

---

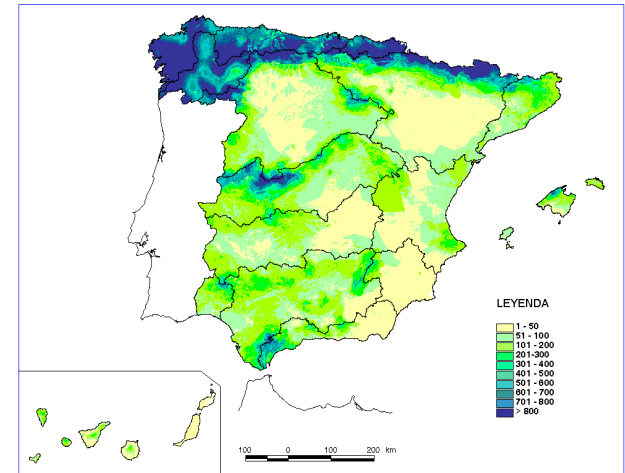
# Water reuse and desalination in Spain

Teodoro Estrela

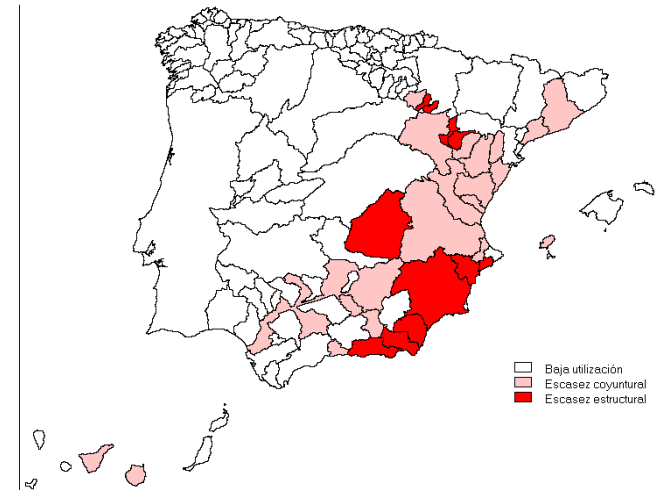
Head of Water Planning, Júcar River Basin District, Spain  
Permanent Technical Secretary of MENBO

# Water resources in Spain

- A significant increase in conventional resources in water scarcity areas is not foreseen for the future.
- In those areas, the use of non-conventional resources, such as desalination or treated waste water reuse, is extremely important.



Mean annual runoff (mm)



Water exploitation index (WEI) in Spanish Water Resources sytems

# Environmental benefits of reuse and desalination

The substitution of natural water resources by regenerated/desalinated waters reduces water abstraction from groundwater bodies



Aquifers recover, ensuring water levels of groundwater and avoiding marine intrusion



The ecological water flow is maintained safeguarding aquatic and terrestrial linked ecosystems.

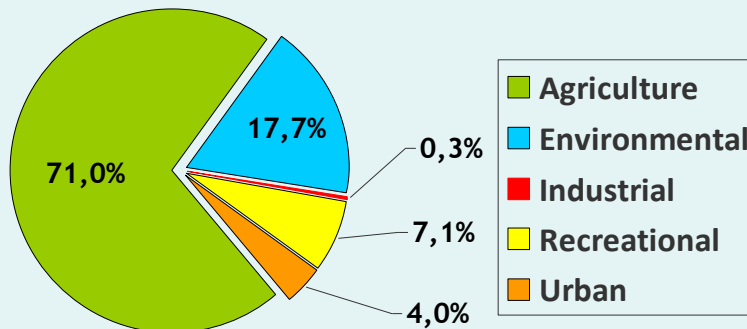


# Quality and uses of reuse and desalinated water in Spain

## REUSE

The reused water quality requirements are regulated, in terms of their uses, since 2007 by Royal Decree 1620/2007.

