E-WAter
Official Publication of the European Water Association (EWA)

Water reuse projects - technical and economic sustainability

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ABSTRACT
Similarly to most of Mediterranean EU member states, Portugal regularly experience severe water supply and demand imbalances, particularly in the summer months.
Tourism is a very important economic activity in Portugal and is pushing water demand particularly in regions suffering occasional water deficit, like the southern half part of Portugal mainland. Golf courses are an important tourist factor contributing to water demand rising. A number of golf courses are installed in tourist areas and need high amount of water for irrigation.
Water reuse is a very important management strategy in situations of water scarcity. Portugal badly needs to include treated wastewater as a dependable resource in the nation water resources management. Sustainable water reuse requires technical guidelines to ensure the public health and environmental protection but the economic sustainability is crucial for the success of water reuse projects as a strategy of water conservation. This paper briefly presents Portuguese guidelines on water reuse focusing mainly on the aspects to be taken into account in the assessment of the economic viability of water reuse projects, such as the model of tariff structure, the costs to internalise, share of costs among users and recovery of investment costs.

Key words: cost; reuse; tariff; wastewater; guidelines

Introduction

ERSAR (Water and Waste Services Regulation Authority) is the Portuguese authority responsible for the regulation of more than 500 operators within the public drinking water supply, wastewater and urban waste management services. Additionally, it is the competent authority for drinking water quality.
Despite water reuse has been a non-core activity within wastewater operators' service has gradually gained importance due to a growing market for water, requiring further attention from the services regulator. In 2007, ERSAR has issued a recommendation [1] (which was replicated in a technical guide in 2010 [2]) aiming to create a set of guidelines to enhance operators' engagement in reuse projects, addressing issues like reclaimed water production, distribution, quality control, use and, particularly focusing the economic and tariff issues

Water reuse systems

The water reuse systems (WRS) are assets that treat wastewater up to the quality level suitable for subsequent reuse and convey the reclaimed water to supply the users

(Figure 1). The mains components of a WRS are treatment plants (WWTP), that reclaim water from wastewater (WW), tanks for equalization and storage, distribution networks, pumping stations and flow meters of supplied reclaimed water for reuse [2].

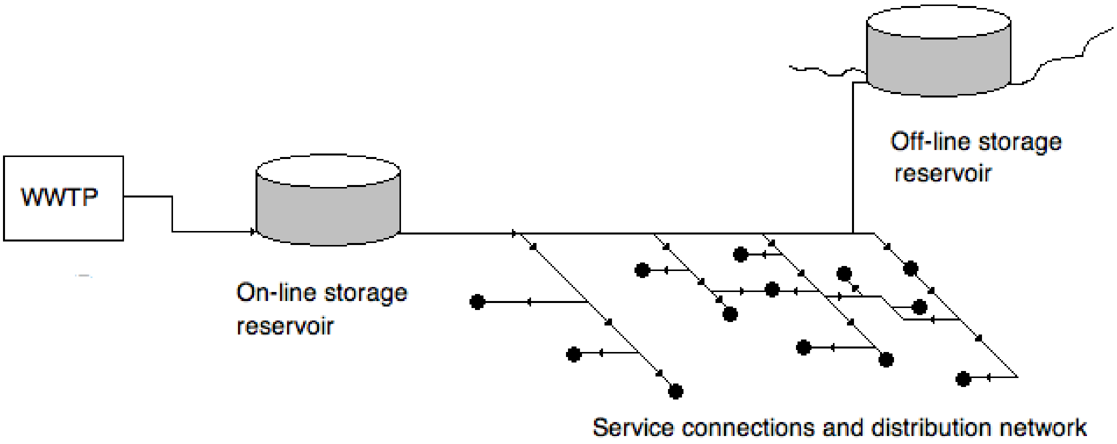

Fig 1 – Schematic representation of a water reuse system.

