Spanish regulation on wastewater reuse: the challenge of bringing the future to the present

José Luis Casas López
Department of Chemical Engineering
University of Almeria
Solar Energy Research Centre (CIESOL)
Joint Centre University of Almería - CIEMAT
Almería, Spain

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The **Solar Energy Research Center (CIESOL)** is a joint research center between the University of Almeria (UAL) and the Plataforma Solar de Almeria (PSA) and has been operating since January 2006

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- **Integration of thermal and photovoltaic energy in buildings**
- **Water treatment (desalination, decontamination, microalgae)**
- **Control, modelling and optimization of solar processes**

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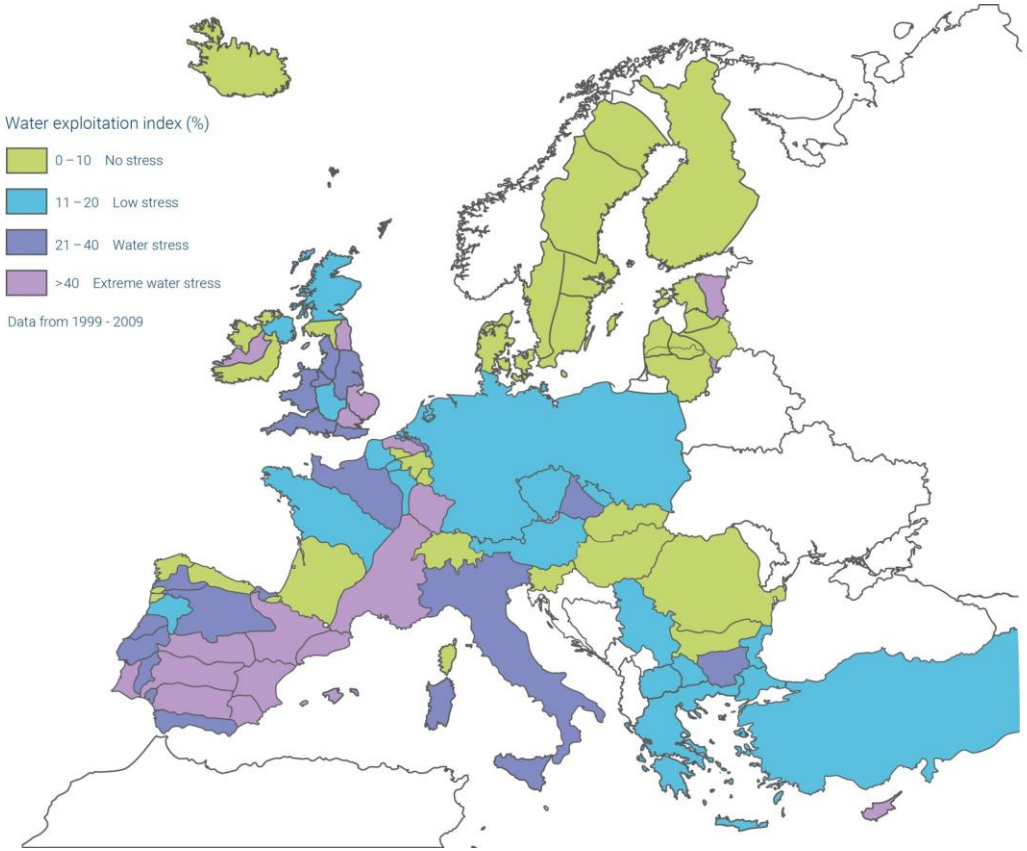
INTRODUCTION TO
WATER REGENERATION AND REUSE

CURRENT SITUATION OF THE WATER REUSE

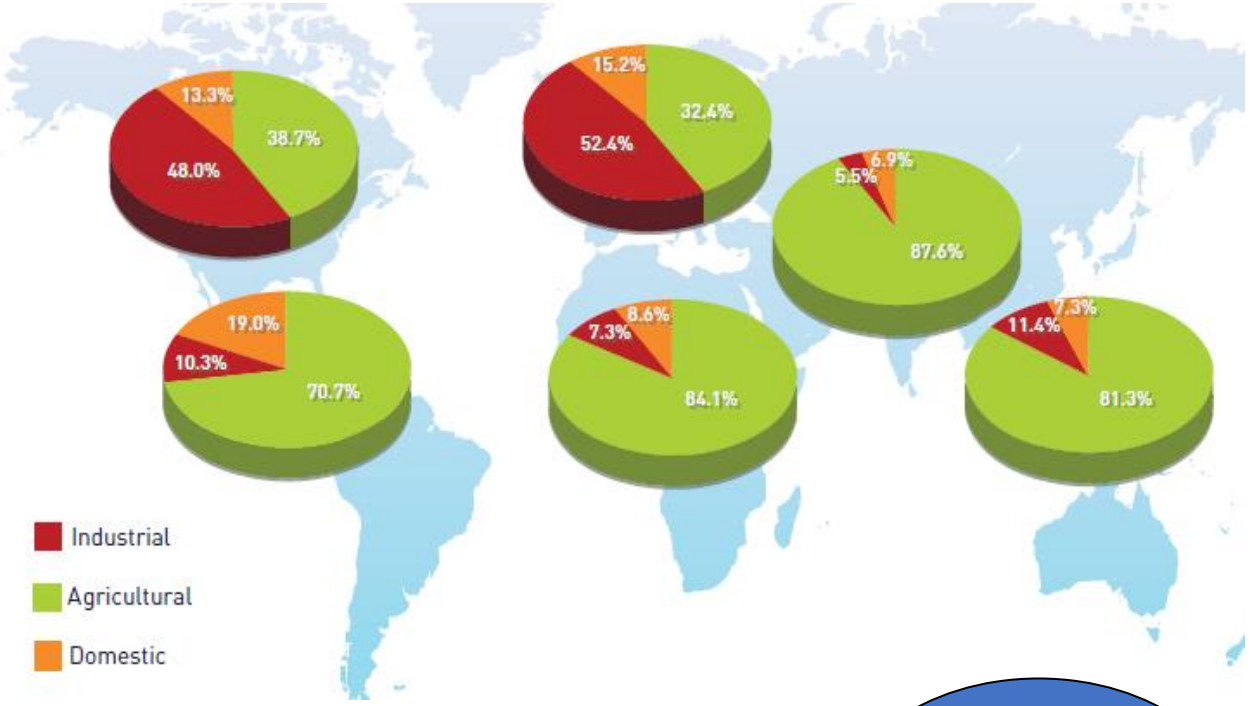
EUROPEAN AND SPANISH REGULATION

WATER AND ITS PROBLEMS

Growing demand for water
Scarcity of water resources
Surface and groundwater pollution



GLOBAL WATER CONSUMPTION

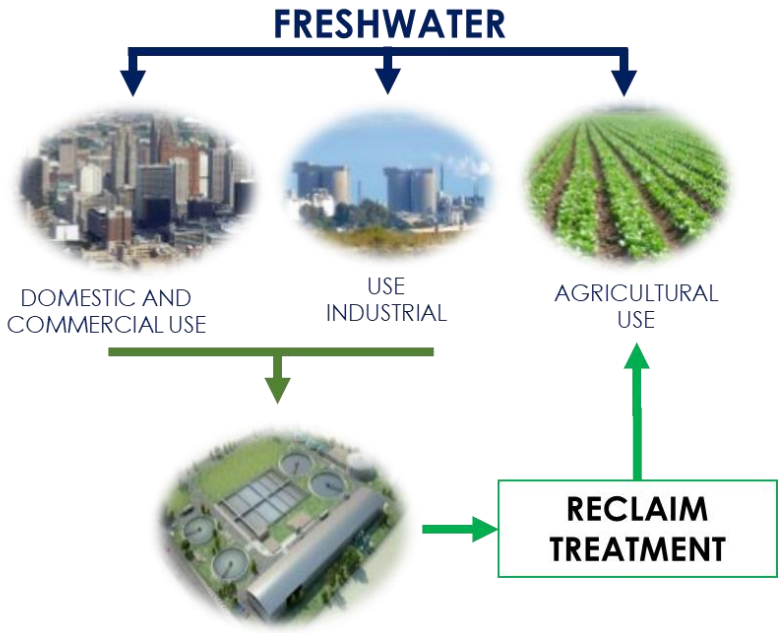


70% OF FRESH WATER IS CONSUMED BY AGRICULTURE

60 % GLOBAL NUTRITION

WHO Guidelines for the safe use of wastewater, excreta and greywater: links the **Millennium Development Goals to water reuse. United Nations Summit, September 2000.**

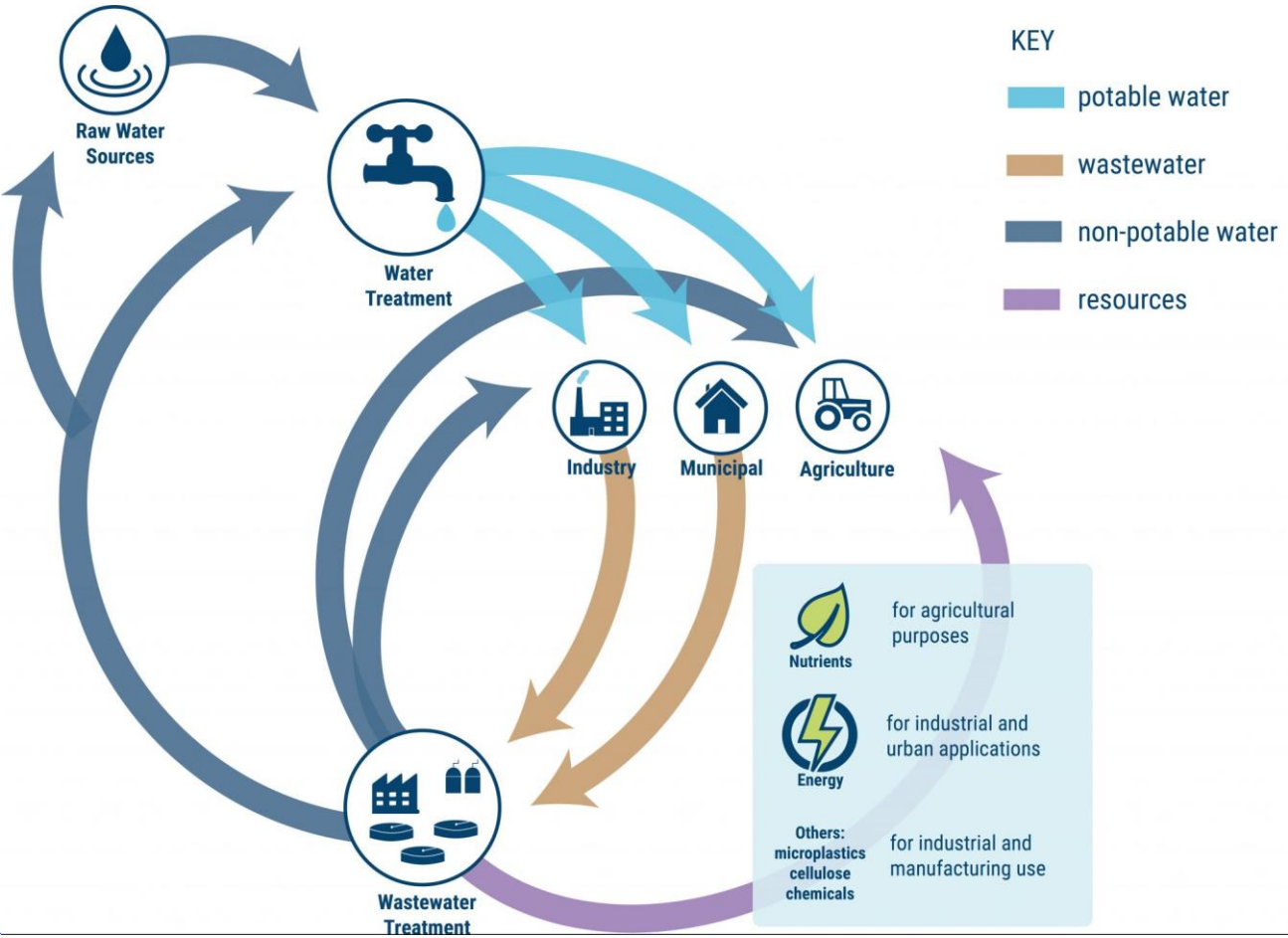
Water reuse is a strategic resource of special value in areas where there is water stress, as long as public health and environmental protection are ensured



