

The Spanish government is actively promoting water reuse for applications in multiple sectors – agriculture, environment, industry, recreation, and urban. According to author **Jesús Yagüe Córdoba** of the Spanish Ministry of Environment, Rural and Marine Affairs, this strategy is creating a new source of water supply from a valuable resource once considered to be waste.

# Water reuse to rise significantly in Spain

In 2007, water reuse in Spain reached a significant milestone when the government established the legal framework necessary to advance an alternative water supply strategy. Royal Decree 1620/2007 has played a crucial role in promoting and improving water recycling and reuse practices as essential parts of the integrated management of water resources.

Reclaimed water is officially recognized as a new water source for agricultural, environmental, industrial, recreational, and urban uses in order to make available existing potable water supplies for uses that require high quality, such as domestic supply. Also, the decree promotes the idea that reclaimed water is a valuable product, not waste to be discharged into the environment.

Since 2006, the reuse of reclaimed water has increased dramatically from 368 million cubic meters (m<sup>3</sup>) to 414 million m<sup>3</sup> in 2009. Government officials estimate that the annual flow of reclaimed water could exceed 983 million m<sup>3</sup> by 2015, and 1,380 million m<sup>3</sup> in subsequent years, according to the draft of the National Water Reuse Plan.

The RD 1620/2007 regulates multiple uses of reclaimed water, but does not restrict it to particular uses such as agriculture or golf course irrigation. This feature is a novelty because the majority of current legislative texts regulate specific sectors of activity, leaving other relevant sectors without any criteria. The many regulated uses make the investment cost-effective because they allow many users to benefit from the reclaimed waters of a single reuse system.

In fact, the RD 1620/2007 establishes 24 uses for reclaimed water that are grouped into five broad categories: urban, agricultural, industrial, recreational, and environmental. The decree also establishes a series of uses that are prohibited, among which is water for human consumption. Annex I of RD 1620/2007 states the required quality, which is defined by a set of maximum acceptable values for a series of parameters established as a function of each of the uses of reclaimed water. In addition, in order to assess compliance with quality requirements, it establishes a self-monitoring program to be carried out at the outlet point of the reuse system.

The Water Framework Directive 2000/60/EC

(WFD) is the basic policy that has, since 2000, regulated water management in Spain, a member state of the European Union. The WFD principle of integrated water resources management means there must be harmonized and balanced water resource allocation within river basins. This takes into account the existing relationships between the different components of the resources, and, particularly, the crucial role of water in the preservation and improvement of the environment.

### Water reclamation applications

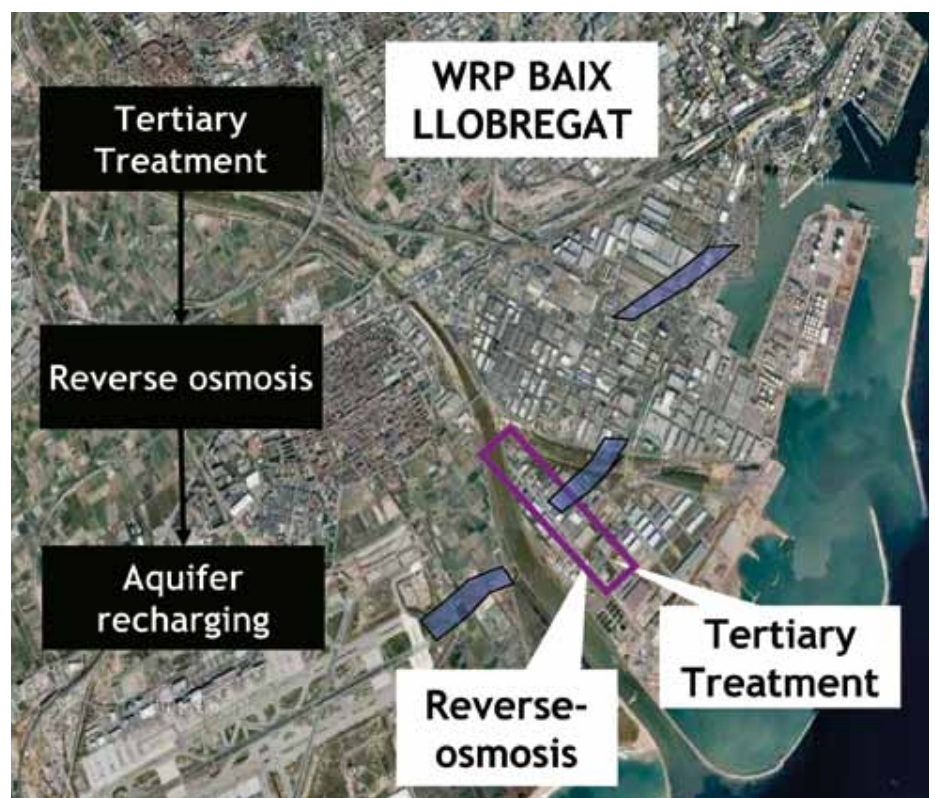
Figure 1 illustrates the percentage shares of water reuse applications in Spain from highest to lowest: agriculture, environmental, recreational, urban and industrial.

