Pioneering collaboration for industrial water circularity

Principality of Asturias

Reducing Fresh Water use: From municipal wastewater to make up water for industry

July 15, 2025

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3 P's

Purpose

Share sustainability industrial water ambitions for the Principality of Asturias, throughout use of reclaimed municipal wastewater to replace its freshwater consumption

Process

- Start with pioneering collaboration between Principality of Asturias and water circularity ambitions for industry
- Share the needs to adapt this innovative solution for chemical, metallurgy and green hydrogen industries

Products

- This partnership has produced a replicable model that will not only deliver significant benefits to Principality of Asturias but will also support municipalities across Europe that face similar challenges
- Learn more on Reclaimed Water Project invested in Europe

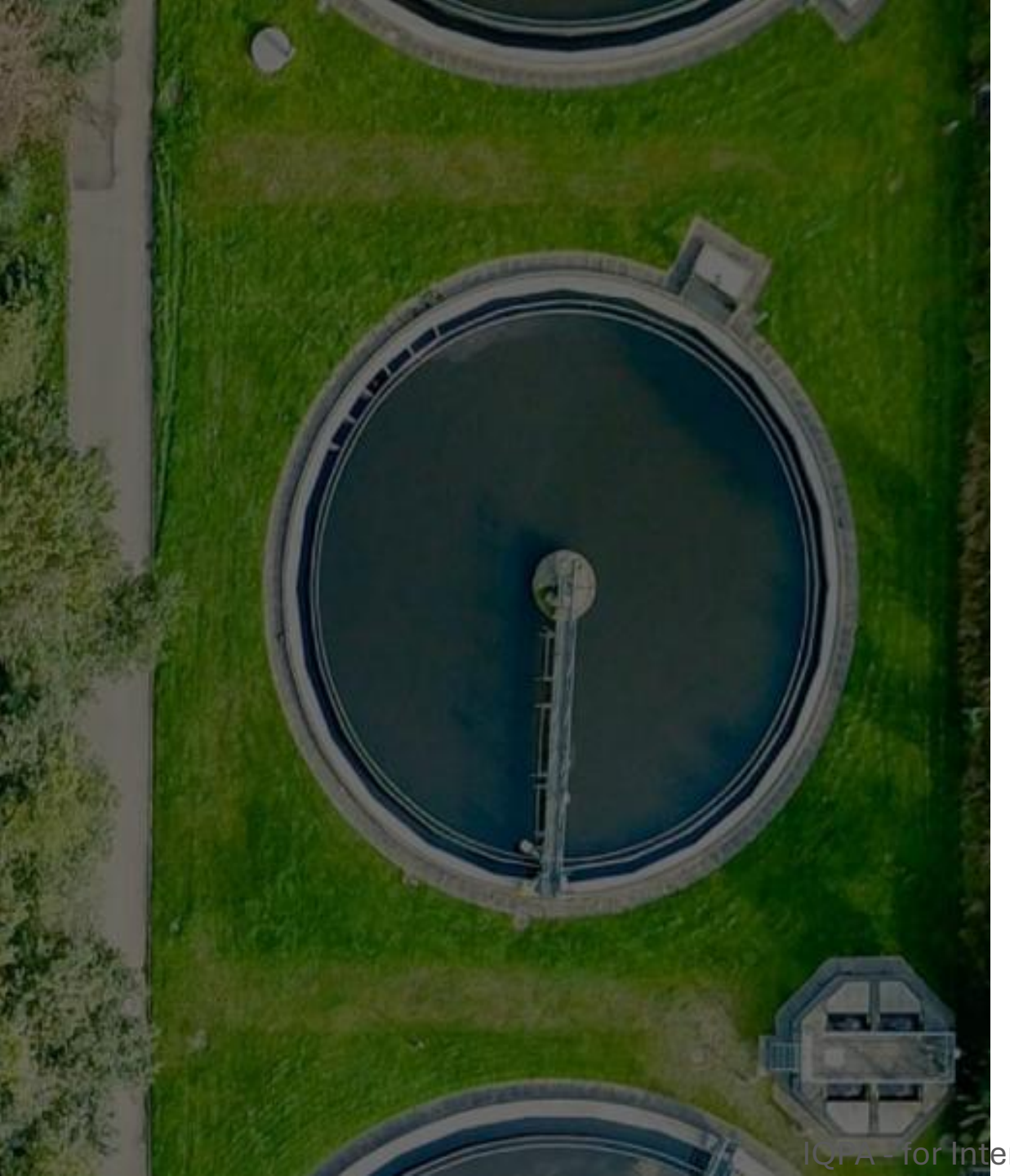

Table of Contents

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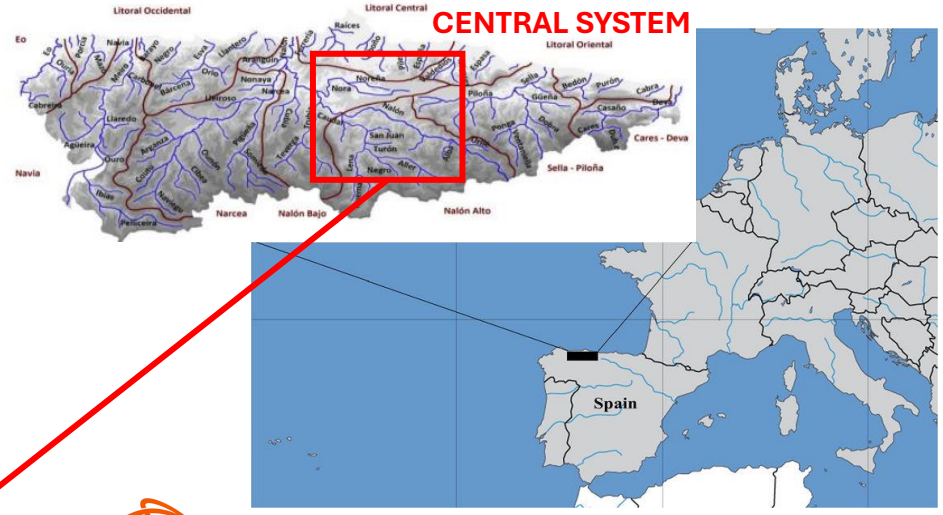
- Freshwater Supply to Industry
- Water Strategy
- Project: Reclaimed Water in Industry
  - ✓ Objectives
  - ✓ Quality
  - ✓ Uses
- Summary Highlights