The main uses of reused water are:



2006 Data

## DESALINATION

Desalinated water must comply with specific quality standards for each use. The main uses are:

- Human supply (sanitary criteria)
- Industrial use (depending on the product)
- Agriculture (depending on the crop and soil characteristics)

# Governance

## REUSE

In Spain, the first reuse projects took place more than thirty years ago and currently about 500 million m<sup>3</sup>/year come from reuse. This was made possible by the existence of:

- An adequate regulatory frame
- River basin management plans that include water reuse as water allocations
- Appropriate environmental policy



Segura River reuse (Spain)



Barcelona reuse (Spain)

## DESALINATION

The first desalination plant in Europe was built in Spain in 1965. There are currently more than 700 desalination plants in operation with an installed capacity that exceeds 4.5 million m<sup>3</sup>/day. This was possible by the existence of the national water plan and the river basin management plans that include desalination as a new resource



Torrevieja desalination (Spain)

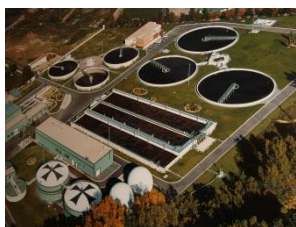


Valdelentisco desalination (Spain)

# Research and Development

## REUSE

- Application of advanced filtration, oxidation, and membranes technology
  - Removal of emerging contaminants
- Decreased energy consumption and operation costs



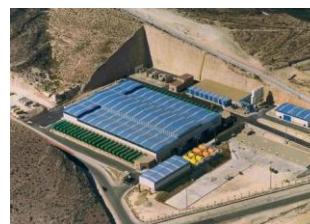
Gijón reuse (Spain)



Albufera Sur reuse (Spain)

## DESALINATION

- Reduction of energy consumption
  - Increased efficiency in plants
- Optimization of operation and maintenance
- Reduction of investment and operation costs
- Mitigation of the environmental effects



Carboneras desalination (Spain)



Águilas desalination (Spain)

