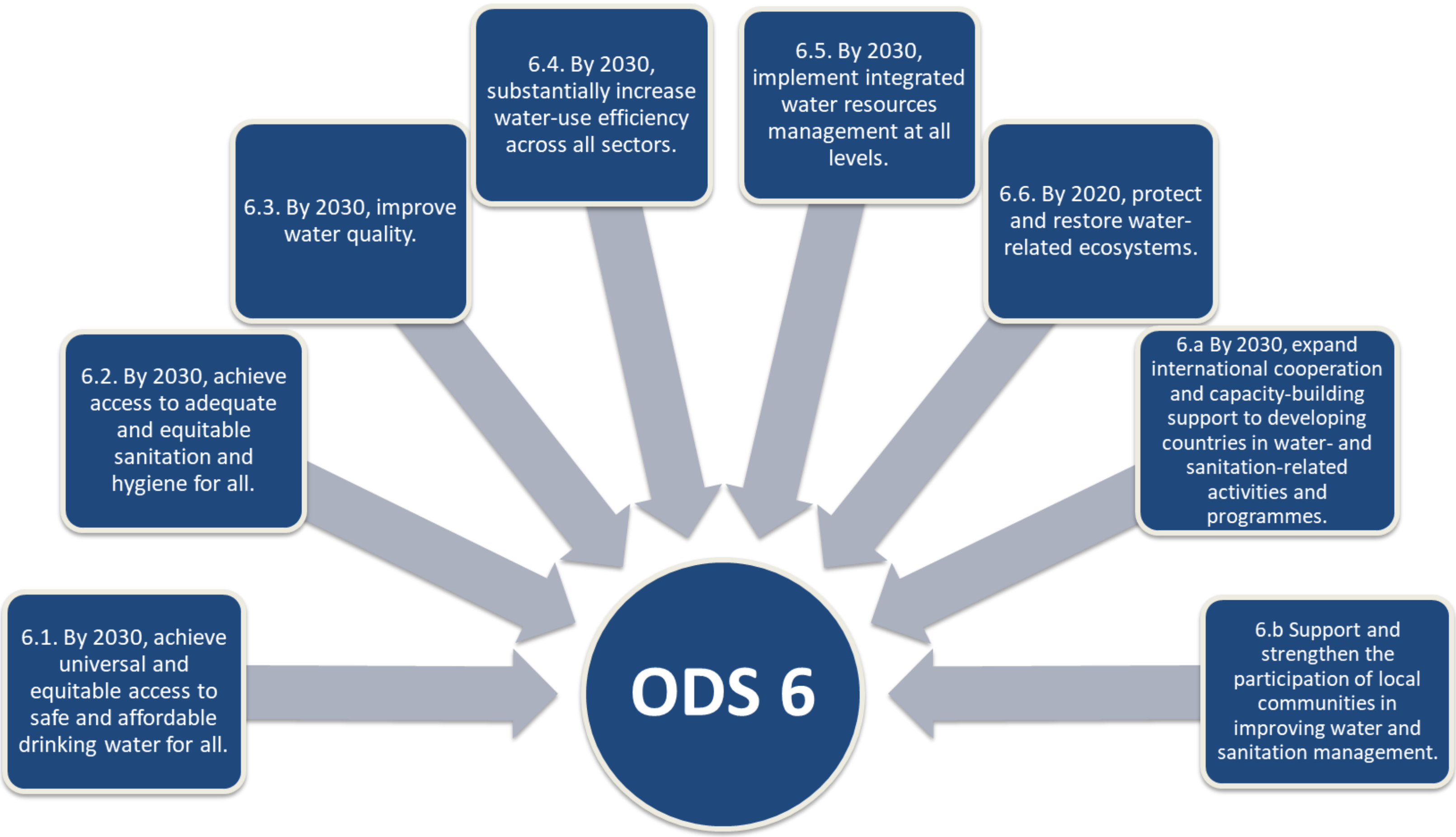
Challenges for Engineering: Contribution to SDG6-Water

Tomás A. Sancho| Paris, 7th March 2018

Sustainable Development Goals (ODS)

ODS 6 – Clean water and sanitation



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WCCE WORLD COUNCIL OF CIVIL ENGINEERS

SDG 6 and other SDGs

Goal 6 related other targets

Goal 3

3.3 End water borne diseases

Goal 3

3.9 Reduce the number of deaths and ilinesses from water

Goal 11

11.4 Significantly reduce the number of deaths and the number of affected people and economic losses due to water dissters

Goal 12

12.4 Sound management of Waste to resuce release in to water

Goal 15

15.1 Ensure conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services

Goal 15

15.8 Introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems

ODS 6 background

- United Nations Conference on the Human Environment (1972);
- United Nations Water Conference (1977);
- International Drinking Water Supply and Sanitation Decade (1981-1990);
- International Conference on Water and the Environment (1992);
- The Earth Summit (1992, 2002);
- Millenium Summit (2000);
- United Nations Conference on Sustainable Development, Rio+20 (2012);

INTRODUCTION

- Human settlements have been usually established **disregarding the water supplies** and taking into account other issues: geostrategic or defendant positions, weather, communications, commercial routes, etc.
- Water supply has to be **adapted** to these contingencies and get a compromise with the environment. **Engineering** is essential to overcome this problems.
- This requires, not only the design and construction of infrastructures, but also a multidisciplinary approach for **planning and management** to keep high standard levels.
- Rising stress on water resources requires a **redefinition** of the world wide **paradigm**: water is not an infinite resource.