✓ And points out as **advantages:**

✓ **Reduction of pressures** on water resources
✓ **Reducing the presence of contaminants in natural water sources**
✓ Reduced **health risks for downstream users**
✓ **Availability and stable flow** of quality water
✓ Use of **organic matter and nutrients present in treated water**
✓ Maintenance of the **quality of ecosystems**.

ADVANTAGES OF WATER REUSE



Growing interest in Europe in research for the use of urban wastewater through advanced purification treatments.

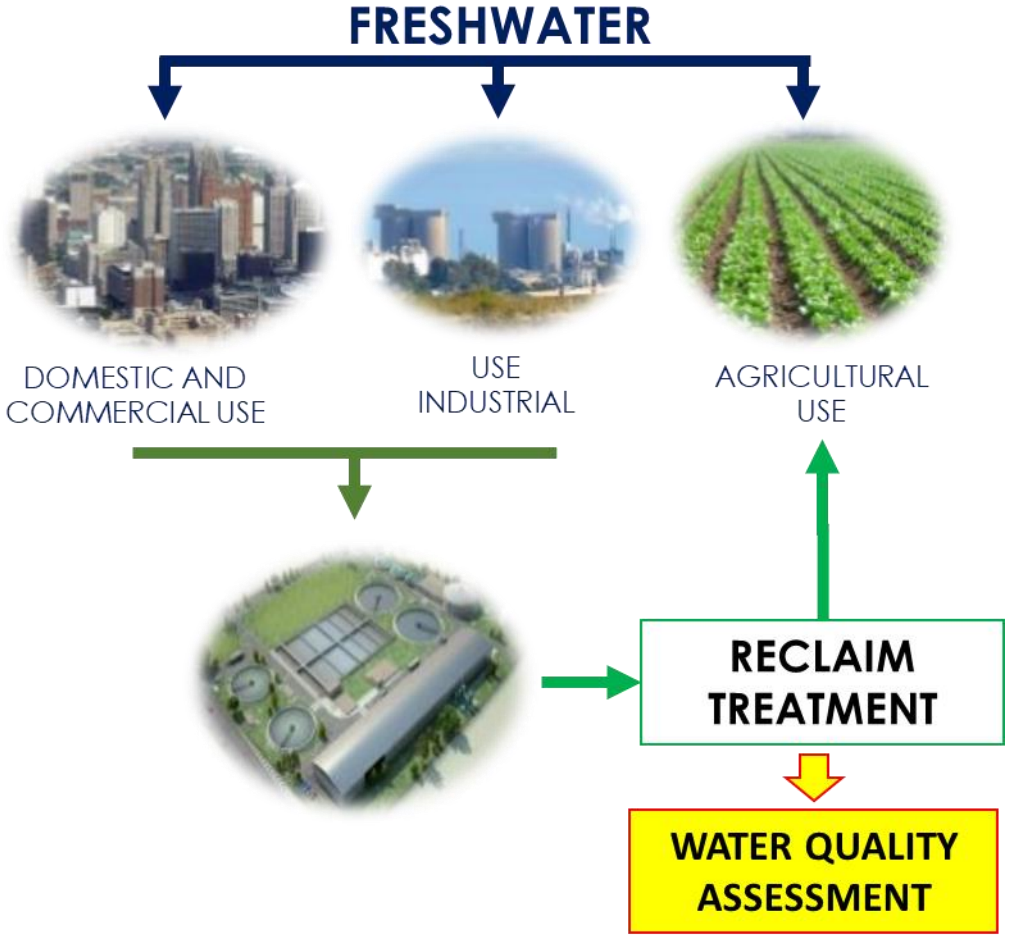
Social Challenge 5 Climate Action, Environment, Resource Efficiency and Raw Materials in Horizon 2020

Priorities of the as the UN-Water has as a **Sustainable Development Goal (SDGS), the increase in security in the reuse of water by 2030.**

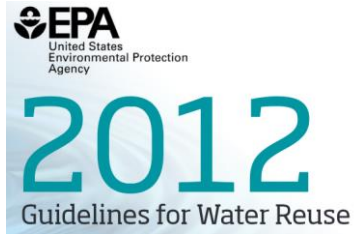
The reuse of water is one of the lines of action articulated by the "**Spanish Strategy for Circular Economy “España Circular 2030" (MITECO, 2020), which considers it a "valuable tool to reduce pressure on natural water resources".**

This is coupled with its potential to **reduce the supply of nutrients** to inland and marine waters and to reduce fertilizer consumption.

WATER QUALITY



US - EPA
Guidelines for
Water reuse



WHO
Guidelines for the safe use of wastewater, excreta and greywater

Spanish Legislation

Royal Decree 1620/2007, of 7 December, which establishes the legal regime for the reuse of treated water

IMPORTANCE OF THE CORRECT USE OF NOMENCLATURE. INFLUENCE ON THE PERCEPTION THAT SOCIETY HAS ON REUSE

GLOSSARY

Recycled water: water used more than once **in the same place before being discharged into the water cycle.**

Wastewater: water that has been used having incorporated a certain **pollutant** load into it.

Treated water: wastewater that has been subjected to a treatment process that allows its quality to be adapted to the applicable **discharge regulations.**

Reclaimed water: treated wastewater that has been subjected to an **additional or complementary treatment process** that allows its quality to be adapted to the use for which it is intended.

Reused water: water that, having been used by the person who derived it, has been subjected to the purification process or processes established in the corresponding discharge authorisation and to those necessary to achieve the quality required for a new private use, depending on the uses to which it is to be used before its return to the public hydraulic and maritime-terrestrial domain.

LEGAL FRAMEWORK IN SPAIN BEFORE EU REGULATION

WATER QUALITY ACCORDING TO USES

Spanish Legislation
Royal Decree 1620/2007, of 7 December, which establishes the legal regime for the reuse of treated water

WATER QUALITY BASED ONLY ON MICROBIOLOGICAL ASPECTS AND GLOBAL PARAMETERS (TURBIDITY, BOD5, COD, SS...)
OTHER POLLUTANTS: DISCHARGE REGULATIONS

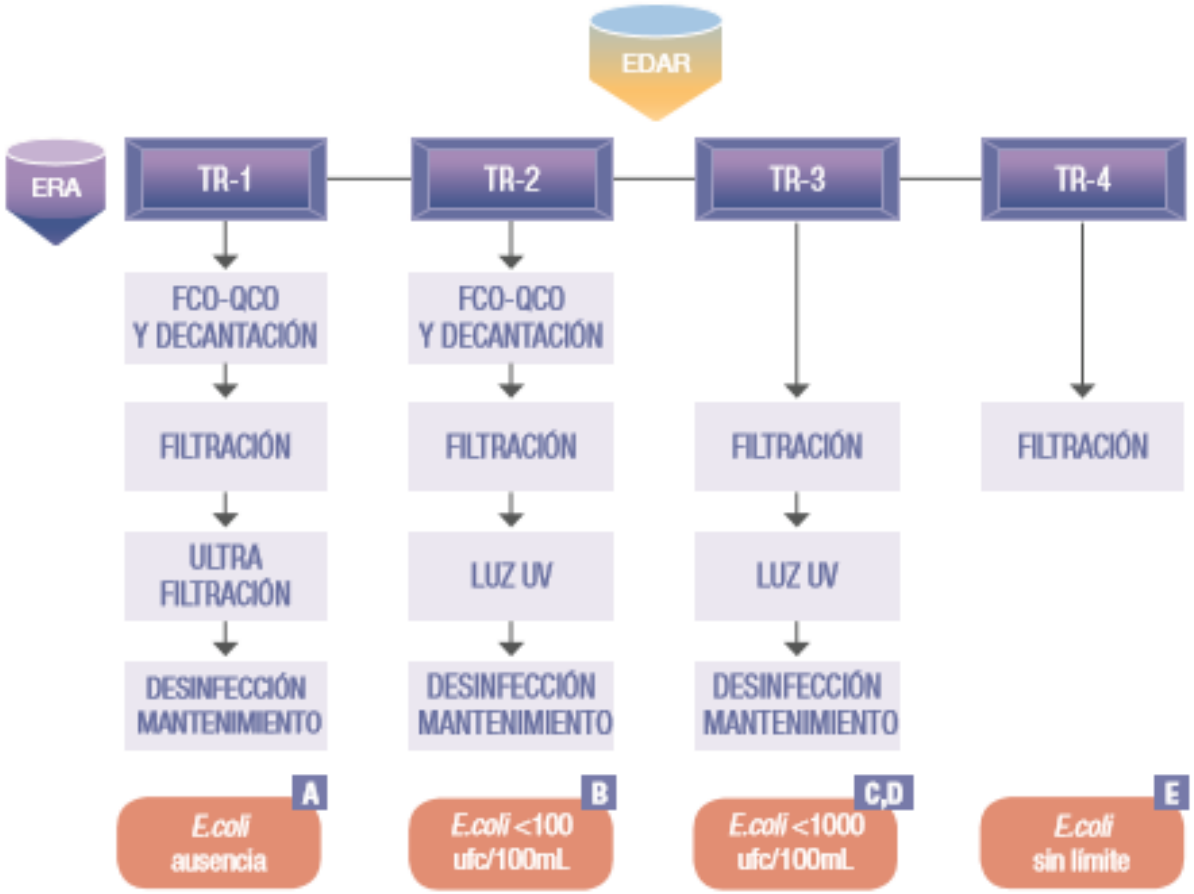
Urban, Agricultural, Industrial, Recreational, Environmental