Freshwater to Industry



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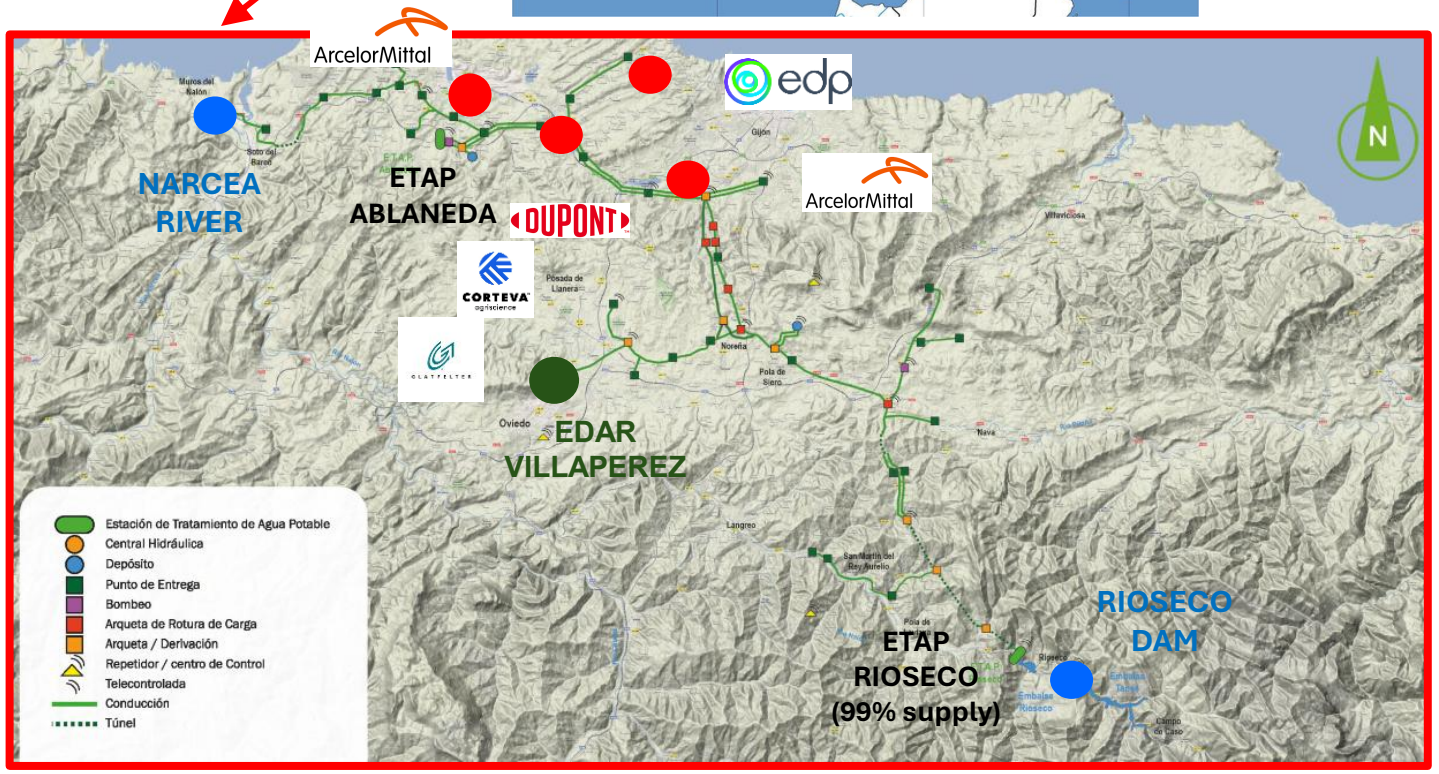
Central System

≈ 51,00 Hm³/year (max 57,08)

30 % volume to Industry

- In 2021, industrial users in the Asturias region of Spain accounted for 29.5% of all freshwater consumption (295.3 hm³)
- while also producing 135.3 hm³ of wastewater; a mere 3% of this wastewater was recycled



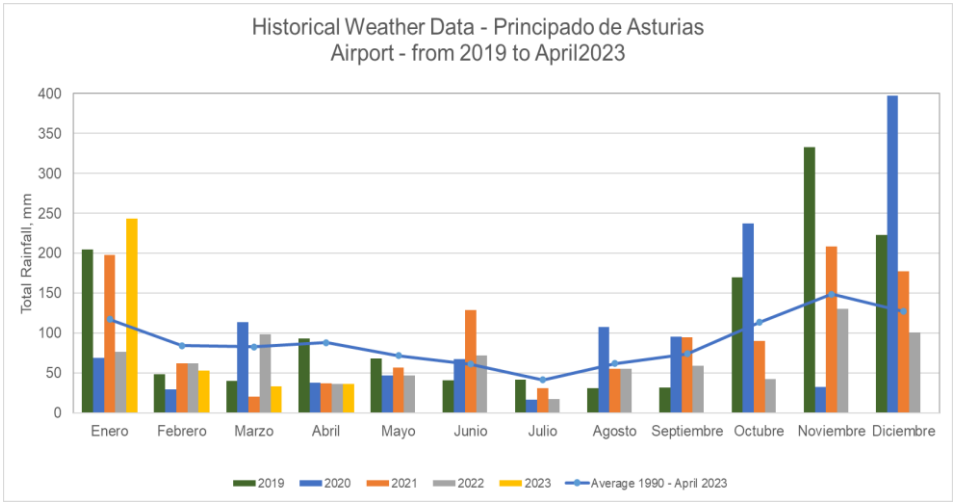
Main distribution network to industry from CADASA