CHANGE OF PARADIGM

XX CENTURY

- Unlimited Water resource
- Quantity
- New infrastructures to satisfy demand
- Government responsibility
- Certainty (predictable situation)
- Public subsidies for development of works
- Local solutions
- Local concern

XXI CENTURY

- Water scarcity and stress on resource
- IWRM: Basin, Quality and quantity, superficial & ground water, supply & demand
- Water stewardship
- Master planning
- Sustainable development
- Uncertainty and risk management
- Adaptation to climate change
- Give the right economical signals (cost recovery, environmental & resource costs, universal access to service)
- Regional solutions
- Global concern

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Situation in 2015

- **In 2015, 844 million people lack even a basic drinking-water service.**
- **2.3 billion people still do not have basic sanitation facilities.**
- **Access to drinking water is actually deteriorating in developing countries where the most rapid urbanization is outpacing public services.**
- **The situation is worse in sub-Saharan Africa: the percentage of people served by piped water decreased from 42% to 34%**

Source: World Bank

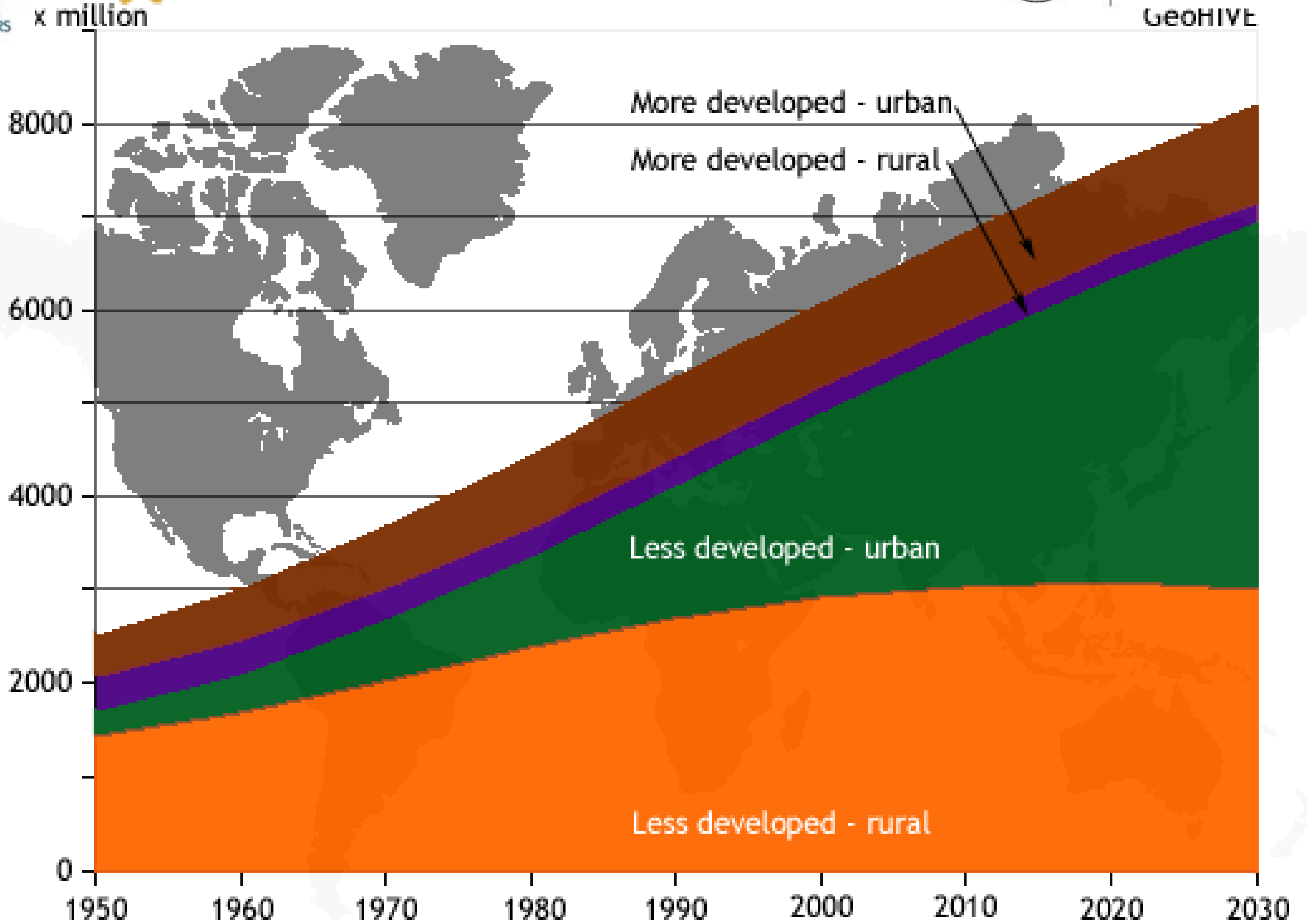
INTRODUCTION: CHALLENGES AND SOLUTIONS

CHALLENGES:

- Exponential growth of the world population, demanding greater need for food production
- Concentration of population in cities
- Increase in living standards, resulting in a larger water consumption per person
- CC: Increasing Spatial and temporal irregularity of water resource