A reference in Europe

USOS	Tipo de Calidad	*Escherichia coli* UFC/100 ml	Nematodos	*Legionella spp.* UFC/100 ml
- Torres de refrigeración y condensadores evaporativos (3.2)	A	Ausencia	Ausencia	Ausencia
- Residenciales (1.1)		Ausencia	< 1 huevo/10L	< 100
- Recarga acuíferos inyección directa (5.2)		Ausencia	< 1 huevo/10L	No se fija límite
- Servicios urbanos (1.2) - Riego agrícola sin restricciones (2.1) - Riego campos de golf (4.1)	B	< 100-200	< 1 huevo/10L	< 100
- Riego de productos agrícolas que no se consumen frescos. - Riego pastos animales productores. - Acuicultura (2.2) - Aguas proceso y limpieza industria alimentaria (3.1)	C	< 1.000	< 1 huevo/10L	No se fija límite
- Recarga acuíferos por percolación a través del terreno (5.1)		< 1.000	No se fija límite	No se fija límite
- Riego cultivos leñosos, viveros y cultivos industriales (2.3) - Masas agua sin acceso público (4.2)	D	< 10.000	< 1 huevo/10L	< 100
- Riego de bosques y zonas verdes no accesible al público (5.3)	E	No se fija límite	No se fija límite	No se fija límite
- Ambientales: mantenimiento humedales, caudales mínimos (5.4)	F	La calidad se estudiará caso por caso		

Tabla 6. Tipos de calidad según los límites bacteriológicos del RD de reutilización

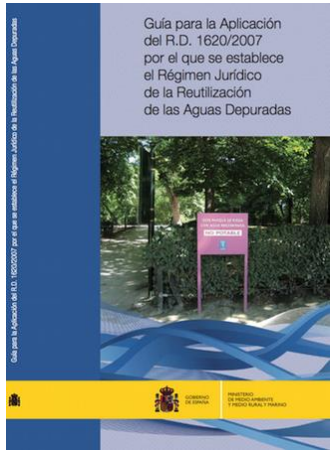
RECOMMENDED TECHNOLOGIES



COMBINATION OF RECOMMENDED TECHNOLOGIES WITH AND WITHOUT DESALINATION

SITUATION IN SPAIN

Spanish Legislation ROYAL DECREE 1620/2007, which establishes the legal regime for the reuse of treated water



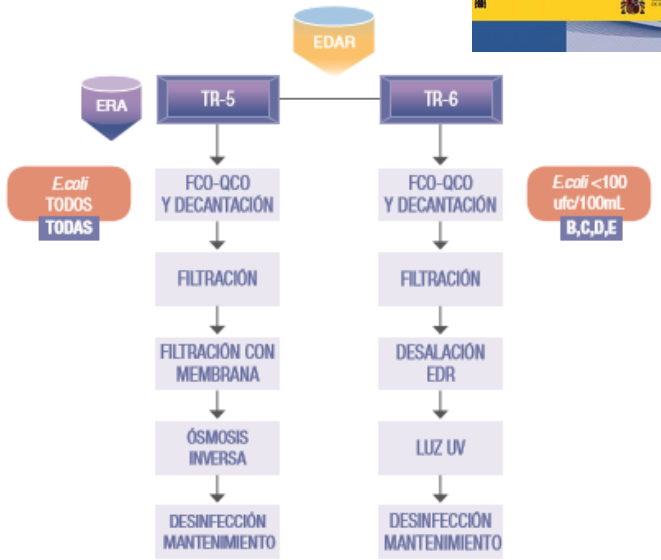


Figura 14. Tratamientos de regeneración propuestos con desalación

SITUATION IN SPAIN (2010)

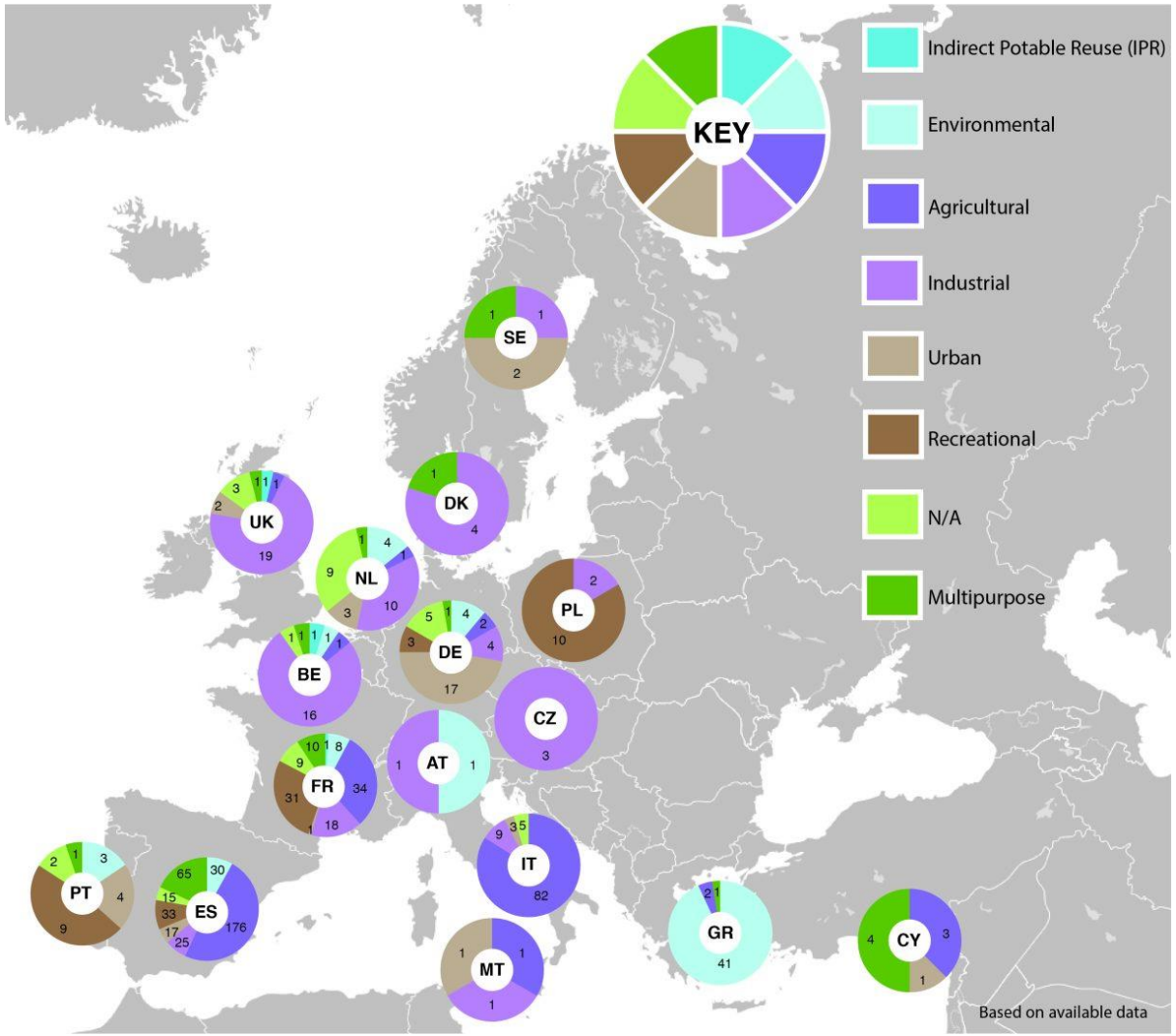
TREATMENT PROCESSES USED FOR RECLAIMED WATER

WITHOUT DESALINATION	No.	%	WITH DESALINATION	No.	%
F + D	58	39.0	F + EDR	4	2.6
P/C + F + D	28	18.9	P/C + F + EDR + D	2	1.4
F + M	8	6.0	M + EDR	1	0.7
P/C + F + M	1	0.7	M + RO	2	1.4
MBR	2	1.4	MBR + RO	1	0.7
NS	18	12.0	F + M + RO	4	2.6
D	18	12.0	P/C + M + RO	1	0.7
			P/C + F + M + RO	1	0.7
Total	133	89.3	Total	16	10.7

F = Filtration; P/C = Physical–chemical with settling; M: Filtration with Membranes; NS = Natural Systems; D = Disinfection; EDR = Electro-dialysis reversal; RO: Reverse Osmosis; MBR: Membrane Bioreactor.