NOTE: Not included local and own supply networks

Strategic Response to Climate Change

- **Small basins**, short channels with large slopes
- **Low snowfall**, short melting periods
- Flows with great monthly **variability** (absence of regulation)
- The main resource is **surface water** (rivers/reservoirs). Increase the number of reservoirs will add significant **cost and environmental impacts**
- Summer temperature produces **strong evaporation**

- 50% of the months **rained 50% less**
- **Irregular** distribution
- **Reduction of 10%-19% of annual average rainfall** compared to the current one is expected in the next 100 years (AEMET)



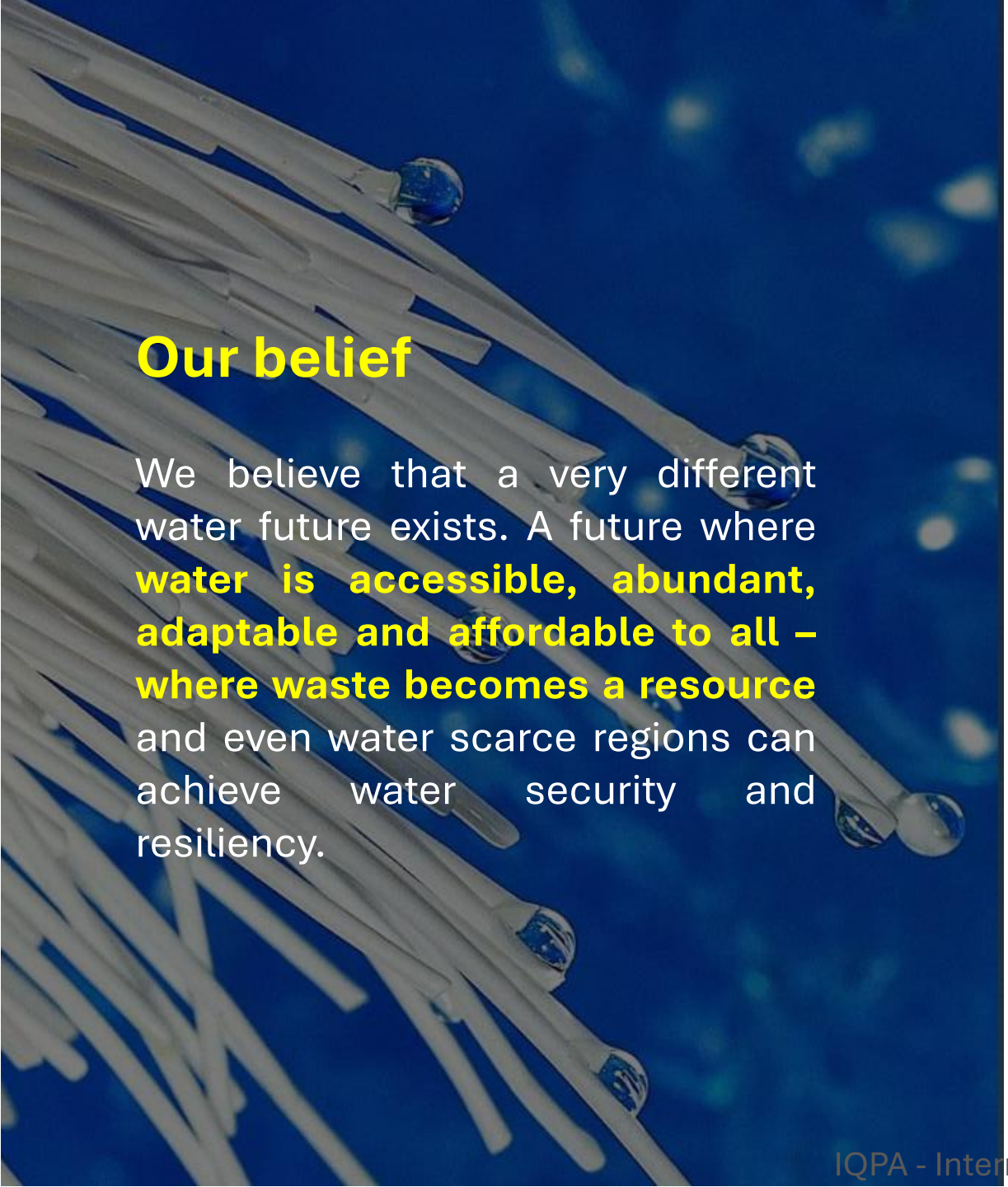
Planning and Regulations Reclaimed Water for Industry