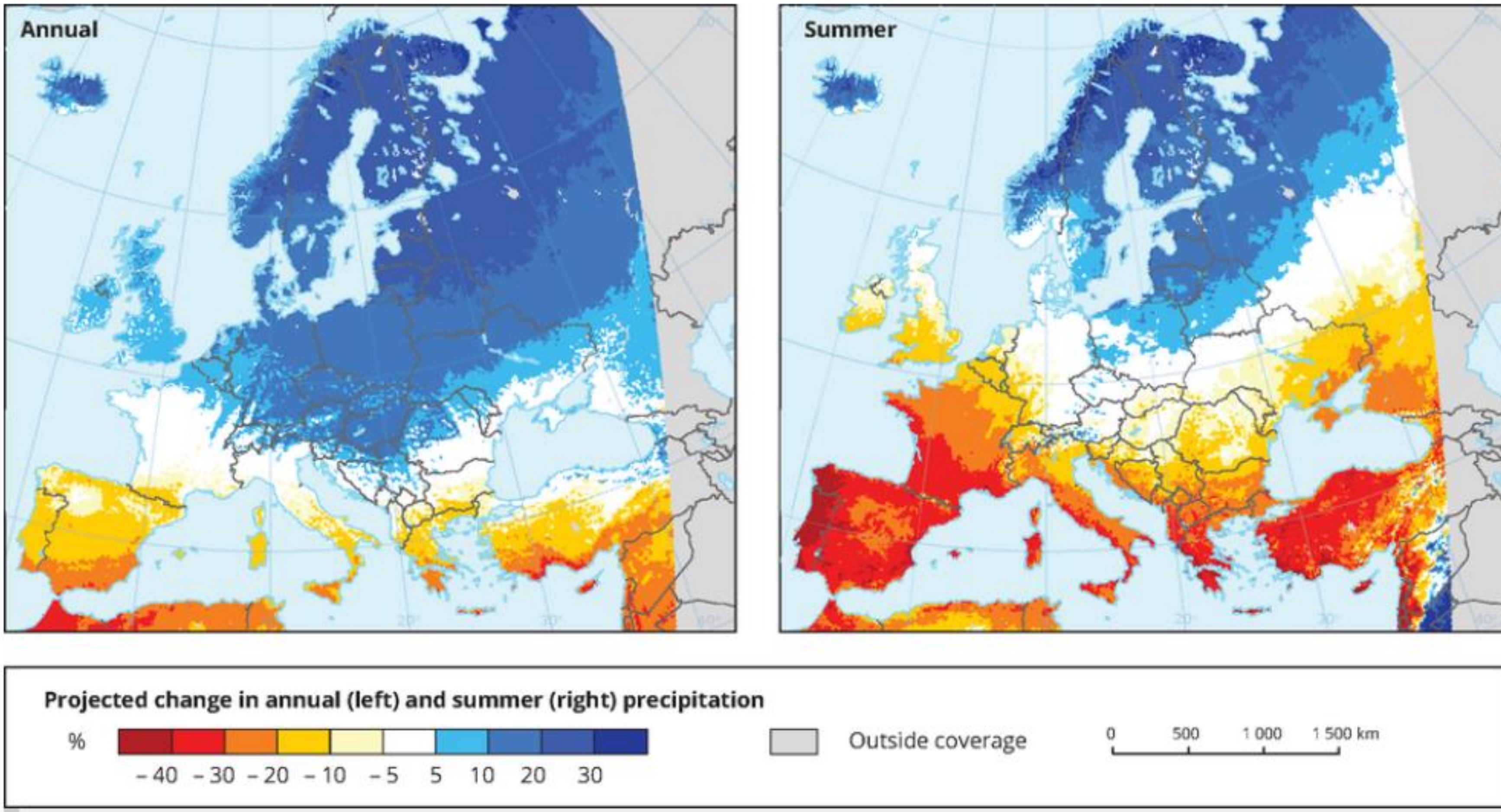
SOLUTIONS from ENGINEERING:

- Successful known experiences
- Research for new possibilities



Urban/rural population for less and more developed regions

Climate change impact on precipitation



Source: European Environmental Agency

Portuguese experience

Legislation

- Lei da Água 2005 (Water Framework Directive 2000)

Planning

- Plano Estratégico de Abastecimento de Água e Saneamento de Águas Residuais
- Plano Nacional da Água (PNA)
- Planos de Gestão de Região Hidrográfica
- Planos Específicos de Gestão de Águas
- Programa Nacional para o Uso Eficiente da Água 2020

Risk

- Estratégia Nacional para Adaptação às Alterações Climáticas
- Programa de Vigilância e Alerta de Recursos e o Sistema Nacional de Informação e Recursos Hídricos, que permite efetuar a gestão de situações de risco (cheias e poluição da água).

Internacional Conventions

- Convenção de Albufeira (1998) and former conventions (1968, 1960, …)

Spanish experience

The Water Governance System of Spain

two thousand years of safe and efficient planning and management of water resources

Spain's hydrology, in figures	
Surface area	509.000 km²
Average annual precipitation	649 mm
Average annual precipitation Vigo (Northwest Spain)	1.909 mm
Average annual precipitation Almería (Southeast Spain)	196 mm
Average annual runoff	220 mm
Average annual runoff of the Cantabrian coast (Northern Spain)	700 mm/year
Average annual runoff of the Segura district (Southeast Spain)	<50 mm

SPAIN CASE OF STUDY: SPANISH WATER "BUILDING":