The increasing number of WRS for several applications – irrigation, industrial uses, groundwater recharge, non-potable urban uses, environmental and recreation uses – requires that the reliable supply of reclaimed water is ensured both in terms of quantity and quality.

Fig 2 – Golf course watered with treated wastewater (island of Porto Santo, Madeira)

Economic and financial characteristics of the activity of water reuse

Water reuse (the reuse of reclaimed wastewater) means a dependable water source for non-potable uses, such as agricultural and landscape irrigation, industrial applications, groundwater recharge, urban uses and simultaneously reduces the discharge of effluents in receiving waters. Consequently, water reuse presents environmental and economic benefits [3].

Typically, water reuse projects are characterized by requiring high investment costs to build complementary treatment facilities and dedicated distribution networks, and by uncertainty and larger elasticity concerning the demand for reclaimed water compared to alternative water sources (potable water is the most common example).

Potential high risk investment – higher rate of return

Such characteristics significantly contribute to the high potential risk of investments in water reuse projects, consequently higher return rates are to be expected. Therefore, assessment studies are necessary to evaluate the technical, economic environmental and social feasibility of water reuse projects, as well as to properly define the rights and duties to record in a contract between water suppliers (operators) and users (customers).

Water reuse costs

The long term sustainability of a public water supply project require that tariffs include all costs involved in the service (investment, O&M and financial), as well as the scarcity costs and environmental aspects.

The feasibility assessment of a project should consider the cost of all the main activities associated to water reuse, *e.g.* additional treatment required to comply with water quality standards, water storage and pressure, water distribution and water quality monitoring. In addition, the costs of marketing activities and client management must be included too.

Water reuse costs may be classified into two categories:

- Investment costs:
  - Common costs – necessary to provide the service to all users (e.g., infrastructures and equipment used for additional treatment;
  - Specific costs to each user (*e.g.*, dedicated distribution infrastructures to a specific user or group of users);
- Operation and maintenance (O&M) costs - additional treatment costs necessary to comply with reuse specific water quality guidelines;
- Return on investment (equity and debt).

In order to ensure equity among all users/customers, the charges applied to every user must be directly related to water reuse either through tariffs (in the case of availability costs or O&M costs) or through a certain initial fixed amount (in the case of some investments required to supply a specific user). Figure 3 shows the relationship between costs and charges to be paid by the users.