CURRENT STATUS OF THE WATER REUSE

CURRENT STATUS OF WATER REUSE



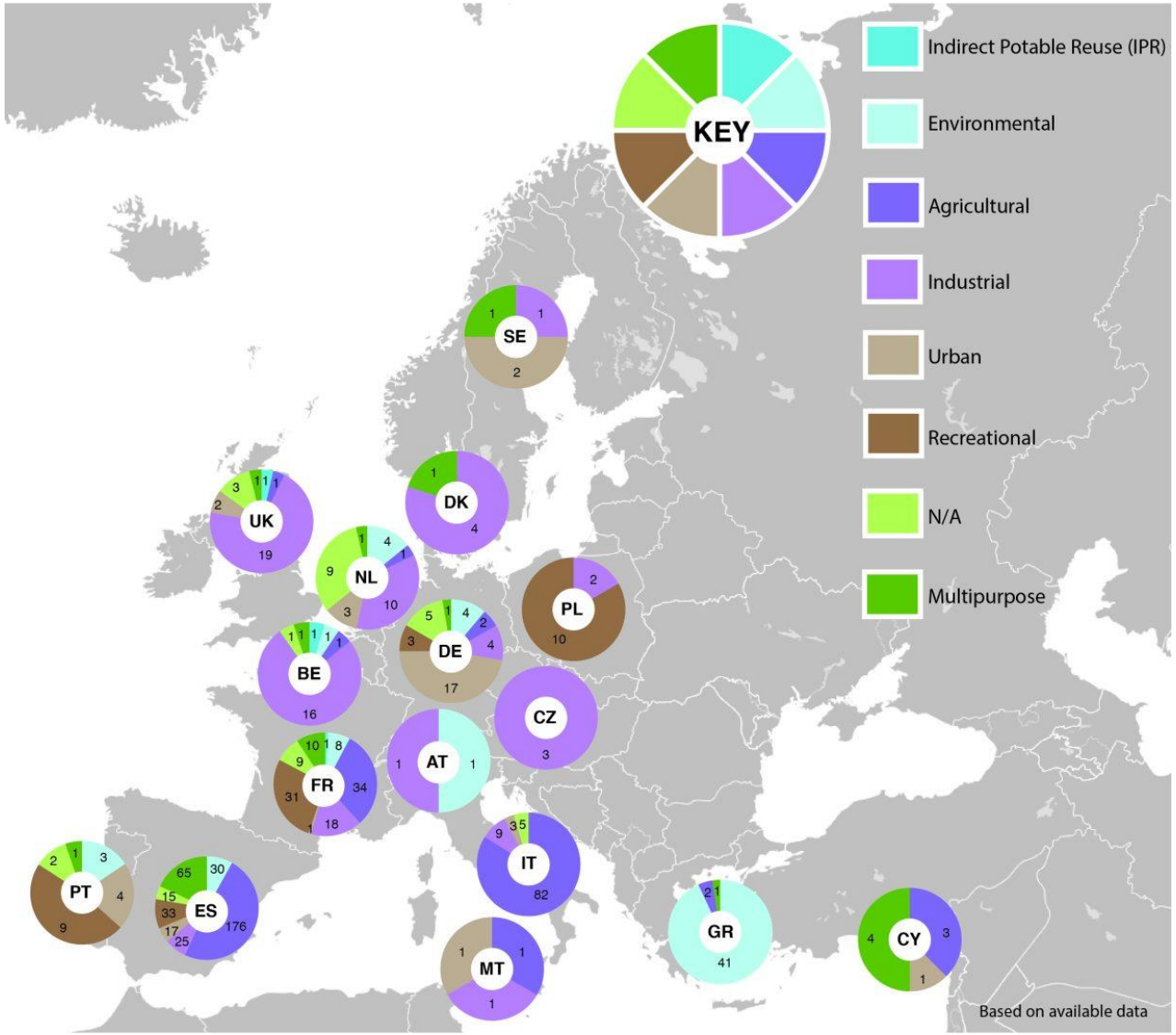
- ✓ **The global market for water reuse solutions has grown significantly since the early 90s, when less than 1 million m³/d of reuse plant was installed annually, to 7 million m³/d installed capacity during 2017, and is projected to continue to expand to over 10 million m³/d by 2022.**

- ✓ Europe is experiencing increasing water scarcity but only represents a small percentage of the global reuse market : **2.6 million m³/day total installed capacity compared to 30 million m³/day globally.**

- ✓ Through a review of the sector performed in 2017 by Water Reuse Europe, **787 schemes practicing reuse were identified, distributed across 16 countries, 437 more than identified by the previous review of the water reuse sector in Europe performed in 2006.**

IN EUROPE, ONLY 2.4% OF TREATED WATER IS REUSED, 793 hm3/y.

CURRENT STATUS OF WATER REUSE



- ✓ In terms of geographical distribution, **250 schemes are located in Northern Europe,** with 112, 36 and 28 of them in France, Germany, and the Netherlands respectively.
- ✓ In contrast, **537 schemes, were identified in Southern Europe**, with **361, 99 and 44 schemes in Spain, Italy and Greece respectively**.
- ✓ Of the **787 schemes identified,** 62% are located in water scarce countries such as **Spain, Italy and France**.
- ✓ **47% of the listed schemes are located along the Mediterranean coast with over 200 schemes situated on the east coast of Spain in the Murcia, Valencia, Tarragona and Barcelona regions.**
- ✓ In EUROPE:
  - ✓ **Agricultural reuse:** (39% of the schemes)
  - ✓ **Industrial reuse** (15%) (68%) located in northern Europe.
  - ✓ **Recreational purposes** (11%)

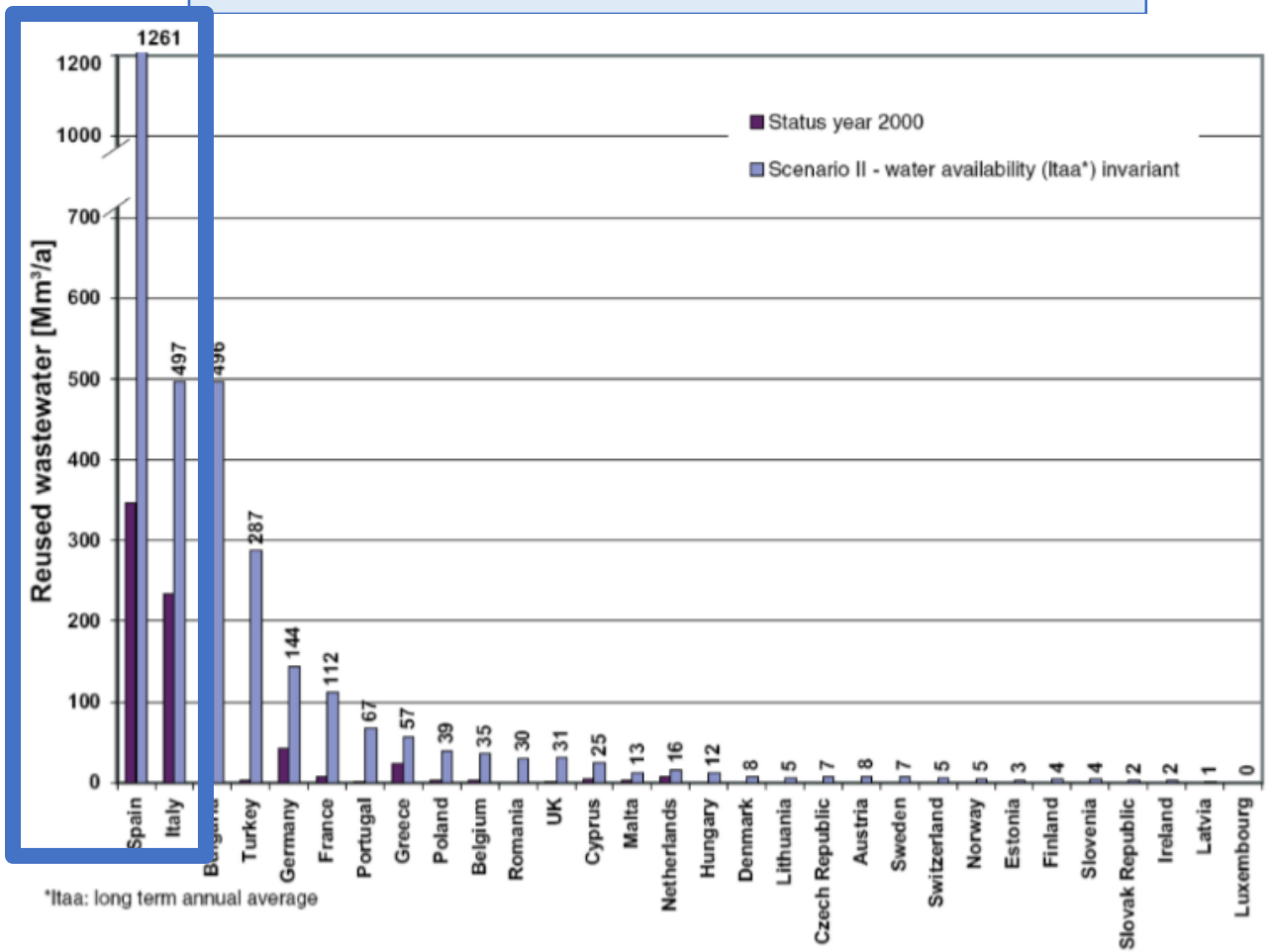
CURRENT STATUS OF WATER REUSE IN SPAIN

Recent estimates indicate that about **400-500 Hm3/year** of reclaimed water is reused in Spain, which represents **between 10 and 13% of the total.**

More than 95% of reuse in Spain takes place on the Mediterranean coast and in the Canary and Balearic Islands, with Murcia, the Valencian Community and Andalusia, accounting for 80%.

Growth has been lower than expected a few years ago, 1,200 Hm3/year in 2015.

LEADERS IN EUROPE.
400-500 Hm3/year. Far from the forecasts



CURRENT STATUS OF WATER REUSE IN SPAIN

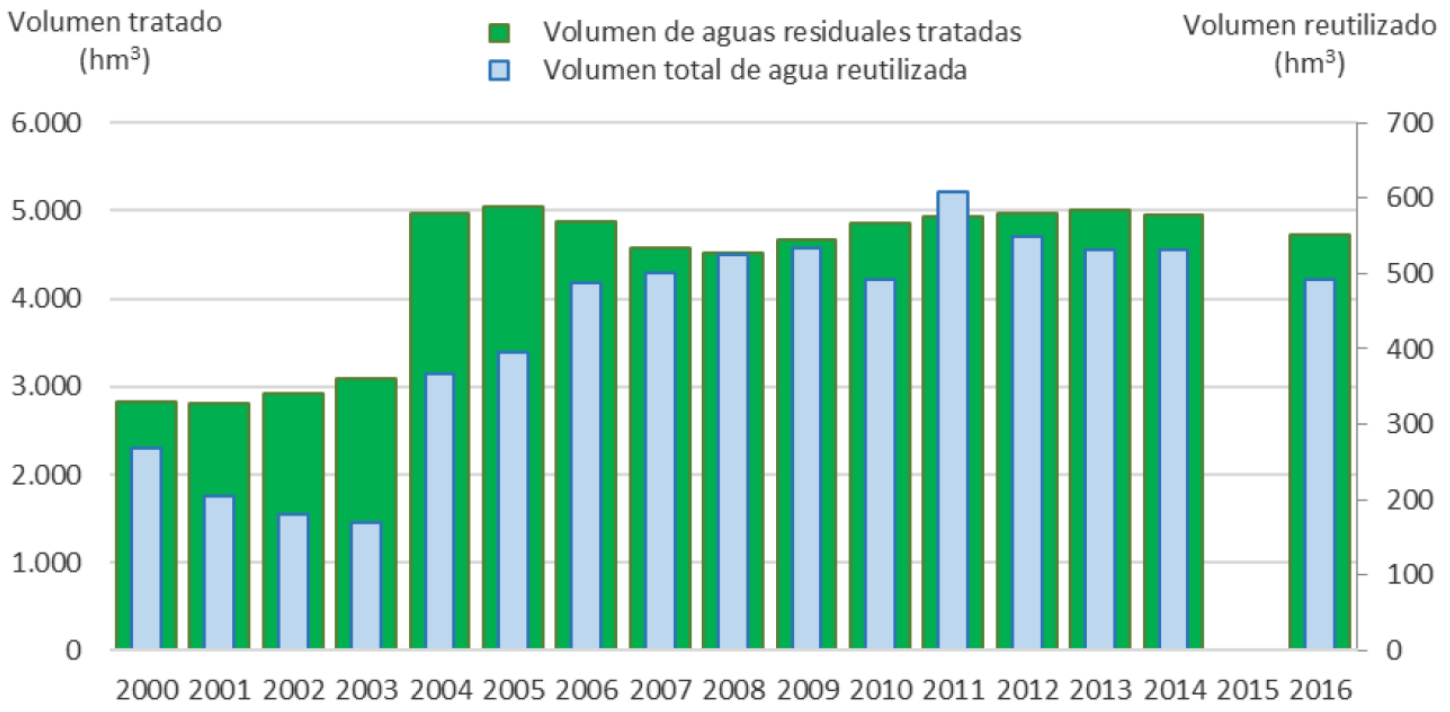
LEADERS IN EUROPE, IN QUANTITY, NOT IN %

The volume of treated water reused in Spain in 2006 was around 368 hm3/year, which represented 10.8% of the total treated wastewater flows.

