USD 32,646 per year.
- By updating the flows of costs and benefits of the project with the application of the social discount rate of 9.5%, regulated by the Public Investment System of Colombia, a Net Economic Present Value of USD 24,971 is obtained.
- The Internal Rate of Return obtained is 11%, higher than the social discount rate.

Regarding the above, the project is profitable for society and should be promoted, so the relevance of financing the investment even with public resources is ratified. Therefore, the decision to include the standard required for reuse in the investment necessary to ensure the proper functioning of the WWTP is a wise one.

This result is interesting because it shows how in a region where there is no perceived structural lack of water resources (although there is seasonal scarcity), a very small-scale project, evaluated by only benefits of direct use value, is profitable for society.

The above provides relevant information to establish active financing policies or public co-financing for reuse infrastructure in areas with permanent or seasonal scarcity (current or projected even in the medium term given the long periods of maturation and realization of wastewater treatment and reuse projects). In these areas, all reuse projects should be promoted and, if required, should have public co-financing.

## Lessons learned

### 1. What not to do?

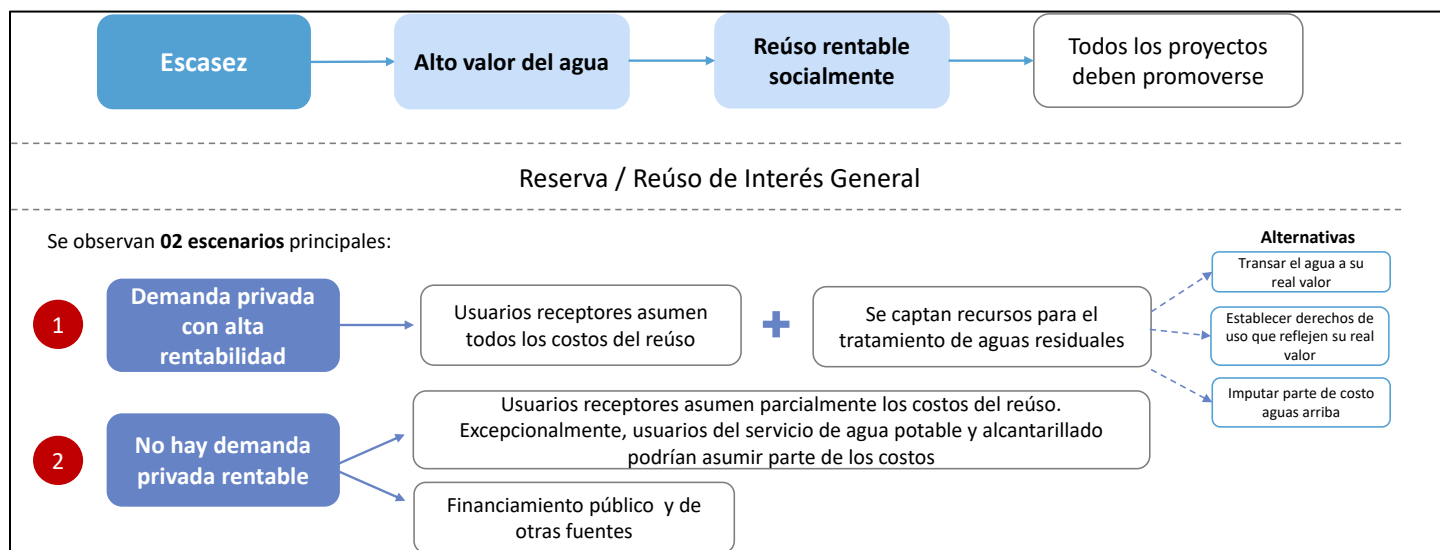
- Continue waiting for the development of reuse without comprehensive policies and specific regulations for wastewater reuse.
- Accept the lack of clear specific policies on public and private financing of wastewater reuse.
- Allow, in environments of permanent or seasonal scarcity of water resources, the construction of wastewater treatment plants that do not include the standard required for reuse.

- Assume that if there is no potential for high-profit, large-scale private reuse, wastewater reuse projects are not beneficial to society and therefore public funding should not be allocated.
- Establish as a requirement for the allocation of public resources to wastewater reuse projects, rigorous procedures for demonstrating profitability for society. This will be difficult to comply with and will also have a deterrent effect.

## 2. What works?

- Establishing express policies that promote the reuse of wastewater and regulations that establish the framework for its development. These instruments can be perfected over time, but as long as they are not developed and put into force, they delay the development of the circular economy around water resources.
- Evaluating in specific projects with apparently not ideal conditions for reuse, the profitability of the projects from the perspective of society, to generate criteria for the establishment of public financing policies, in addition to the private, for wastewater reuse infrastructure projects.
- As a consequence of the above, establishing policy guidelines that state that, at least in environments of permanent or seasonal scarcity of water resources, projects should be promoted in all cases, given that reuse has high net benefits for society.
- Establishing guidelines for cases with profitable demand, where it is possible to ensure the financing of reuse with private resources, making the receiving user fully responsible for the costs of investment and operation as well as maintenance. It should be borne in mind that, in these cases, it is possible and convenient to capture part of the benefits generated by reuse for society. This can be achieved by trading wastewater at prices that reflect its real value in the context of scarcity or by establishing rights of use that reflect that value, or, when it is not possible, like in the Colombian case, evaluating imputing part of the upstream costs to the receiving user. This would even contribute to the financial sustainability of wastewater treatment itself and, as has been analyzed in an independent regulatory document, benefit users of the basic public sanitation service because there are avoided costs in treatment and final disposal.
- Establishing guidelines for projects that are not profitable privately, but that have social profitability, and in which it is therefore justified and convenient for society to ensure financing or public co-financing for investments. If wastewater treatment systems do not yet exist, and their investment were to be financed by the State, the design must include the quality levels necessary for reuse. The operating and financing costs could be borne by the users receiving the wastewater and, exceptionally, for the fraction not covered, by the users of the basic sanitation service, considering that the State is subsidizing the investment in the treatment of domestic wastewater and that, normally, this subsidy should be higher than the part of the operation and maintenance costs of the reuse that they assume.

Figure 3: Reuse scenarios by demand type



Source: Own production.

## Sustainability, Upscaling and Downscaling

- It is necessary to continue with the execution of the San Antero project as its social viability has been confirmed.
- Larger-scale pilot projects should be carried out, in which an assessment of social profitability should also be conducted, to have an additional reference to establish an explicit policy for financing reuse projects.

In addition, a well-implemented larger-scale pilot experience of wastewater reuse in the most viable uses for the Colombian case would allow:

- To demonstrate the benefits of wastewater use, by providing a secure and permanent supply, as well as the supply of nutrients that replace much of the chemical fertilization now scarce and expensive.
- To identify the risks that these practices could generate and identify control measures to avoid negative impacts on health and the environment.
- To evaluate the results of the experience to better support a regulation more adjusted to the local reality.
- To value the wastewater resource until a price is established for the treatment service, which would be proposed to users seeking attractive economic benefits in their businesses.
- To ensure that the operating companies are more willing to offer this resource to have additional economic income, which at least partially finances good operation and maintenance of the WWTPs.

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