- RICH HISTORY AND HERITAGE ON WATER
- REALITY MARKS: DEEP SPACE AND TEMPORARY IRREGULARITY IN WATER AVAILABILITY
- WATER ALWAYS HAS BEEN "AFFAIR OF STATE"
- FOUNDATIONS ON 19th CENTURY, STRUCTURE OF 20th CENTURY
- EXTENSION OF THE BUILDING IN LAST THIRD 20th CENTURY
- IT HAS SURVIVED DIVERSE POLITICAL REGIMES AND IT HAS ENJOYED ACCEPTANCE AND SOCIAL SUPPORT

SPANISH WATER "BUILDING":

- **MANTAINING THE PILLARS ABLE TO SUPPORT IT:**

✓ **LEGAL CERTAINTY**
✓ **RIVER BASIN AUTHORITY**
✓ **USERS' CORPORATIONS**
✓ **PARTICIPATORY MANAGEMENT**
✓ **HYDROLOGICAL PLANNING**
✓ **TECHNICAL AND SCIENTIFIC KNOWLEDGE**
✓ **INVESTMENT IN HYDRAULIC INFRASTRUCTURES**

Spain's **long history of dam construction is well known**. This construction process began in Roman times (the Inventory of Great Dams began with the Cornalbo and Proserpina dams in the 2nd century AD) and has been marked by technological milestones, such as the Almansa arch dam, whose origins remain unknown, and many others (Elche, Elda, Ontigola, Relleu, Alcantarilla, Gasco,...), without leaving out Spain's activity in its overseas colonies. It is important to note that the construction of dams and irrigation land extended from Mexico to Texas and California, as demonstrated by the small dams constructed around San Antonio, and El Molino and La Misión, near San Diego and Los Angeles, respectively.

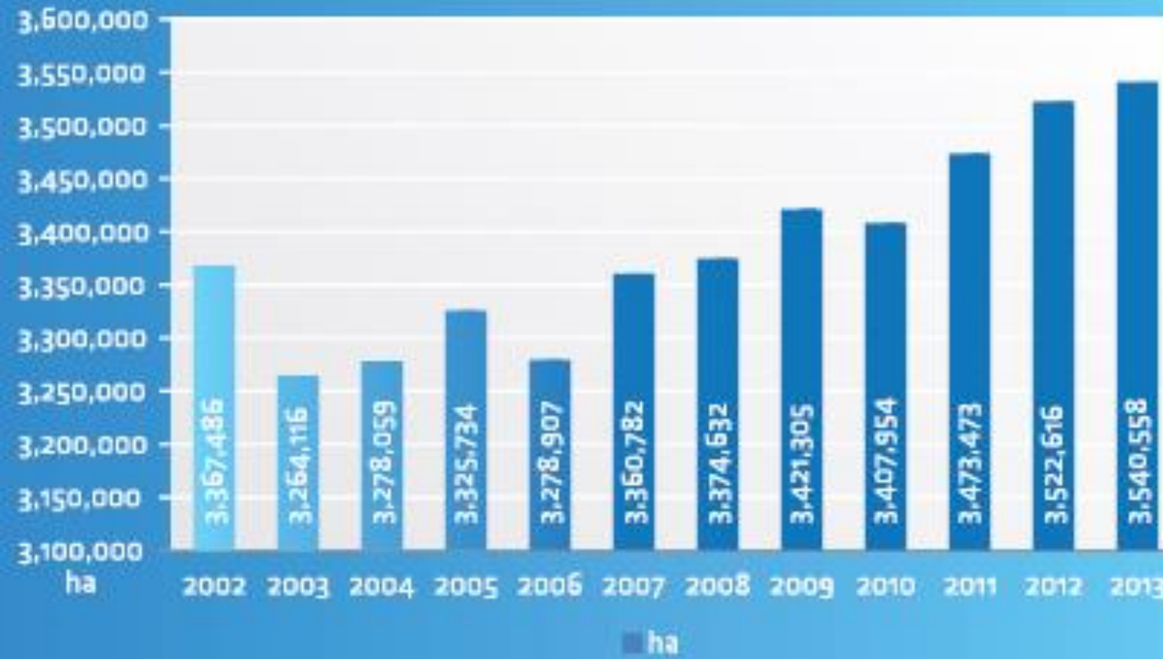
Guaranteeing the availability of water in sufficient quantities and with adequate quality, will be one of the principal problems for the planet that will have to be solved in this century. More efficient use of the resource is achieved through savings techniques, management of demand, of reuse, of combined use of surface and groundwater, etc., and the use of unconventional techniques (desalination) are increasingly among the preferred courses of action for the management of this resource, which is as scarce as it is prized. However, the construction of new dams will undoubtedly continue to be necessary, along with the optimization of the operations of existing reservoirs.

In this sense, **the harmonization of these infrastructures with the environment**, as well as adequate levels of safety will be aspects that are increasingly demanded by society.