*Urban use.* The most frequent uses in urban areas are irrigation of green areas (such as parks and sports fields), street flushing,

fire-fighting systems, and industrial vehicle washing. Reclaimed water is also used in residential areas to irrigate private gardens and flush toilets. Its most widespread application is the irrigation of urban green areas.

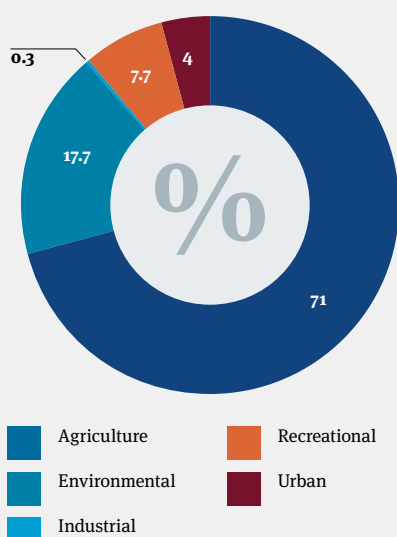
During the drought period of 1991-1995, reclaimed water started being reused to water gardens. A milestone in this process was the use of reclaimed water from the “La China” wastewater treatment plant in 17 public gardens in the city of Madrid, with a surface of 295 hectares including the historical park El Retiro. A pipeline network transports reclaimed water from the treatment plant in the south of the city to the Manzanares River, and into the historical quarter until it reaches the public gardens.

Water supply access points at several locations in the network enable municipal



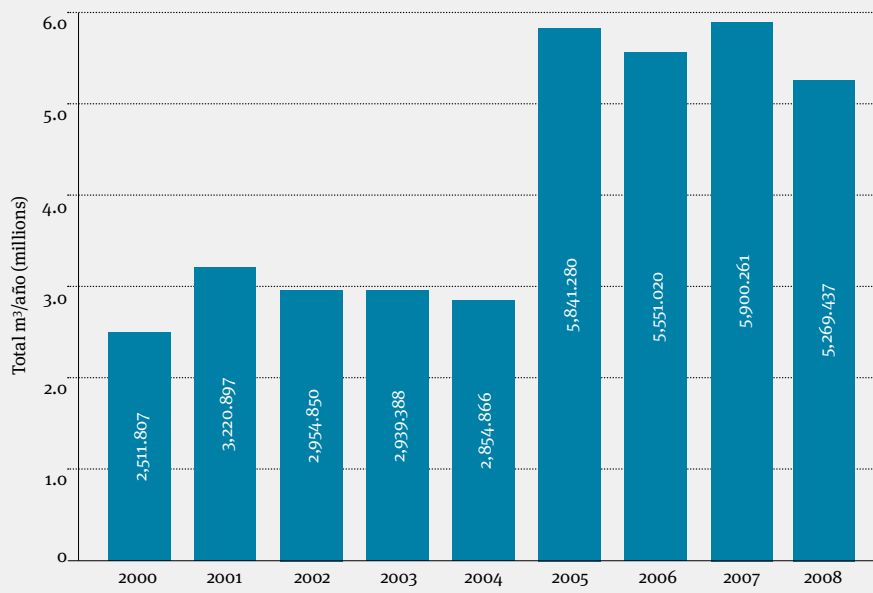
Location of the Baix-Llobregat recycling facility and the aquifers that receive reclaimed water produced by the tertiary treatment plant.