The National Water Reuse Plan 2010-2015 estimated an upward evolution of this volume to 983 for 2015, reaching 1380 hm3/year for subsequent years.

The percentage of volume of reused water with respect to treated water in Spain has remained practically constant from 2006 to 2016 (10.7%).

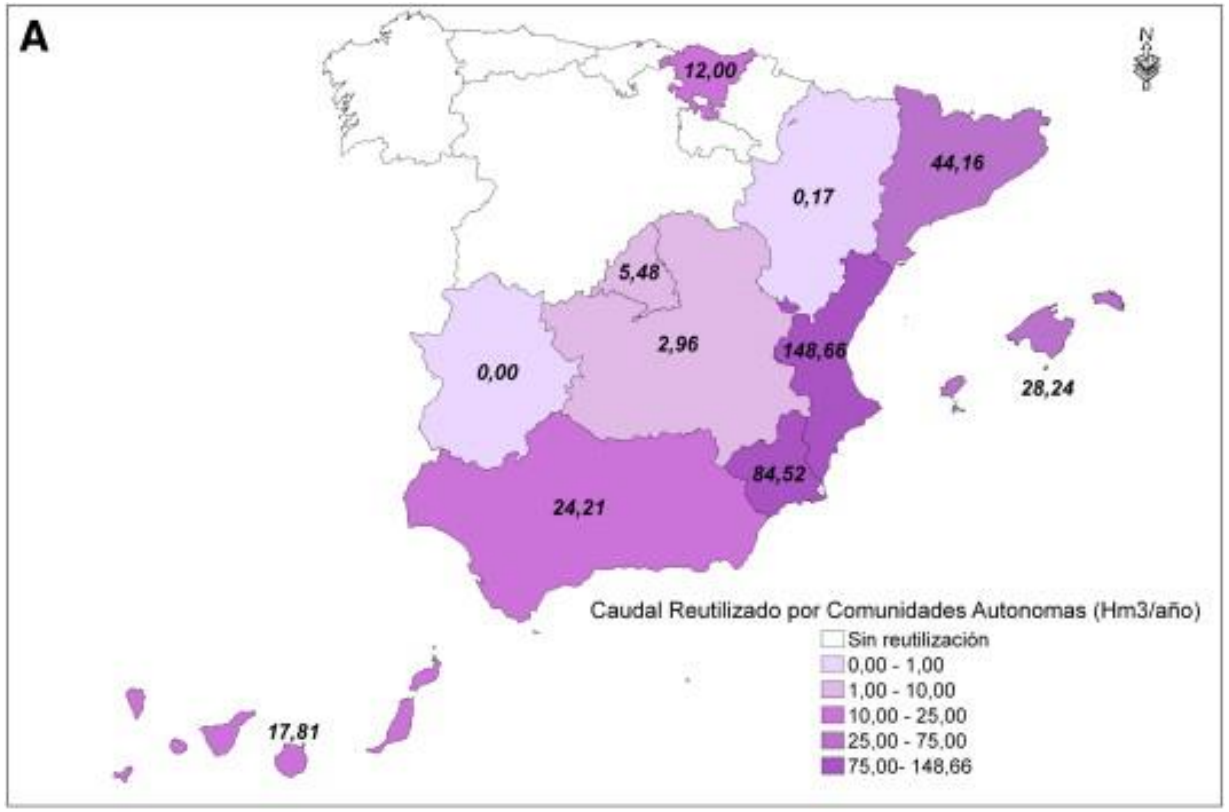
Cyprus, Malta, Crete or Israel with higher %