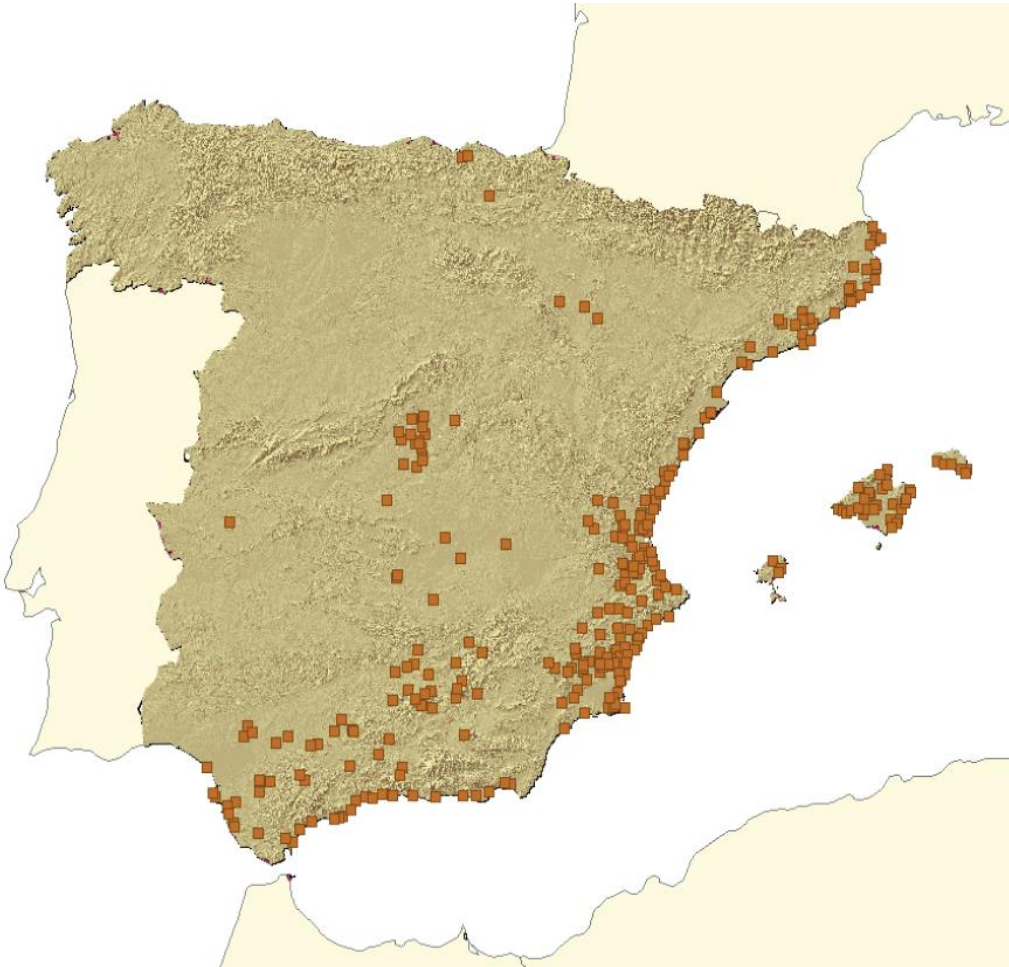
---

# Water reuse and desalination projects in Spain



# Water reuse systems

---



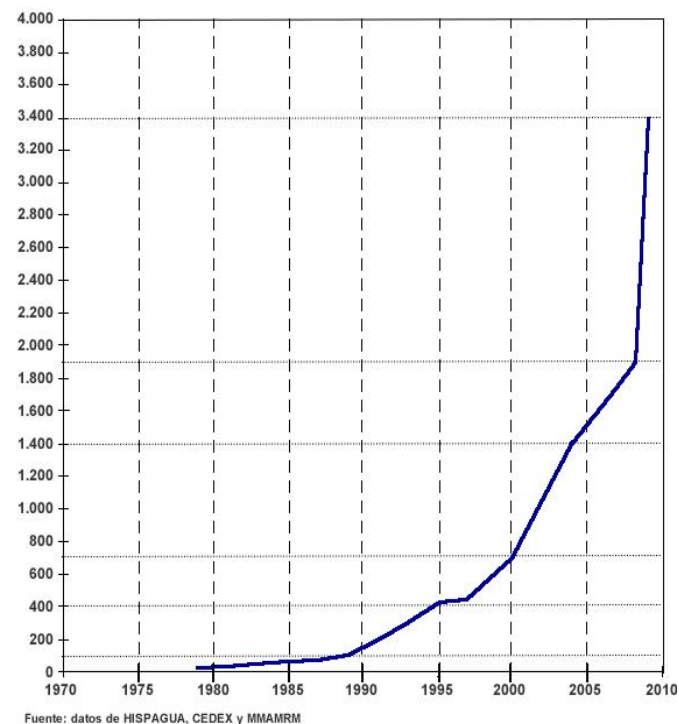
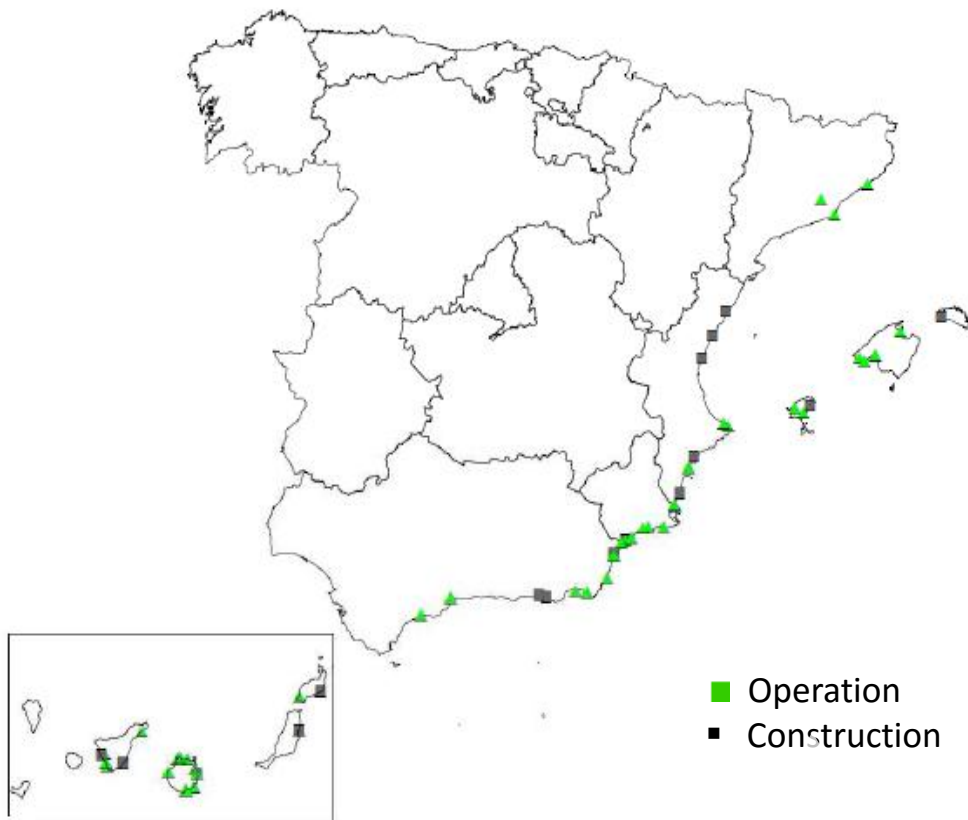
There are 340 water reuse systems in Spain, mostly located in the Mediterranean area and in the islands.