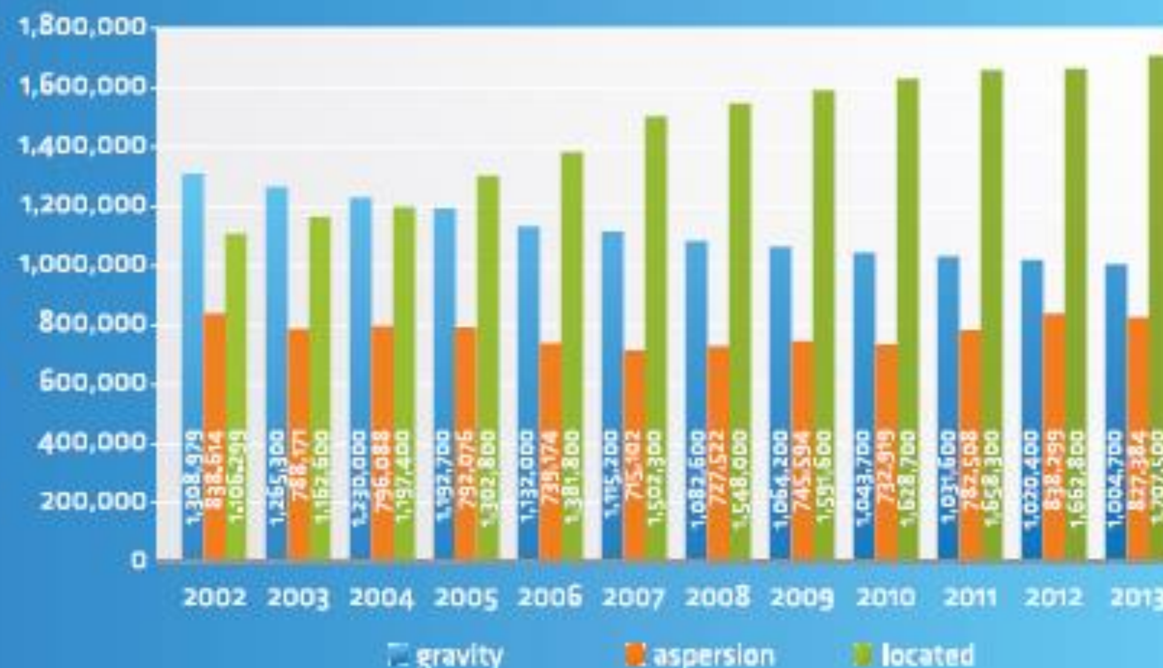
As a result of the long-standing dam-construction activity in Spain, the number of reservoirs has increased considerably, in addition to the age of a large number of them.

There are currently more than 1,200 dams with an approximate capacity of 56,000 hm^3. Of these, 450 were constructed prior to 1960, and more than 100 before 1915.

EVOLUTION OF TOTAL IRRIGATED SURFACE AREA. 2002-2013



EVOLUTION OF IRRIGATED SURFACE AREA IN SPAIN BY IRRIGATION TYPE



February 2018: 96% of Portugal under drought

Expresso

ÚLTIMAS OPINIÃO ECONOMIA EXPRESSO CURTO PODCASTS TRIBUNA CONGRESSO PSD 2:59 MULTIMÉDIA

Quase 10% de Portugal está em seca extrema

“A 15 de fevereiro deste ano, **9%** do território nacional estava em seca extrema, **77%** em seca severa e **10%** em seca moderada, de acordo com uma avaliação do Instituto Português do Mar e da Atmosfera (IPMA).” - **Jornal Expresso**

Público

Pyeongchang Pandas, k-pop e promessas diplomáticas por cumprir

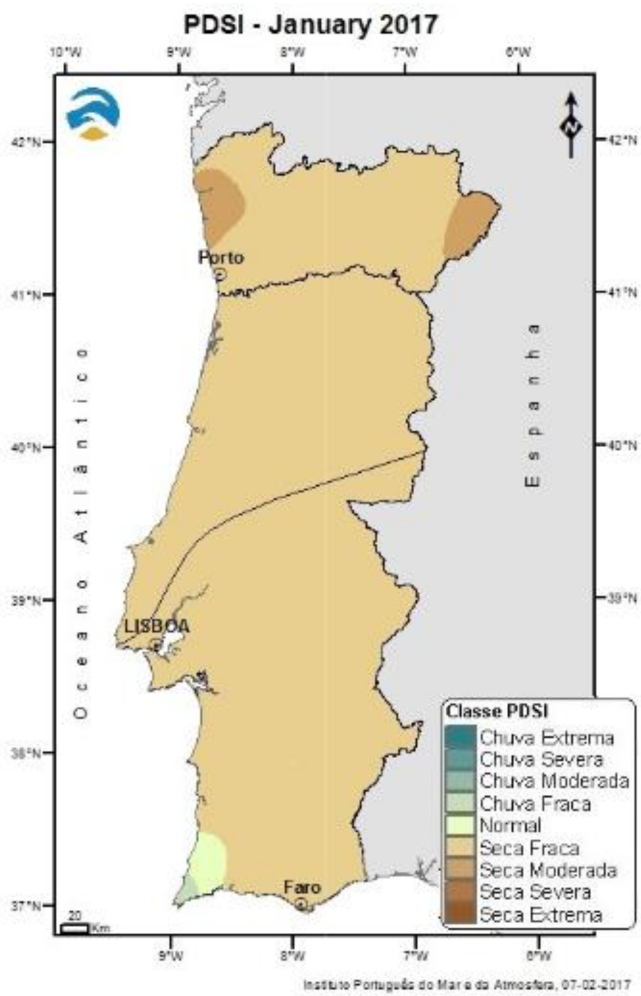
Adolescentes Smartphone na mão e sempre prontos para correr riscos