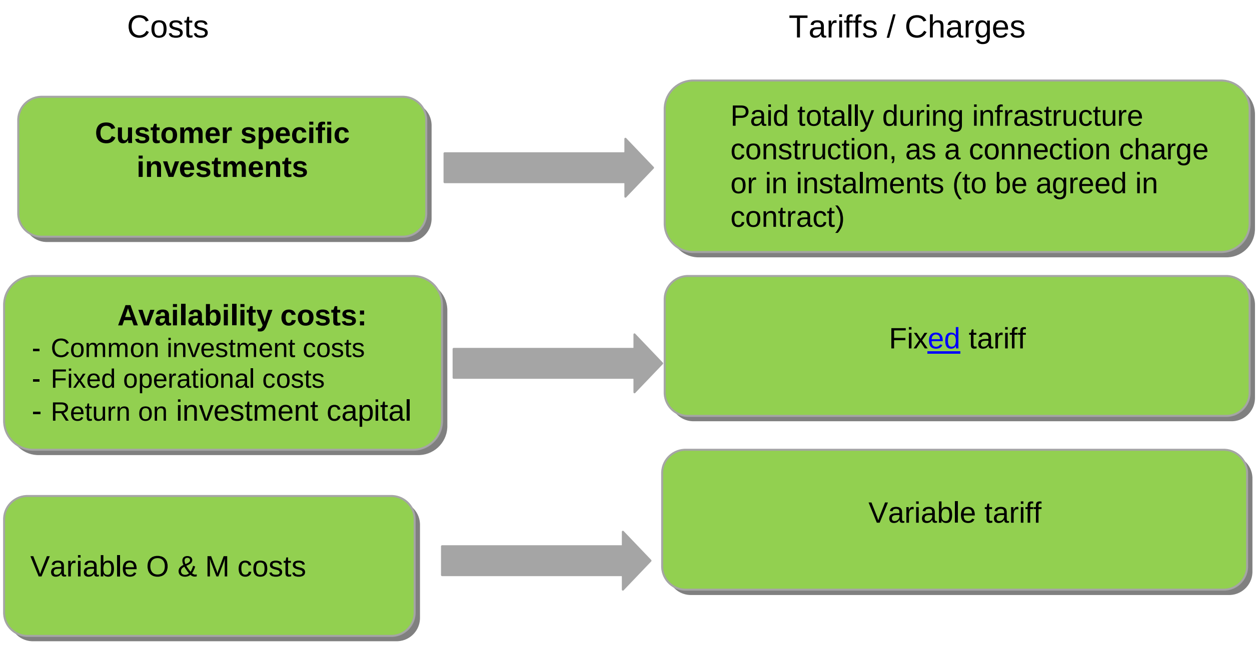

Figure 3 - Relationship between costs and charges.

ERSAR issued a recommendation [1] concerning specific models to calculate the fixed and variable tariffs, taking into account the fixed and variable costs associated to the service of providing the customer with reusable water:

a) Fixed tariff: this parcel includes the service availability costs, such as investment costs, O&M costs and the return on investment (calculated to every user as a function of the maxim daily volume of reclaimed water contracted).,

The fixed tariff (PF) is calculated as follows:

$$PF_{i(N)} = \frac{\sum_{j=1}^{m} (A - PPTE + CEF + COC)_{j(N)}}{\sum_{i=1}^{n} Q\max_{i(N)}} * Q\max_{i(N)}$$

b) *Variable tariff:* this parcel includes the variable O&M costs by means of the same unit value (€/m^3) for all the users.

The variable tariff (PV) , is calculated as follows:

$$PV_{i(N)} = T_{v(N)} * Q_{i(N)} = \frac{\sum_{j=1}^{m} (CEV)_j}{\sum_{i=1}^{n} Q_{i(N-1)}} * Q_{i(N)}$$

where:

PF = Annual value of the fixed parcel;

PV = Annual value of the variable parcel;

i = User;

n = Number of users/customers supplied by the operator;

j = Treatment plant;

m = Number of water reclamation plants;

N = Year of tariff calcution;

N-1 = Previous year;

A= Depreciation;

PPTE = Revenues from the payment of specific distribution sections;

CEF = Fixed O&M costs;

CEV = Variable O&M costs;

COC = Opportunity cost of capital engaged in funding for this activity (whether debt, or equity);

Qmax = Maximum daily volume contracted by each user (m^3/d);

T_v = Variable tariff (unit value, €/m^3);

Q = Volume used (m^3).

Conclusions

Financial aspects are extremely important in the viability assessment of water reuse projects. In order to mitigate the high investment risks (when compared with the expected return on investment) some aspects should not be underestimated:

- an adequate design of the infrastructures, the equipment and the distribution network;
- the prior contracting with potential users in order to ensure a minimum profit level;
- an adequate contracting of users' rights and obligations.

Despite this focus on financial feasibility, the expected benefits of water reuse (environmental and water resources management benefits) may justify engaging in an otherwise non-financial feasible project. This implies some kind of subsidization from national or supranational authorities if the targets for water reuse are to be attained (in Portugal, the water strategic plan – PEAASAR II – has set a target of 10% of reclaimed water on percentage of total wastewater volume).

Water reuse projects in Portugal have, however, suffered from lack of economic incentives, probably due to a generalized existence of low tariff substitutes for reclaimed water (e.g., own abstraction sources or drinking water tariffs) which in many cases also do not reflect the true economic costs.

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