CIRCULAR ECONOMY STRATEGY - SPAIN 2030
✓Increase water use efficiency by 10%

CIRCULAR ECONOMY STRATEGY - PRINCIPALITY of ASTURIAS 2030
✓Program reclaimed water for industry

HYDROLOGICAL PLANNING > PLAN DIRECTOR ABASTECIMIENTO AGUAS - PRINCIPALITY of ASTURIAS 2030
✓01.04 Recycled municipal wastewater

ROYAL DECREE 1085/2024 October 22– SPAIN
✓Regulations on recycled wastewater reuse



Our belief

We believe that a very different water future exists. A future where **water is accessible, abundant, adaptable and affordable to all – where waste becomes a resource** and even water scarce regions can achieve water security and resiliency.

Our Water Strategy

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- **Leadership** in water stewardship
- Reduce water consumption with **circular solutions,** using advanced water treatment and reuse efficiency technologies
- Replace freshwater with **reclaimed municipal wastewater**
- Demonstrate **best available technologies** to identify and repair water losses
- Implement **international water standards** that drives, recognizes and rewards good water stewardship performance
- **Digitalization** of water distribution systems
- Strategic **partnerships** with administration and Industry

Benefits of reclaimed water for industrial uses

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Double impact: reduced freshwater make-up and reduced water discharge

Circular Economy Solution for Scarce freshwater country

Fit-for Purpose
Human Health
Environmental Protection
Ensuring Supply

Breakthrough Collaboration to tackle the problem

- Principality of Asturias-DG Water
- Cluster IQPA
- ArcelorMittal
- DuPont
- edp
- Water Technology Experts

Reclaimed water for cooling, processing, washing, and other industrial processes

- Sustainability Development goals, **6 & 17**
- Operational Resilience, reliable **supply to industry** (not for human use)
- **Stability** in the levels of all parameters
- **Microbiological** and chemical monitoring and regulation
- **Reduce freshwater** demand
- Environmental protection, **reduce wastewater** discharge
- **Reduce chemical** needed
- **Cost savings** associated with make up water and treating, improving **competitiveness of the industry**
- **Reduced environmental footprint,** minimizing freshwater consumption and wastewater discharge

Reclaimed Water Quality

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Reclaimed Water Regulations for Industrial Uses

Industrial Use (Excluded Food Industry)	E. Coli (UFC/100mL)	Turbidity (NTU)	SS (mg/L)	Legionella spp. (UFC/L)	Contaminants (Pollutant Discharge Limits)
Quality I. A+	0	5	10	0	Permit Limits
RD 1085/2024-oct 22 RD 1620/2007-dic 07				RD 487/2022-Jun 21	RD 817/2015-sep 11 RD 1514/2009-oct 02

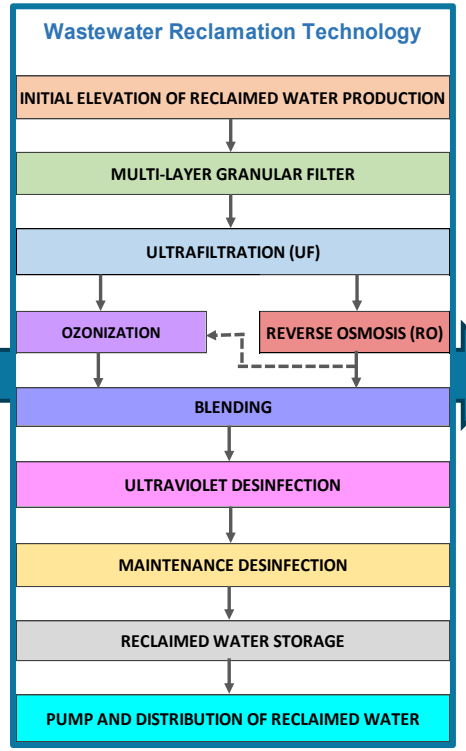
Chemical, Metallurgical and Green Hydrogen Industries define limits of 45 chemical parameters of reclaimed water