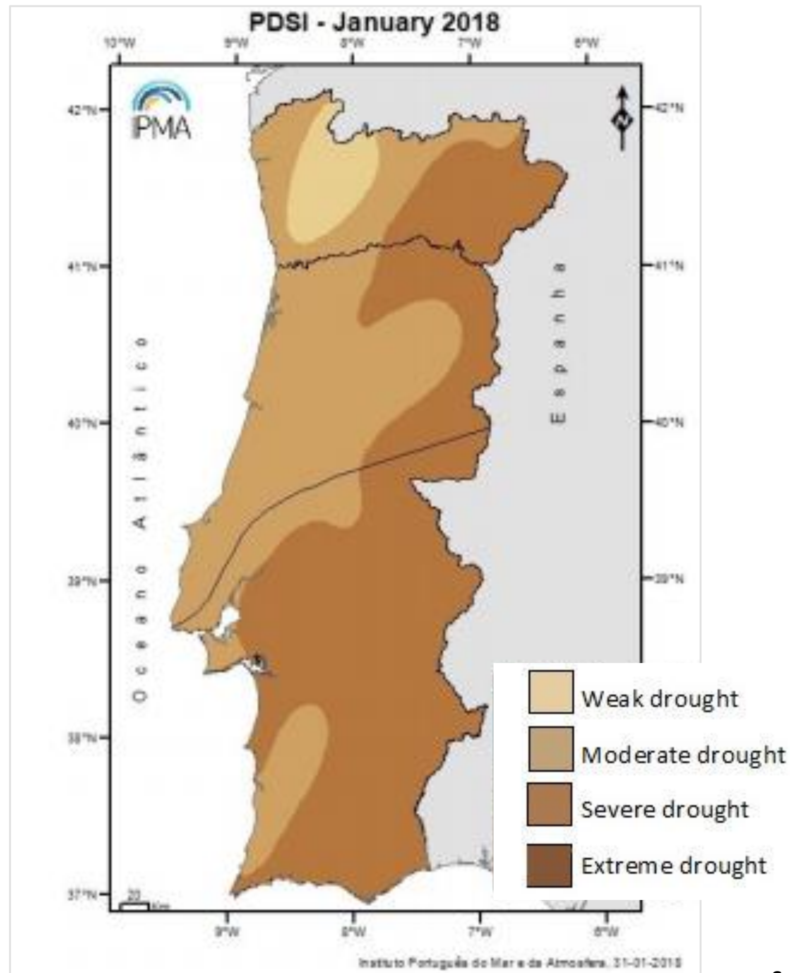
Um país a seco

De Trás-os-Montes ao Algarve, o cenário é o mesmo: “Parece Julho”

p2 a 9 e Editorial

Drought conditions in Portugal jan 2017 vs. 2018





Source: IPMA, 2017 and 2018

Drought in Spain

ELCOMERCIO.ES
Jueves, 24 agosto 2017, 04:11

El embalse de Barrios de Luna, por debajo del 10%

El embalse leonés de Barrios de Luna ofrece estos días una imagen inédita, que llama especialmente la atención de los miles de asturianos que cruzan cada día el puente Ingeniero Fernández Casado, de la autopista del Huerna. Bajo sus pies, un vacío total. Según los últimos datos de la Confederación Hidrográfica del Duero, actualmente solo contiene 28 hectómetros cúbicos de agua, de los 308 para los que fue diseñado. Es decir, se encuentra al 9,1% de su capacidad. Apenas lo suficiente para mantener el caudal ecológico del río Luna.