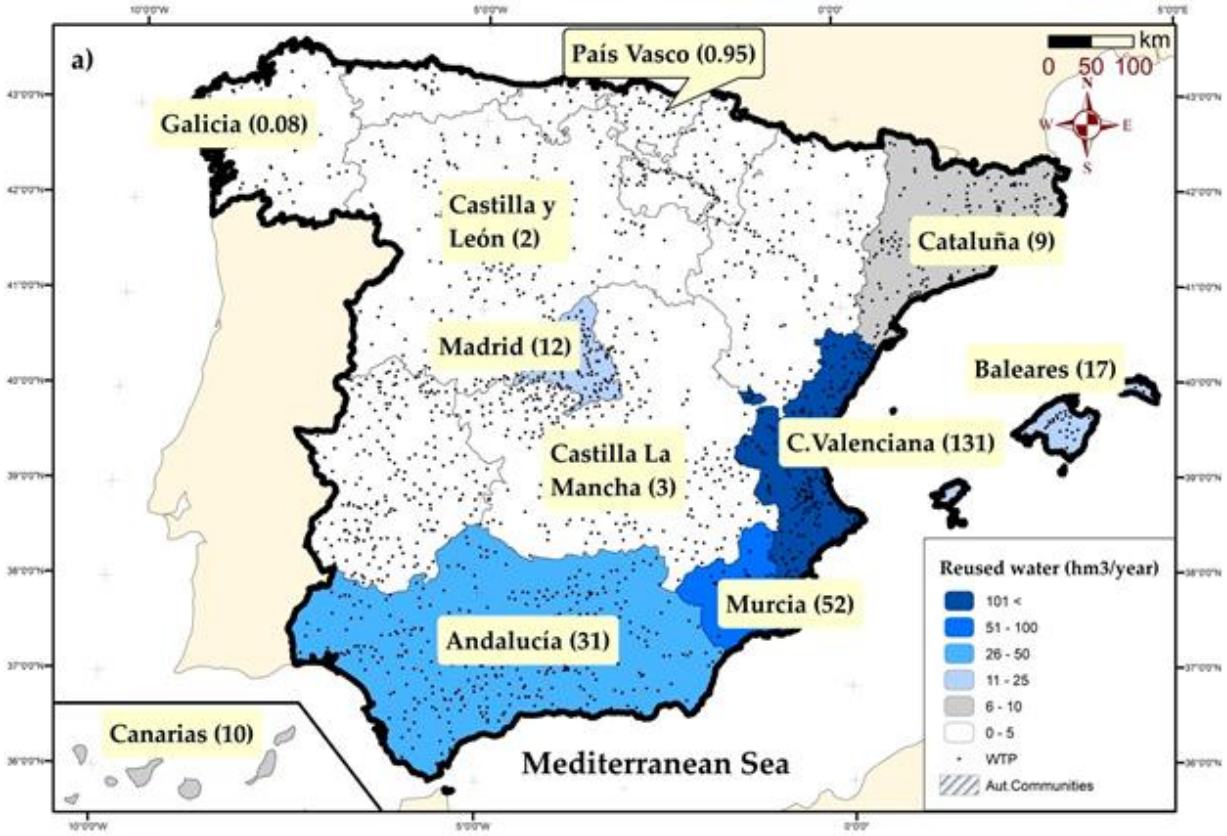
STAGNATION OF EVOLUTION

CURRENT STATUS OF WATER REUSE IN SPAIN

Distribution and uses of reuse in Spain **(2010)**



Distribution and uses of reuse in Spain **(2016)**



Easy to evaluate installed reclaim capacity, difficult to quantify actual reuse

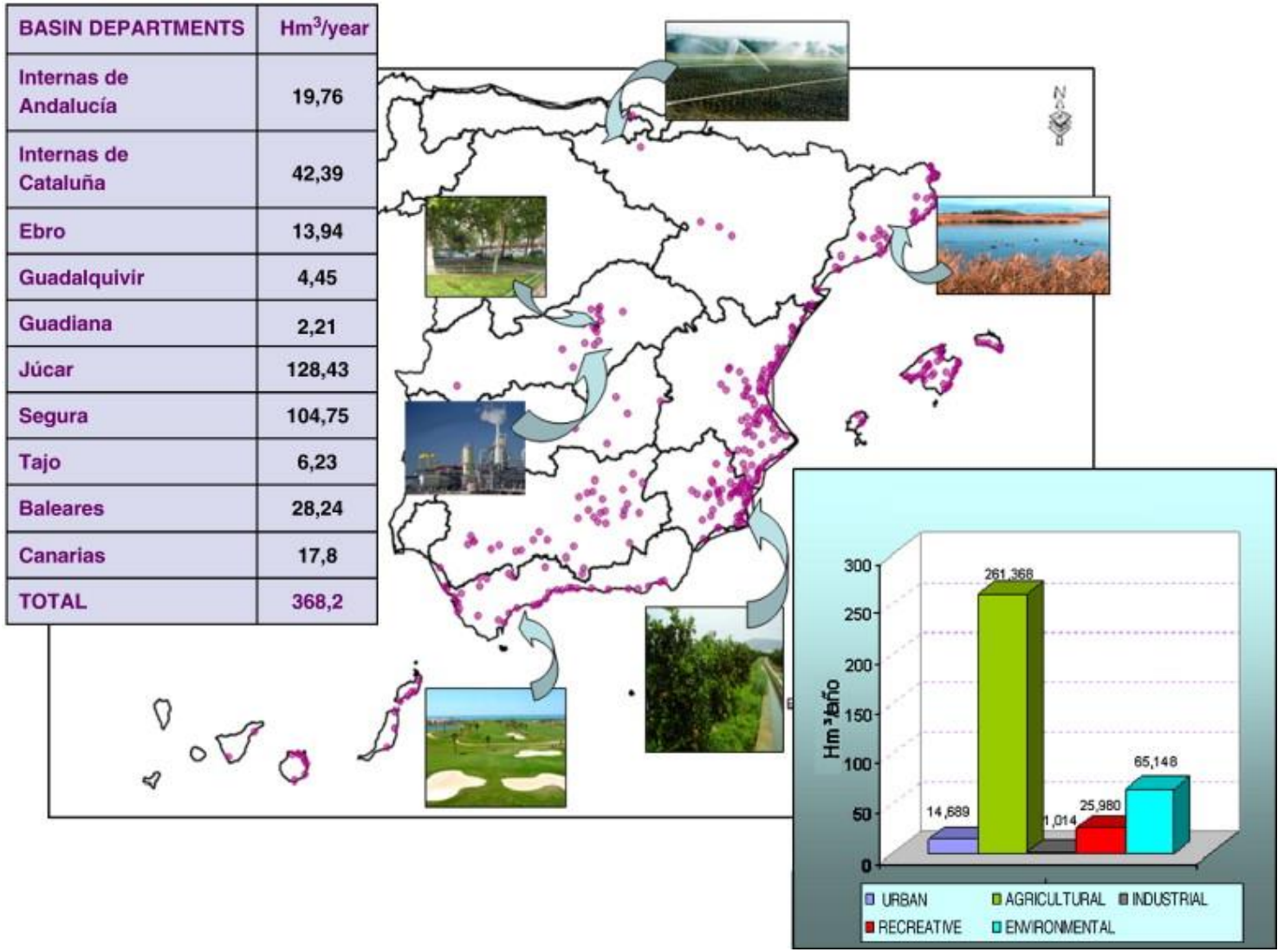
CURRENT STATUS OF WATER REUSE IN SPAIN

Distribution and uses of reuse in Spain **(2016)**

Different uses depending on the regions, highlighting:

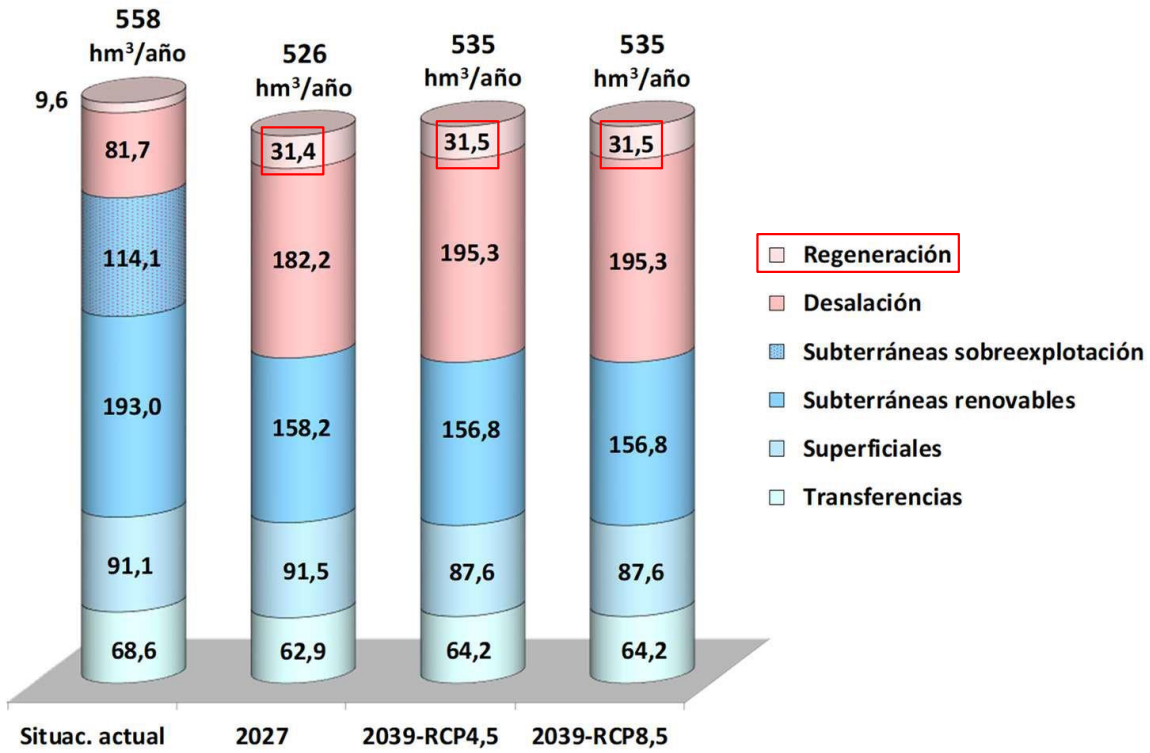
- **Golf course** irrigation on the **Costa del Sol**
- Garden irrigation and **municipal** use in **Madrid**
- **Crop irrigation** in the Region of **Murcia, Andalucia and the Valencian** Community
- **Crop irrigation and aquifer recharge** in **Catalonia**

BASIN DEPARTMENTS	Hm³/year
Internas de Andalucía	19,76
Internas de Cataluña	42,39
Ebro	13,94
Guadalquivir	4,45
Guadiana	2,21
Júcar	128,43
Segura	104,75
Tajo	6,23
Baleares	28,24
Canarias	17,8
TOTAL	368,2



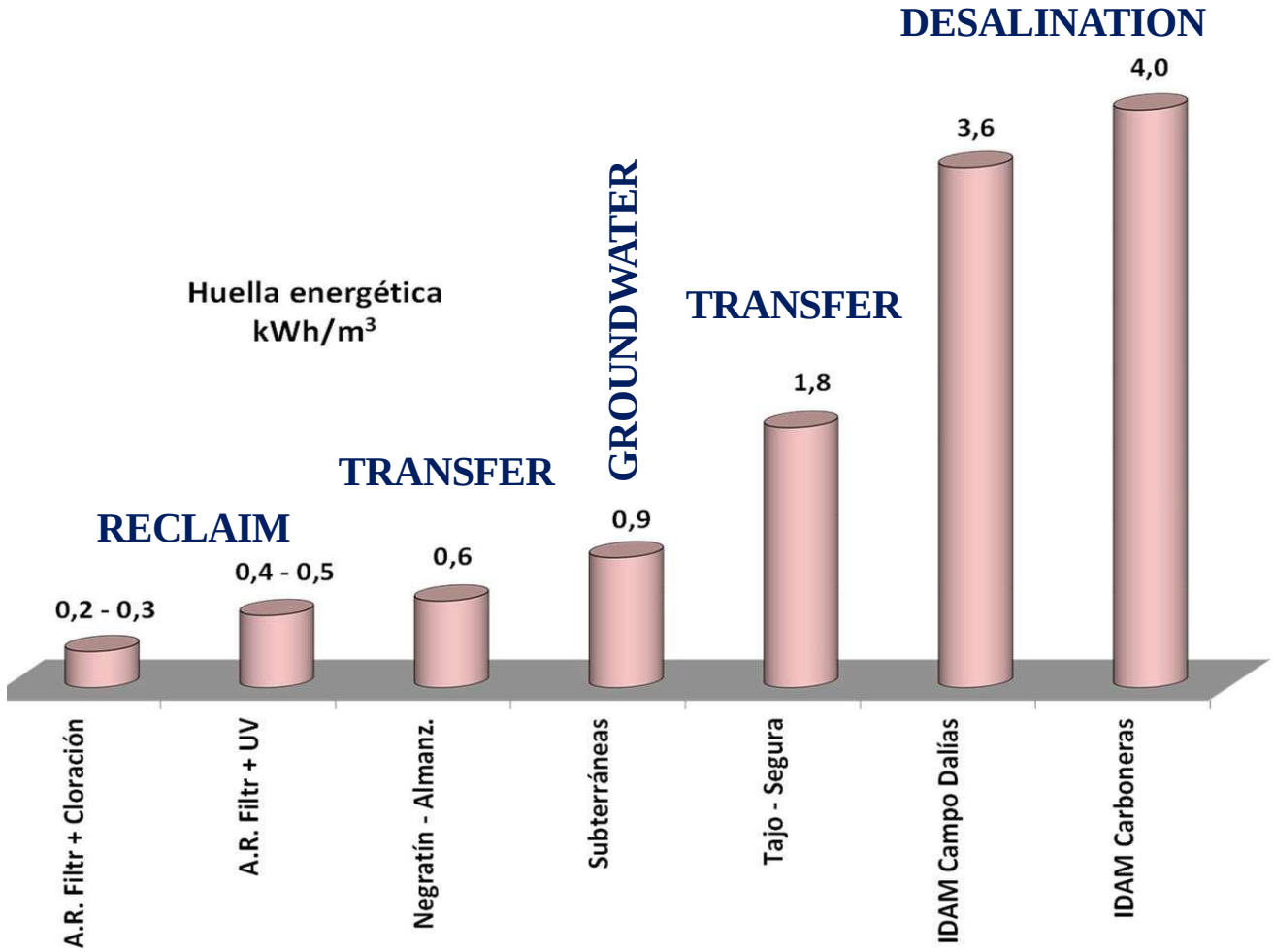
CURRENT STATUS OF WATER REUSE IN ALMERIA

WATER RESOURCES USED AND TO BE USED IN THE PROVINCE



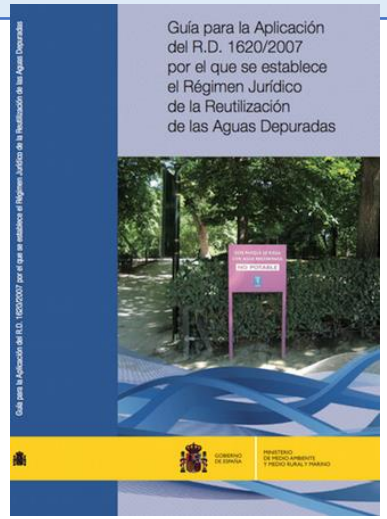
>35.000 hectares greenhouses
5000 $m^3/h \cdot y$ 175.000 h^3/y

ENERGY FOOTPRINT ASSOCIATED WITH RESOURCE SOURCES



EVOLUTION OF THE LEGAL FRAMEWORK IN SPAIN

Spanish Legislation
Royal Decree 1620/2007, of 7 December, which establishes the legal regime for the reuse of treated water



Old Framework

- 1973 – WHO experts recomendations
- 1991 –Protocol of the SAS Provincial Director
- 1999- Ministerial Order, 6th september