Freshwater Central Network (Dam and River)

Parameter	Unit	Current Supply to Industry
Conductivity @20ºC	µS/cm	192
Turbidity	NTU	0,8
pH @22+/2ºC		7,5 - 8
Nitrates	mg NO3/L	4
Chemical Oxygen Demand (COD)	mg/L	5
Phosphates	mg PO43-/L	0,2
Total Dissolved Solids (TDS)@105ºC	mg/L	
Suspended Solids (SS)	mg/L	5
Chloride	mg CL-/L	10
Free Chlorine	mg CL2/L	<0,5
Total Chlorine		
Sulphate	SO42-/L	9
Calcium Hardness	Mg Ca/L	80
Total Alkalinity @pH4.5	mg HCO3/L	98
Sodium	mg Na+/L	2,5
Dissolved Silica	mg SiO2/L	3
Zinc	µg Zn/L	22
Iron	µgFe/L	30
Intestinal Nematodes	*huevo/10L*	*0*
Taenia saginata	*huevo/10L*	*0*
Taenia solium	*huevo/10L*	*0*
Total Coliforms	*NMP/100ml*	*0*
Fecal Coliforms	*UFC/100ml*	*0*
Fecal Streptococci	*UFC/100ml*	*0*
Salmonella	*UFC/100ml*	*0*
Escherichia Coli	*UFC/100ml*	*0*
Legionella spp	*UFC/L*	*0*

Reclaimed Water for Industrial Processes (Municipal Wastewater)

Parameter	Unit	Municipal Wastewater	Required Industry
Conductivity @20ºC	µS/cm	696	192
Turbidity	NTU	0,70	0,7
pH @22+/2ºC		7,6	7,3 - 8
Nitrates	mg NO3/L	26,60	2,4
Chemical Oxygen Demand (COD)	mg/L	15,00	5
Phosphates	mg PO43-/L	0,53	0,2
Total Dissolved Solids (TDS)@105ºC	mg/L	406,00	163
Suspended Solids (SS)	mg/L	0,00	5
Chloride	mg CL-/L	61,00	10
Free Chlorine	mg CL2/L	0,00	< 0,05
Total Chlorine			
Sulphate	SO42-/L	60,00	9
Calcium Hardness	mg Ca/L	61,85	80
Total Alkalinity @pH4.5	mg HCO3/L		70
Sodium	mg Na+/L	57,00	2,5
Dissolved Silica	mg SiO2/L	5,12	2,3
Zinc	µg Zn/L	35,00	22
Iron	µgFe/L	460,00	28
Intestinal Nematodes	*huevo/10L*		*0*
Taenia saginata	*huevo/10L*		*0*
Taenia solium	*huevo/10L*		*0*
Total Coliforms	*NMP/100ml*		*0*
Fecal Coliforms	*UFC/100ml*		*0*
Fecal Streptococci	*UFC/100ml*		*0*
Salmonella	*UFC/100ml*		*0*
Escherichia Coli	*UFC/100ml*		*0*
Legionella spp	*UFC/L*		*0*



Parameter	Unit	Reclaimed Water (UF 27%-RO 73%)
Conductivity @20ºC	µS/cm	203
Turbidity	NTU	0,03
pH @22+/2ºC		
Nitrates	mg NO3/L	7,55
Chemical Oxygen Demand (COD)	mg/L	4,27
Phosphates	mg PO43-/L	0,14
Total Dissolved Solids (TDS)@105ºC	mg/L	116,19
Suspended Solids (SS)	mg/L	
Chloride	mg CL-/L	17,35
Free Chlorine	mg CL2/L	
Total Chlorine		
Sulphate	SO42-/L	17,08
Calcium Hardness	mg Ca/L	
Total Alkalinity @pH4.5	mg HCO3/L	
Sodium	mg Na+/L	16,19
Dissolved Silica	mg SiO2/L	1,46
Zinc	µg Zn/L	9,96
Iron	µgFe/L	130,92
Intestinal Nematodes	*huevo/10L*	*0*
Taenia saginata	*huevo/10L*	*0*
Taenia solium	*huevo/10L*	*0*
Total Coliforms	*NMP/100ml*	*0*
Fecal Coliforms	*UFC/100ml*	*0*
Fecal Streptococci	*UFC/100ml*	*0*
Salmonella	*UFC/100ml*	*0*
Escherichia Coli	*UFC/100ml*	*0*
Legionella spp	*UFC/L*	*0*