November 2017: drought in Spain

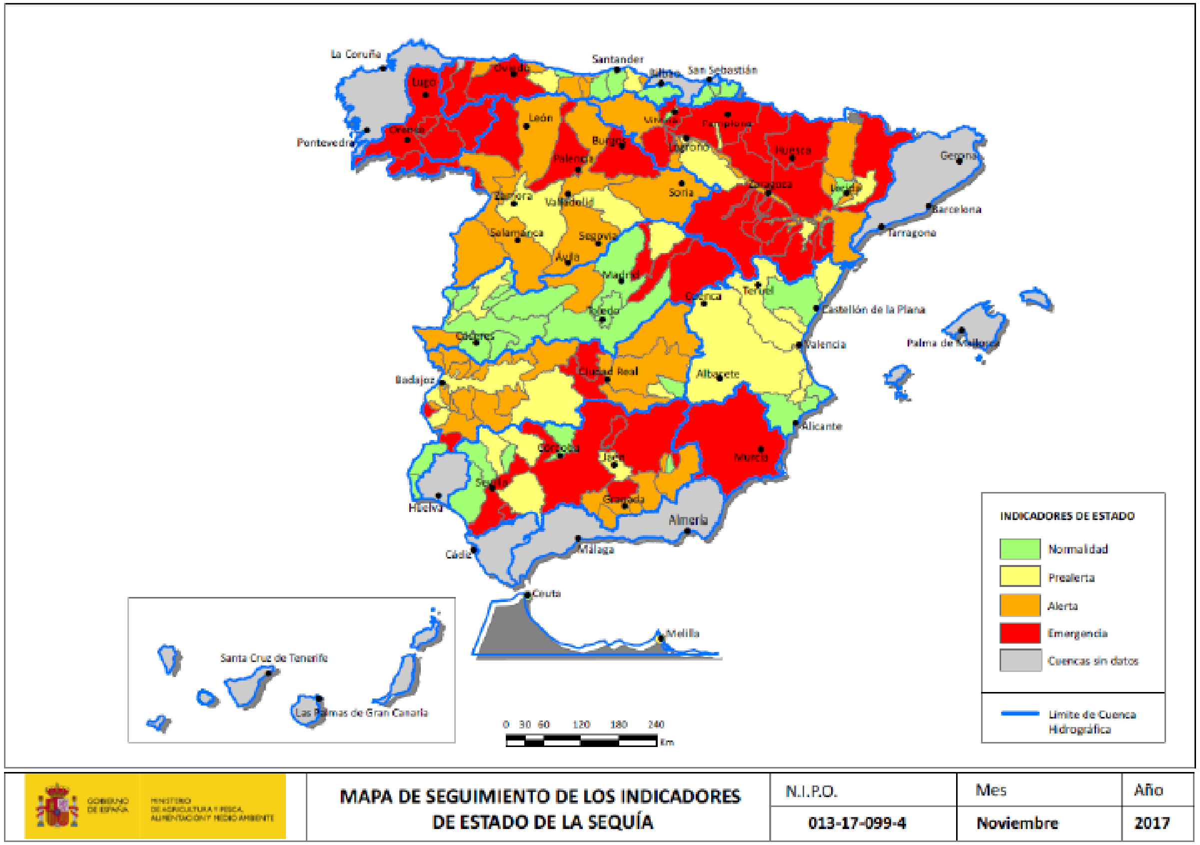


Figura 1. Situación de los indicadores de estado de la sequía hidrológica a fecha 30 de noviembre de 2017.

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Climate change and extreme events (storms)

S // MUNDO

PORTUGAL

13 desalojados, um morto e cinco feridos ligeiros provocados pela tempestade Ana

Os distritos de Lisboa, Porto, Aveiro, Viseu, Braga, Coimbra, Leiria, Setúbal e Viana do Castelo foram os mais atingid

Mau Tempo: agitação marítima mantém aviso amarelo em seis distritos

Estão sob aviso amarelo até ao meio dia, por causa da agitação marítima, os distritos do Porto, Viana do Castelo, Leiria, Aveiro, Coimbra e Braga.

LUSA · 28 de Dezembro de 2017, 11:14

Expresso

SOCIEDADE

Depois da tempestade Ana, vem aí o Bruno

OBSERVADOR

Início Política Economia País Mundo Desporto Fact Check Cultura Lifestyle Auto

METEOROLOGIA

Depois da Ana, tempestade Bruno está a chegar a Espanha, com nevões e chuvas fortes

26/12/2017, 13:53

A tempestade Bruno vai atingir Espanha com chuvas, ventos fortes e agitação marítima. Nas zonas montanhosas esperam-se também nevões intensos.

Partilhe

OBSERVADOR

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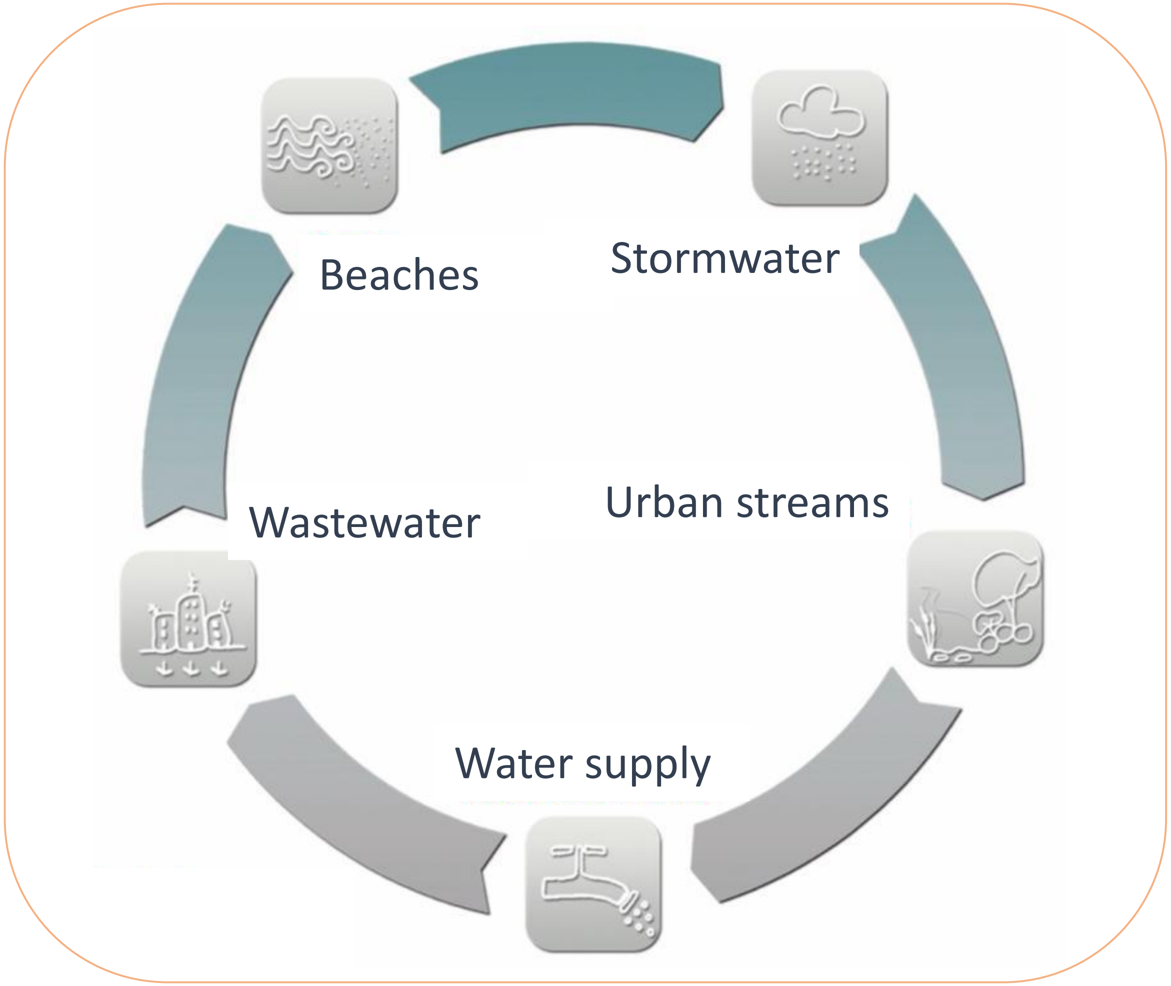
METEOROLOGIA