A reference in Europe

CURRENT LEGAL FRAMEWORK IN SPAIN

European Regulation EUR2020/741

In force from 26 June 2023

ROYAL DECREE 1620/2007

Recently derogated, 24 October 2024

ROYAL DECREE 1085/2024

In force from 24 October 2024

WATER QUALITY

FRESHWATER

DOMESTIC AND COMMERCIAL USE

USE INDUSTRIAL

AGRICULTURAL USE

RECLAIM TREATMENT

WATER QUALITY ASSESSMENT

THE EUROPEAN UNION HAS ALREADY EXPRESSLY LEGISLATED ON REUSE

EN

Official Journal of the European Union

REGULATION (EU) 2020/741 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 25 May 2020

on minimum requirements for water reuse

(Text with EEA relevance)

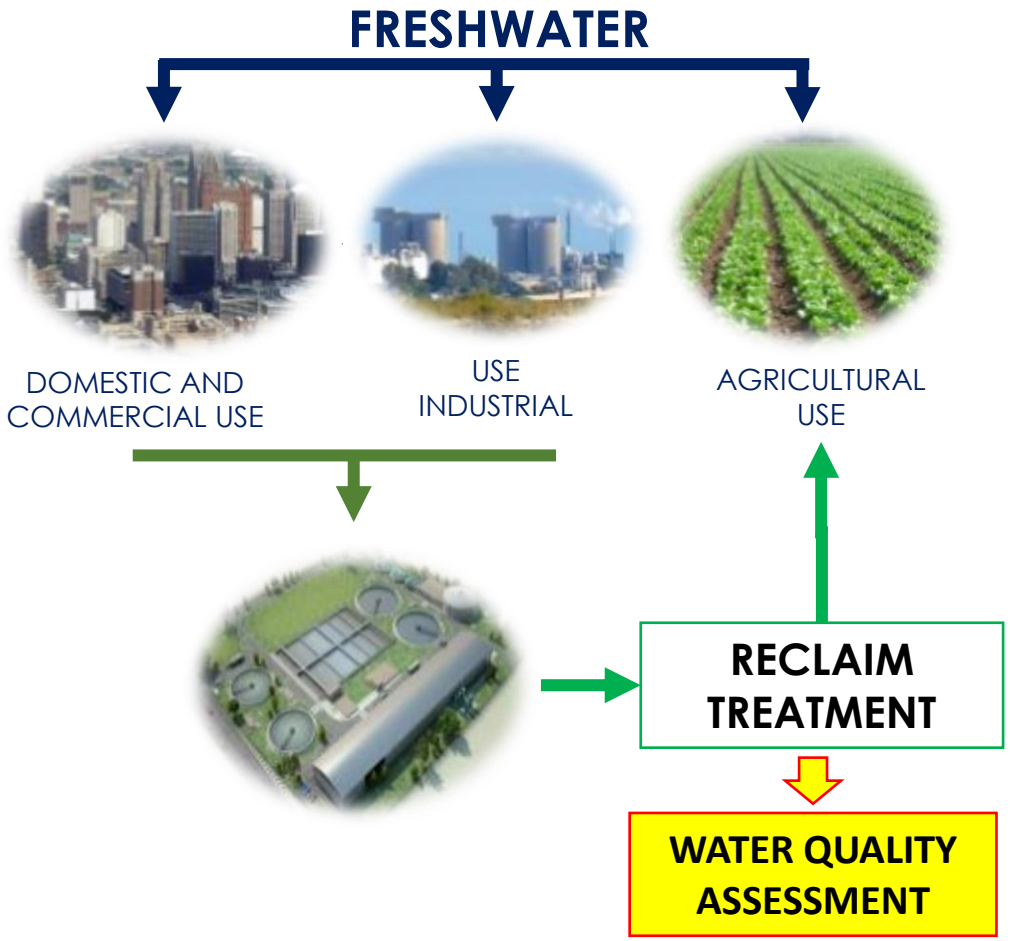
Scope

1. This Regulation applies whenever treated urban waste water is reused, in accordance with Article 12(1) of Directive 91/271/EEC, for agricultural irrigation as specified in Section 1 of Annex I to this Regulation.

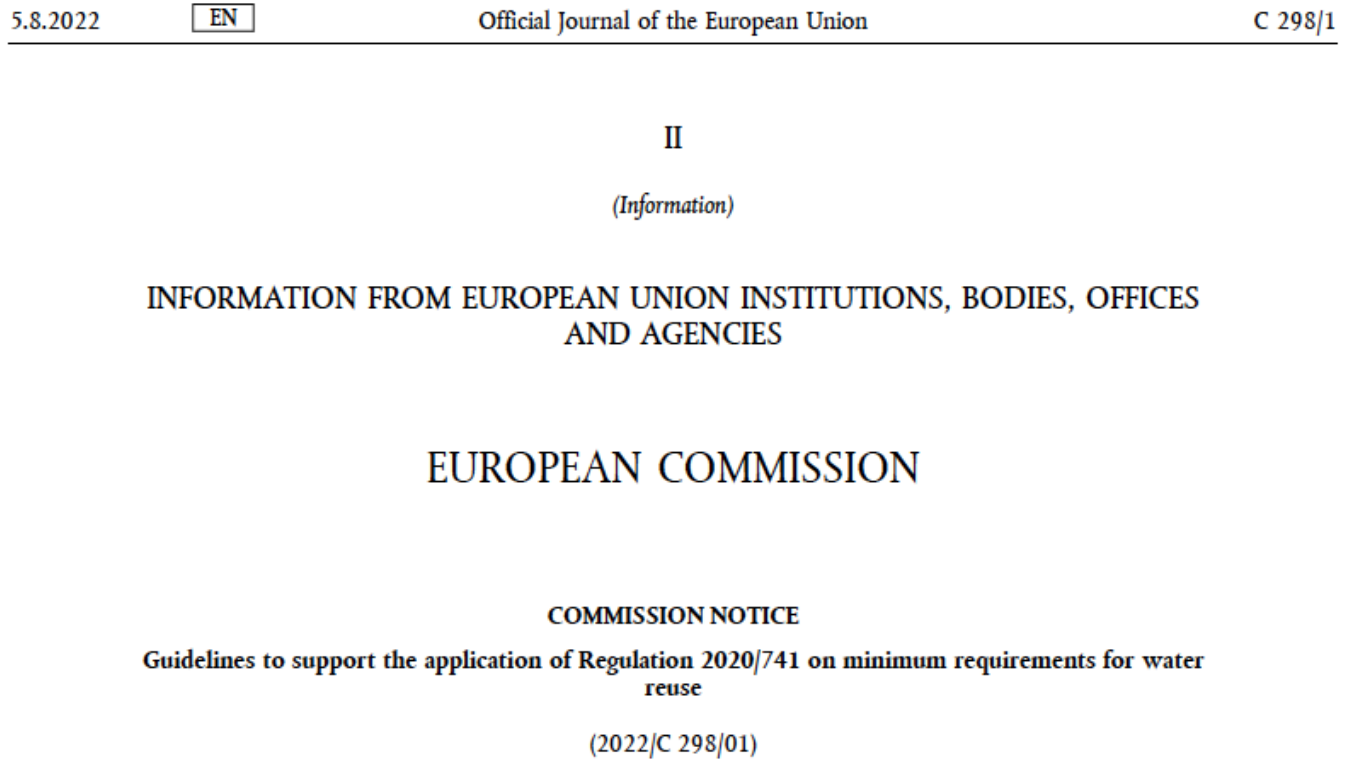
EFFECTIVE DATE: 26th JUNE, 2023

Focused only on irrigation for agricultural use

EVOLUTION OF THE LEGAL FRAMEWORK IN SPAIN



EUROPEAN REGULATION



5.8.2022 EN Official Journal of the European Union C 298/1

II

(Information)

INFORMATION FROM EUROPEAN UNION INSTITUTIONS, BODIES, OFFICES AND AGENCIES

EUROPEAN COMMISSION

COMMISSION NOTICE

Guidelines to support the application of Regulation 2020/741 on minimum requirements for water reuse

(2022/C 298/01)

Focused only on irrigation for agricultural use

Four water quality classes as a function of the crops.

Table 1 – Classes of reclaimed water quality and permitted agricultural use and irrigation method

Minimum reclaimed water quality class	Crop category (*)	Irrigation method
A	All food crops consumed raw where the edible part is in direct contact with reclaimed water and root crops consumed raw	All irrigation methods
B	Food crops consumed raw where the edible part is produced above ground and is not in direct contact with reclaimed water, processed food crops and non-food crops including crops used to feed milk- or meat-producing animals	All irrigation methods
C	Food crops consumed raw where the edible part is produced above ground and is not in direct contact with reclaimed water, processed food crops and non-food crops including crops used to feed milk- or meat-producing animals	Drip irrigation (**) or other irrigation method that avoids direct contact with the edible part of the crop
D	Industrial, energy and seeded crops	All irrigation methods (***)

(*) If the same type of irrigated crop falls under multiple categories of Table 1, the requirements of the most stringent category shall apply.

(**) Drip irrigation (also called trickle irrigation) is a micro-irrigation system capable of delivering water drops or tiny streams to the plants and involves dripping water onto the soil or directly under its surface at very low rates (2–20 litres/hour) from a system of small-diameter plastic pipes fitted with outlets called emitters or drippers.

(***) In the case of irrigation methods which imitate rain, special attention should be paid to the protection of the health of workers or bystanders. For this purpose, appropriate preventive measures shall be applied.

Table 2 Reclaimed water quality requirements for agricultural irrigation

Reclaimedwater quality class	Indicative technology target	Quality requirements				
		E. coli (number/100 ml)	BOD_5 (mg/l)	TSS (mg/l)g/l)	Turbidity (NTU)U)	Other
A	Secondary treatment, filtration, and disinfection	≤10	≤10	≤10	≤5	*Legionella* spp.: <1,000 cfu/l where there is risk of aerosolization
B	Secondary treatment, and disinfection	≤100	According to Council Directive 91/271/EEC[1] ((Annex I, Table 1)	According to Directive 91/271/EEC ((Annex I, Table 1)	-	Intestinal nematodes (helminth eggs): ≤1 egg/l for irrigation of pastures or forage
C	Secondary treatment, and disinfection	≤1,000			-	
D	Secondary treatment, and disinfection	≤10,000			-	

[1] Council Directive 91/271/EEC of 21 May 1991 concerning urban waste water treatment (OJ L 135, 30.5.1991, p. 40).

Four water quality classes as a function of the crops.