Júcar River Basin  
(120 million m<sup>3</sup>/year)

Segura River Basin  
(86 million m<sup>3</sup>/year)



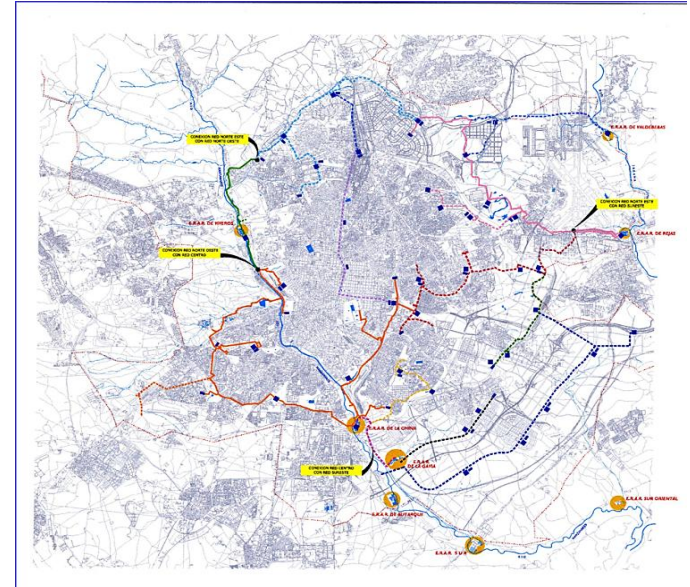
# Desalination systems



**Desalinated water production in Spain**  
 $10^3 \text{ m}^3/\text{day}$

# Water Reuse in the Region of Madrid

- City of Madrid and 21 municipalities.
- Reclaimed water capacity: 70 millions m<sup>3</sup>/year.
- Distribution network for reclaimed water 493 Km.
- Green areas and parks: 619,9 ha in Madrid city and 592,6 ha in other municipalities.
- Golf courses: 10 (Irrigated area 698 m<sup>2</sup>)

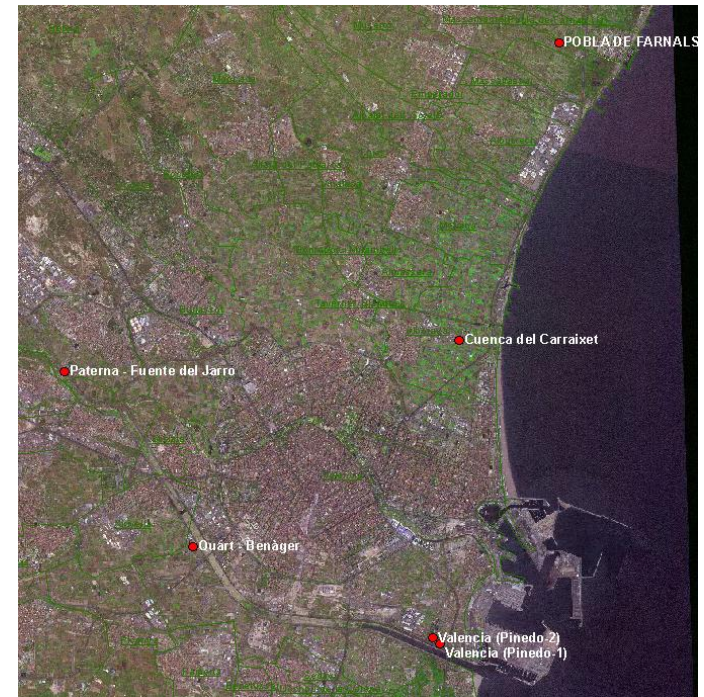


# Water reuse in Valencia and its metropolitan area

Waste Water Reuse Plant	Treated volume (Hm <sup>3</sup> /year)	Reused volume (Hm <sup>3</sup> /year)
Pinedo (I y II)	116,65	29,16
Cuenca del Carraixet	13,08	3,74
Paterna-Fuente del Jarro	3,7	3,35
Quart-Benàger	11,00	11,00
Puebla de Farnals	9,29	5,06
<b>TOTAL</b>	<b>153,72</b>	<b>52,31</b>

Source: EPSAR (Public Entity of Waste Water Sanitation,2015)

- Users: Traditional irrigation.
- EPSAR (Public Entity of Waste Water sanitation) finances tertiary treatment.
- Discharge holders have a reduction in their Discharge Control Fee.