**Figure 1: Applications of reused water**



Source: BDR CEDEX-MMA Year 2006

**Figure 2: Reclaimed water from the water recycling plants managed by ACOSOL**



tankers to fill up for their street cleaning and flushing work. The supply points expanded the use of reclaimed water to those municipal services.

**Agricultural use.** Agriculture needs a constant supply of water resources such as sources independent of rainfall and water in the basin, so increased supplies of reclaimed water is absolutely necessary for this sector. In water-scarce areas, using reclaimed water helps improve the longevity of traditional water sources.

A case in point of reclaimed waters used in agricultural applications is the Irrigated Area of Los Auriles Channel (Tomelloso, Ciudad Real), located over an overexploited groundwater aquifer. The reuse system consists of a water recycling plant and a concrete open channel 14 km in length (Los Auriles Channel) that transfers reclaimed water to the place of irrigation. This system irrigates 745 ha of the 855 ha that comprise the entire irrigated area with reclaimed water.

**Recreational use.** The proliferation of golf courses near cities and tourist areas allows for a symbiosis inherent to the complementary nature and coincidence (seasonally and spatially) of both areas' needs: higher intensity of wastewater treatment and significant consumption of water resources.

The development of water reuse systems to irrigate golf courses has emerged as a private initiative, but it has also been encouraged by the development of local regulating policies in the regions of Murcia and Andalucía.

In Andalucía, 50 golf courses are irrigated with reclaimed water with an annual consumption of 23 million m<sup>3</sup>. Thirty-four of them use reclaimed water from the water recycling plants managed by ACOSOL, an entity created by the Federation of Municipalities of Western Costa del Sol. In Madrid, the municipality and regional authority are committed to supply reclaimed water to more than 20 golf courses.

**Industrial use.** The industrial sector could achieve significant savings in water consumption by reusing reclaimed water. It is well substantiated that industrial reuse, as a part of resource conservation policies, can contribute qualitatively and quantitatively to freeing up resources from conventional groundwater or surface sources. In addition, it represents a considerable improvement in the quality of the assigned effluents since the tendency in industrial treatment is toward advanced technological treatment to allow the use of reclaimed water.

In the pulp and paper sector, the Spanish company Holmen Paper Madrid signed an agreement with the Canal de Isabel II to replace 100 percent of its fresh water supply with reclaimed water in 2010. This agreement followed economic and technical feasibility studies conducted in a pilot plant that persuaded the municipality to select the most appropriate double-membrane treatment – microfiltration or ultrafiltration combined with reverse osmosis and ultraviolet disinfection. Consequently, Holmen Paper Madrid will stop using fresh water and start using reclaimed water from the effluent of a municipal plant that treats urban and industrial wastewater.

**Environmental use.** To date, the use of reclaimed water for environmental purposes has progressed to a lesser extent than for other applications. Only about 18 percent of reclaimed water in Spain is used in environmental applications such as artificial groundwater recharge through direct injection and infiltration, irrigation of forests and green areas inaccessible to the public, silviculture, environmental flows, and the maintenance of wetlands.

A prominent example of the environmental uses of reclaimed water is the reuse system in the Llobregat Delta. One of its intended objectives is to reduce saline intrusion into the overexploited groundwater aquifer that supplies the city of Barcelona. Reclaimed water

## 414m

The volume (million cubic meters) of reclaimed water for reuse in Spain in 2009.

## 983m

The annual flow of reclaimed water (million cubic meters) government officials estimate could be surpassed by 2015.

from the Baix Llobregat water recycling plant is used to maintain ecological flows in the delta and recover wetlands. The reclaimed water undergoes tertiary treatment that includes ultrafiltration and reverse osmosis.

### Conclusions

Reclaimed water has become a new source of water supply that makes available additional water resources for a multitude of applications. Being able to choose different uses for reclaimed water makes it more feasible to put into operation a water reuse system to save water for uses that require higher quality. Particularly useful in coastal areas where treated wastewater is discharged directly to the sea, it also results in a net increase in water resources because water reuse eliminates wastewater discharge to the sea.

A final note: reclaimed water must not be considered as a waste and tertiary treatment should not be considered as just one more treatment process. Instead of treating water for discharge into surface water, water should be reclaimed for multiple uses; therefore treated wastewater would be considered as a valuable product, not a waste.