Validation of facilities for water quality class A

Water class A as a quality label

Table 4 – Validation monitoring of reclaimed water for agricultural irrigation

Reclaimed water quality class	Indicator microorganisms (*)	Performance targets for the treatment chain (log_{10} reduction)
A	*E. coli*	≥ 5,0
	Total coliphages/F-specific coliphages/somatic coliphages/coliphages (**)	≥ 6,0
	Clostridium perfringens spores/spore-forming sulfate-reducing bacteria (***)	≥ 4,0 (in case of *Clostridium perfringens* spores) ≥ 5,0 (in case of spore-forming sulfate-reducing bacteria)

(*) The reference pathogens *Campylobacter*, Rotavirus and *Cryptosporidium* may also be used for validation monitoring purposes instead of the proposed indicator microorganisms. The following log_{10} reduction performance targets shall then apply: *Campylobacter* (≥ 5,0), Rotavirus (≥ 6,0) and *Cryptosporidium* (≥ 5,0).

(**) Total coliphages is selected as the most appropriate viral indicator. However, if analysis of total coliphages is not feasible, at least one of them (F-specific or somatic coliphages) shall be analysed.

(***) *Clostridium perfringens* spores is selected as the most appropriate protozoa indicator. However, spore-forming sulfate-reducing bacteria are an alternative if the concentration of *Clostridium perfringens* spores does not make it possible to validate the requested log_{10} removal.

Methods of analysis for monitoring shall be validated and documented in accordance with EN ISO/IEC-17025 or other national or international standards that ensure an equivalent quality.

Risk assesment

Risk management shall comprise identifying and managing risks in a proactive way to ensure that reclaimed water is safely used and managed and that there is no risk to the **environment or to human or animal health.**

The risk assessment shall consist of the following elements:

(a) an assessment of risks to the environment, including all of the following:

(i) confirmation of the nature of the hazards, including, where relevant, the predicted no-effect level;

(ii) assessment of the potential range of exposure;

(iii) characterisation of the risks;

(b) an assessment of risks to human and animal health, including all of the following:

(i) confirmation of the nature of the hazards, including, where relevant, the dose-response relationship;

(ii) assessment of the potential range of dose or exposure;

(iii) characterisation of the risks.

Risk assesment

Risk management shall comprise identifying and managing risks in a proactive way to ensure that reclaimed water is safely used and managed and that there is no risk to the environment or to human or animal health.

(B) Conditions relating to the additional requirements

6. Consideration of requirements for water quality and monitoring that are additional to or stricter than those specified in Section 2 of Annex I, or both, when necessary and appropriate to ensure adequate protection of the environment and of human and animal health, in particular when there is clear scientific evidence that the risk originates from reclaimed water and not from other sources.

   Depending on the outcome of the risk assessment referred to in point 5, such additional requirements may in particular concern:

   (a) heavy metals;

   (b) pesticides;

   (c) disinfection by-products;

   (d) pharmaceuticals;

   (e) other substances of emerging concern, including micro pollutants and micro plastics;

   (f) anti-microbial resistance.

Risk assesment

Risk management shall comprise identifying and managing risks in a proactive way to ensure that reclaimed water is safely used and managed and that there is no risk to the environment or to human or animal health.

(C) Preventive measures

7. Identification of preventive measures that are already in place or that should be taken to limit risks so that all identified risks can be adequately managed. Special attention shall be paid to water bodies used for the abstraction of water intended for human consumption and relevant safeguard zones.

Such preventive measures may include:

(a) access control;

(b) additional disinfection or pollutant removal measures;

(c) specific irrigation technology mitigating the risk of aerosol formation (e.g. drip irrigation);

(d) specific requirements for sprinkler irrigation (e.g. maximum wind speed, distances between sprinkler and sensitive areas);

NEW NEEDS IN REGENERATION PROCESSES

CONVENTIONAL WATER REGENERATION TREATMENTS ARE NOT EFFECTIVE IN REMOVING PERSISTENT MICROPOLLUTANTS

ROUTINE ANALYTICAL METHODS CANNOT ASSESS ALL THE MICROPOLLUTANT AND THEIR EFFECTS

Advanced Biological Treatment Processes (i.e. MBR)
Advanced Oxidation Processes
Advanced Analytical Techniques
Techniques for Toxicity Assessment
Chronic and acute

GROWING CONCERN ABOUT THE FATE AND EFFECTS OF EMERGING POLLUTANTS AND MICROPOLLUTANTS

ELSEVIER

Water Research

Volume 101, 15 September 2016, Pages 157-166

Pilot-scale UV/H_2O_2 advanced oxidation process for municipal reuse water: Assessing micropollutant degradation and estrogenic impacts on goldfish (*Carassius auratus* L.)

Environmental Science and Pollution Research

January 2017, Volume 24, Issue 2, pp 1093–1104

Ecotoxicity evaluation of a WWTP effluent treated by solar photo-Fenton at neutral pH in a raceway pond reactor

Authors Authors and affiliations

A. M. Freitas, G. Rivas, M. C. Campos-Mañas, J. L. Casas López, A. Agüera, J. A. Sánchez Pérez

WATER QUALITY

FRESHWATER

DOMESTIC AND COMMERCIAL USE

USE INDUSTRIAL

AGRICULTURAL USE

RECLAIM TREATMENT

WATER QUALITY ASSESSMENT

THE SPANISH REGULATION HAS BEEN ADAPTED TO THE NEW EU REGULATION

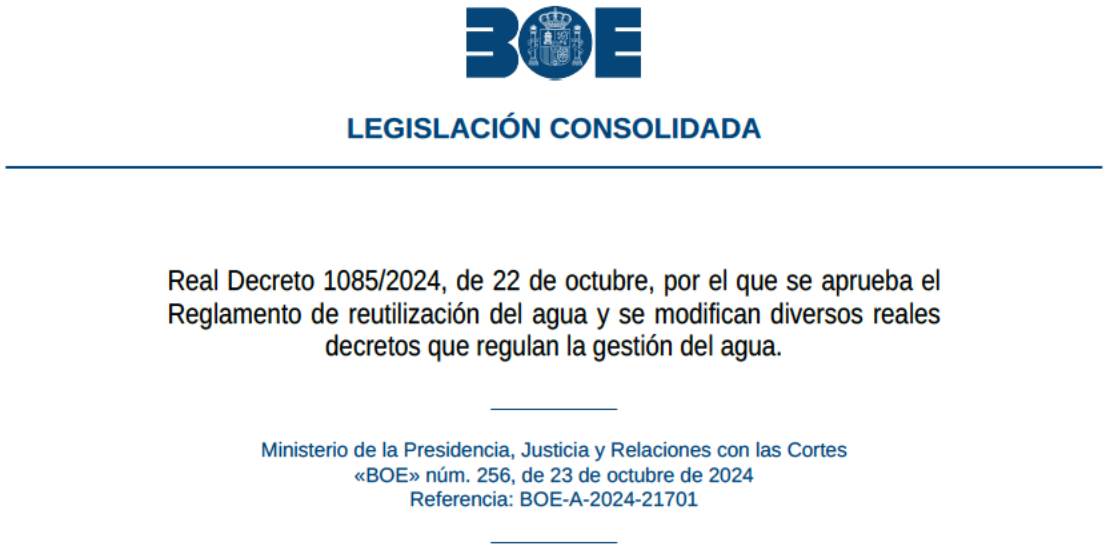
BOE

LEGISLACIÓN CONSOLIDADA

Real Decreto 1085/2024, de 22 de octubre, por el que se aprueba el Reglamento de reutilización del agua y se modifican diversos reales decretos que regulan la gestión del agua.

Ministerio de la Presidencia, Justicia y Relaciones con las Cortes
«BOE» núm. 256, de 23 de octubre de 2024
Referencia: BOE-A-2024-21701

EFFECTIVE DATE: 24th OCTOBER, 2023



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RD 1085/2024 represents a necessary evolution in the water reuse regulations in Spain, not only updating it to current times, but also aligning it with European standards and emphasizing sustainability.

For companies and professionals in the sector, knowing and adapting to these differences is crucial to meet current and future demands in terms of water resource management.

Main new features with respect to RD 1620/2007:

It distinguishes between **"the activity of regeneration of wastewater"** (production and supply) and **"the private use"** that can be made of reclaimed water (concession).

Production and supply: introduces the figures of the **"operator of the regeneration station"**, the **"operator of the storage and/or distribution infrastructures"** and the **"point of compliance of the regerated water".**

Changes in quality classes, quality requirements and control programmes. **(A+ for Food Industry aplicattions)**

The obligation of **"validation of the ERAR" is established for Class A for Agricultural Use**: direct contact of water with food and for tubers that are consumed raw. Exempt ERARs in operation before June 25, 2020.

The figure of the **Risk Management Plan** is introduced.

Adaptation schedule and sending of information

Royal Decree 1085/2024 defines clear deadlines for adapting to the new requirements and sending information related to water reuse. The key dates are:

31ST December 2025: Authorities and users will have to send data on water reuse to the Directorate-General for Water, which **will publish this information in the Observatory of Water Management in Spain.**

26TH June 2026: The Directorate-General for Water will submit to the European Commission an updated report on the situation of water reuse in the country, **with updates every six years.**

31ST December 2028: Facilities that produce and supply reclaimed water will have **to comply with the new quality requirements.**

CONCLUSIONS

- The **reuse of water in Europe, Spain and especially in Almeria is not an option is a NECESSARY**. The range of improvements in the current situation is very wide.
- Spain, with the **RD1620/2007**, has been at the **forefront of European legislation,** which has been in force **for the last 17 years.**
- The European Union, through the new **regulation (EUR2020/741)**, wants to **harmonise and regulate the re-use activity throughout the European Union.**
- The **new regulation implies** that we need to be **technologically prepared** for the new limits in terms of **disinfection and the elimination of pollutants of emerging concern.**
- **RD 1085/2024 represents a necessary evolution in the water reuse regulations in Spain**, not only updating it to current times, but also aligning it with European standards and emphasizing sustainability.
- **Advanced Oxidation Processes are postulated as an alternative solution for disinfection and elimination of micropollutants in water reuse.**

PUREAGROH2O

Ευχαριστώ πολύ!!

CIESOL
CENTRO DE INVESTIGACIÓN EN ENERGÍA SOLAR
CENTRO MIXTO UAL - PSA CIEMAT

J.L. Casas López
email: joseluis.casas@ual.es

WATER TREATMENT GROUP

Elizabeth Gualda
Solaima Belachqer
Daniel Rodríguez
Paula Soriano
Guadalupe Pinna
Nerea López
José L García
José L Guzmán
José A Sánchez
José L Casas