Reclaimed Water for Industrial Uses

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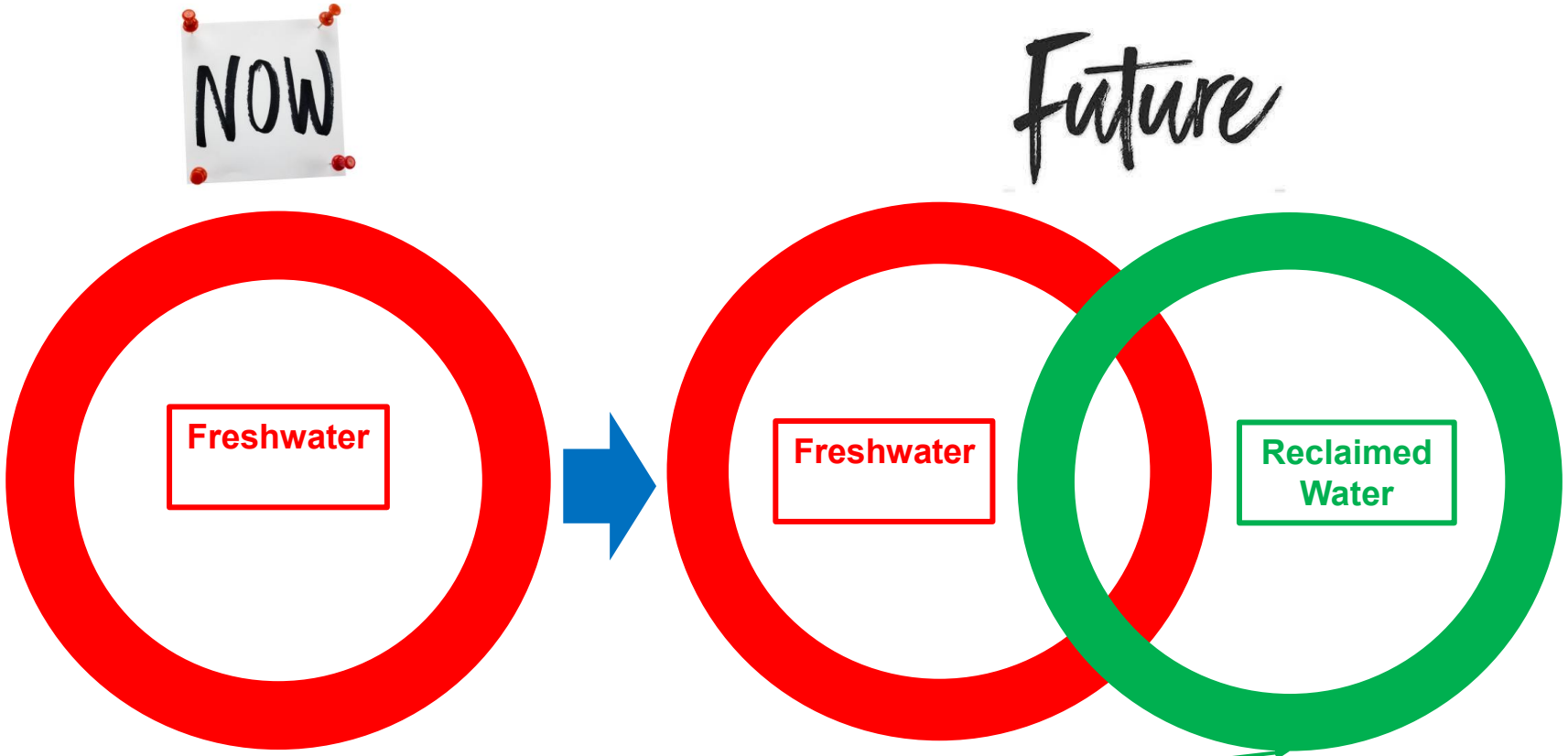
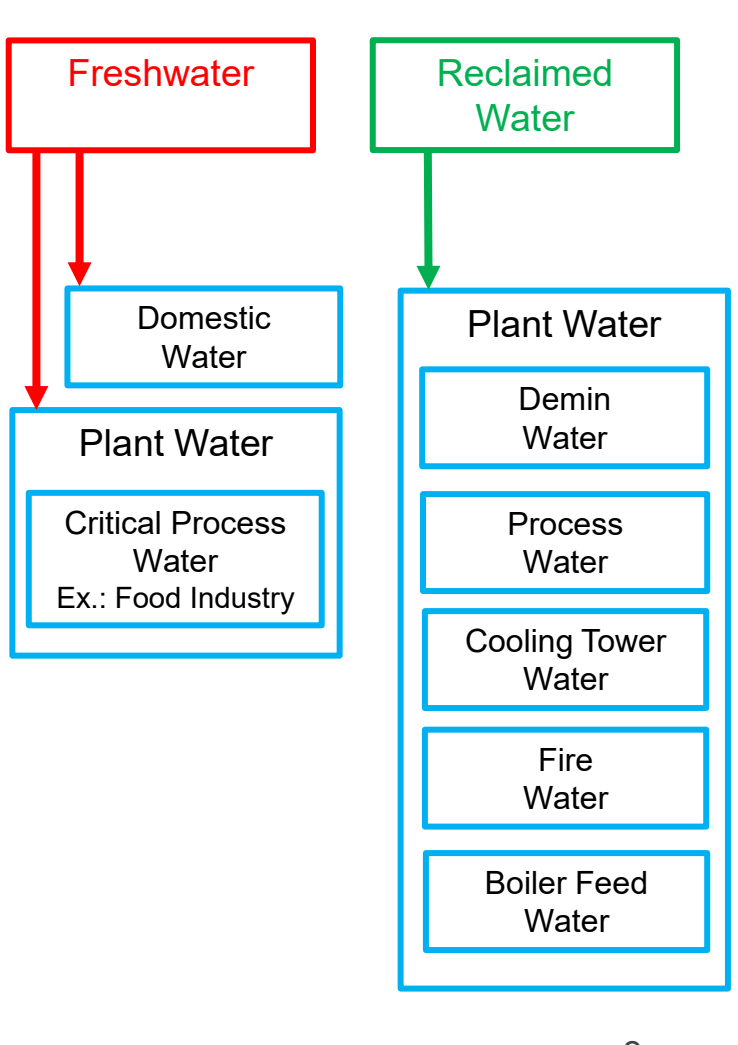
From ONE Network to TWO networks





Flow rate of 17.280,00 m³/d (phase I) / 21.600 m3/d (Phase II). Target Conductivity: 200,00 µS/cm

- Ultrafiltration (27 %). 4.600,00 m³/d. Conductivity 696,00 µS/cm
- Reverse Osmosis (73 %). 12.675,00 m³/d. Conductivity 20,00 µS/cm

Summary Highlights

Small changes in technology of critical resources could change the future of nations

- **Clear project purpose among all parties**: response to climate change, freshwater security, environmental footprint
- **Learn from previous experiences**: municipal wastewater for petrochemical industry in Tarragona, Spain
- **Integrate reclaimed water in hydrological plans**: availability versus demand
- **Administration-Industry collaboration**: management model, safe water, people awareness
- **Define water quality for industrial uses**: end user needs, state of the art technologies
- **Risk Analysis of potential hazards:** focusing on human health, environmental impact and ensuring supply
- **Total cost**: reclaimed water cost, cost of operation and investment needed