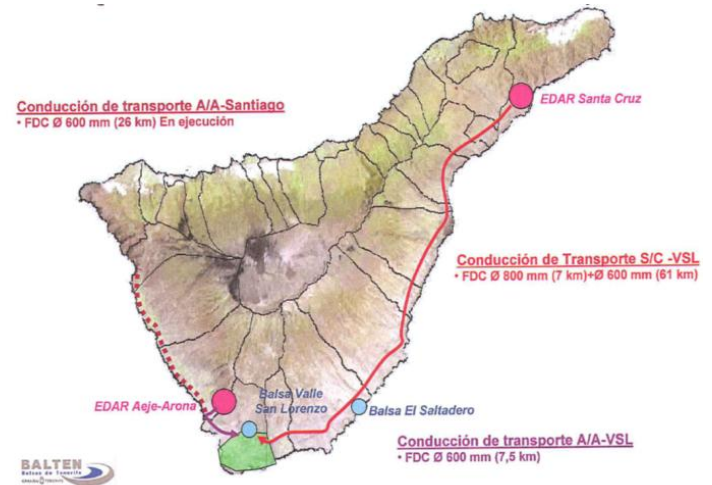
Water reuse in Valencia and its metropolitan area



# Water Reuse and desalination in Canary Island

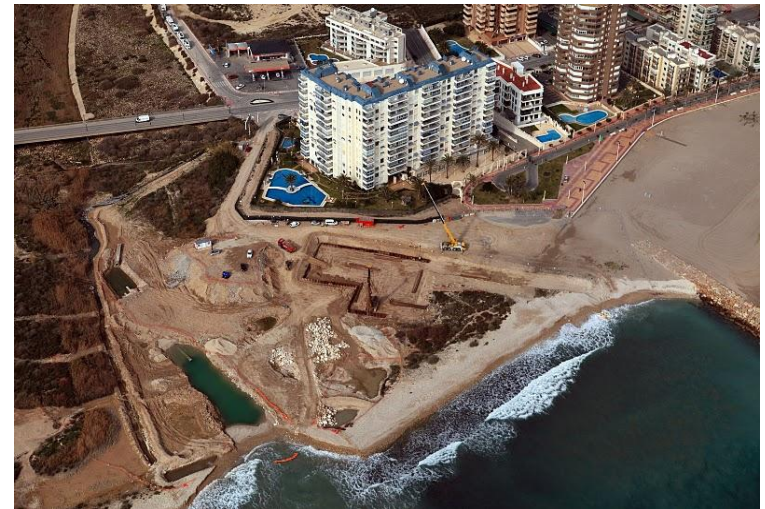
Type of resource	1993	1997	2004	2012
Water reuse	1,0	17,5	35,0	95,0
Desalination	37,0	76,0	130,0	188,0
Goundwater	262,4	326,0	273,0	40,0
Surface water	21,1	24,1	50,0	24,1

Canary islands sources, M<sup>3</sup>/year



# Desalination plant in Muchamiel (Alicante)

- Recent desalination plant with a water production capacity of 48.000 m<sup>3</sup>/day (approximately 18 Mill m<sup>3</sup>/year)
- Investment cost (installation and distribution): 0,150 Euros/m<sup>3</sup>
- Operation costs (fixed and variables): 0,385 Euros/m<sup>3</sup>



# Conclusions

---

- Existing legal and regulatory framework for the use of non-conventional resources in Spain.
- Non-conventional resources have been included in the River Basin Management Plans.
- Important reductions in the cost of non-conventional resources. But there is a need to integrate their economical regime into the general economical regime.
- Complementary actions are needed in the future: promotion of non-conventional resources, specific plans for water reuse in agriculture, ....