Efeitos da tempestade 'Bruno' trazem muita chuva, vento e ondas a partir do final da tarde

Engineering for SDG 6

- **Water security**
- **Sustainable use of water (& good status water bodies)**
- **River basisn as basic planning and management unit**
- **Resources disponibility**
- **Safe water for human use**
- **Quality**
- **Virtous urban water cycle (Smart cities)**
- **Climate change adaptation**
- **Flood and droughts (DRR)**
- **Future: international agreements, no water wars (Water Global Agency?)**

Integrated management of the urban water cycle



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Rehabilitation of urban streams

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Rehabilitation/integration of urban streams (Porto)

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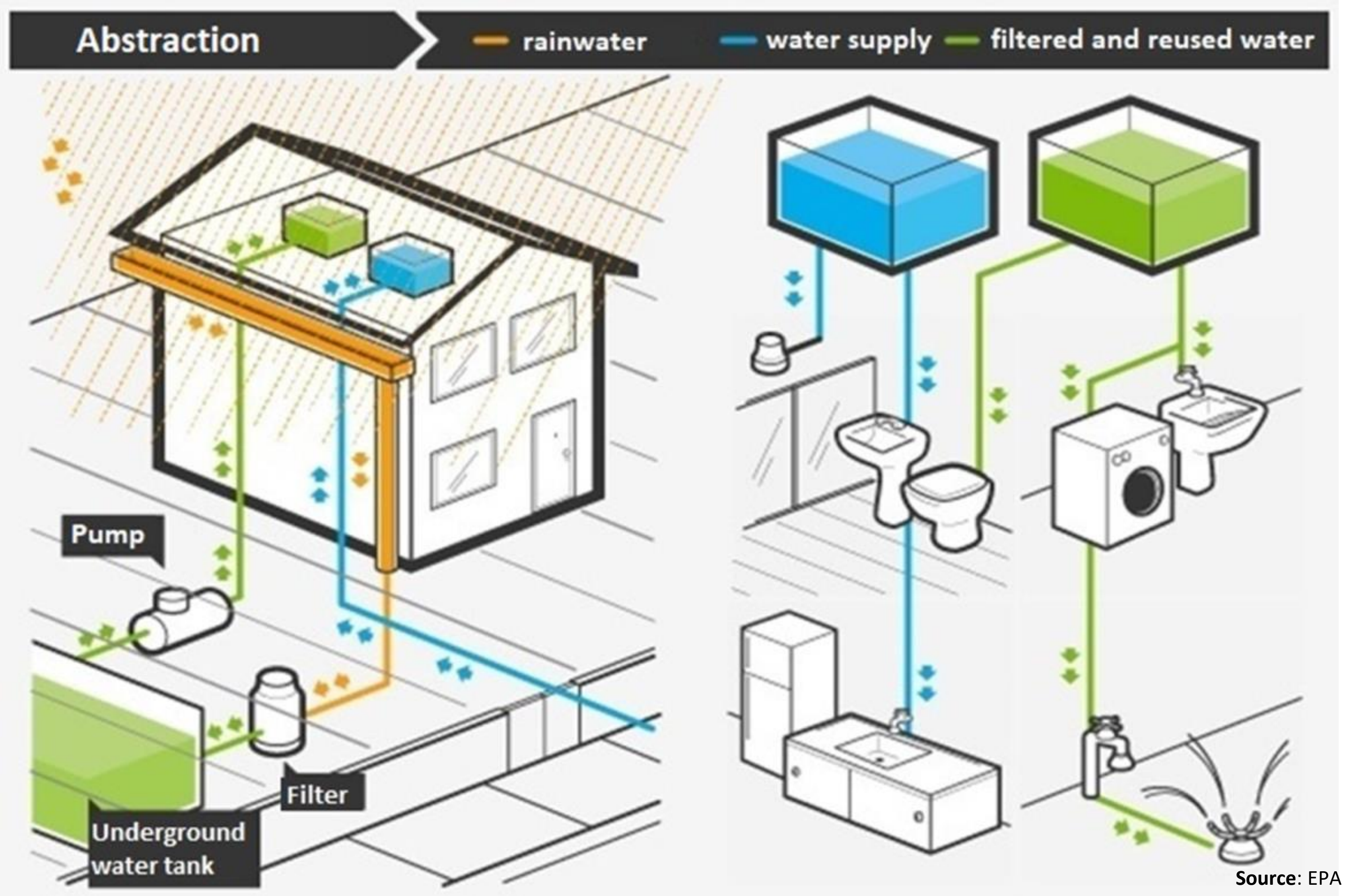
Rehabilitation/integration of urban streams (Zaragoza)

Different uses, different water quality



Source: EPA

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SuDS (Sustainable drainage systems)

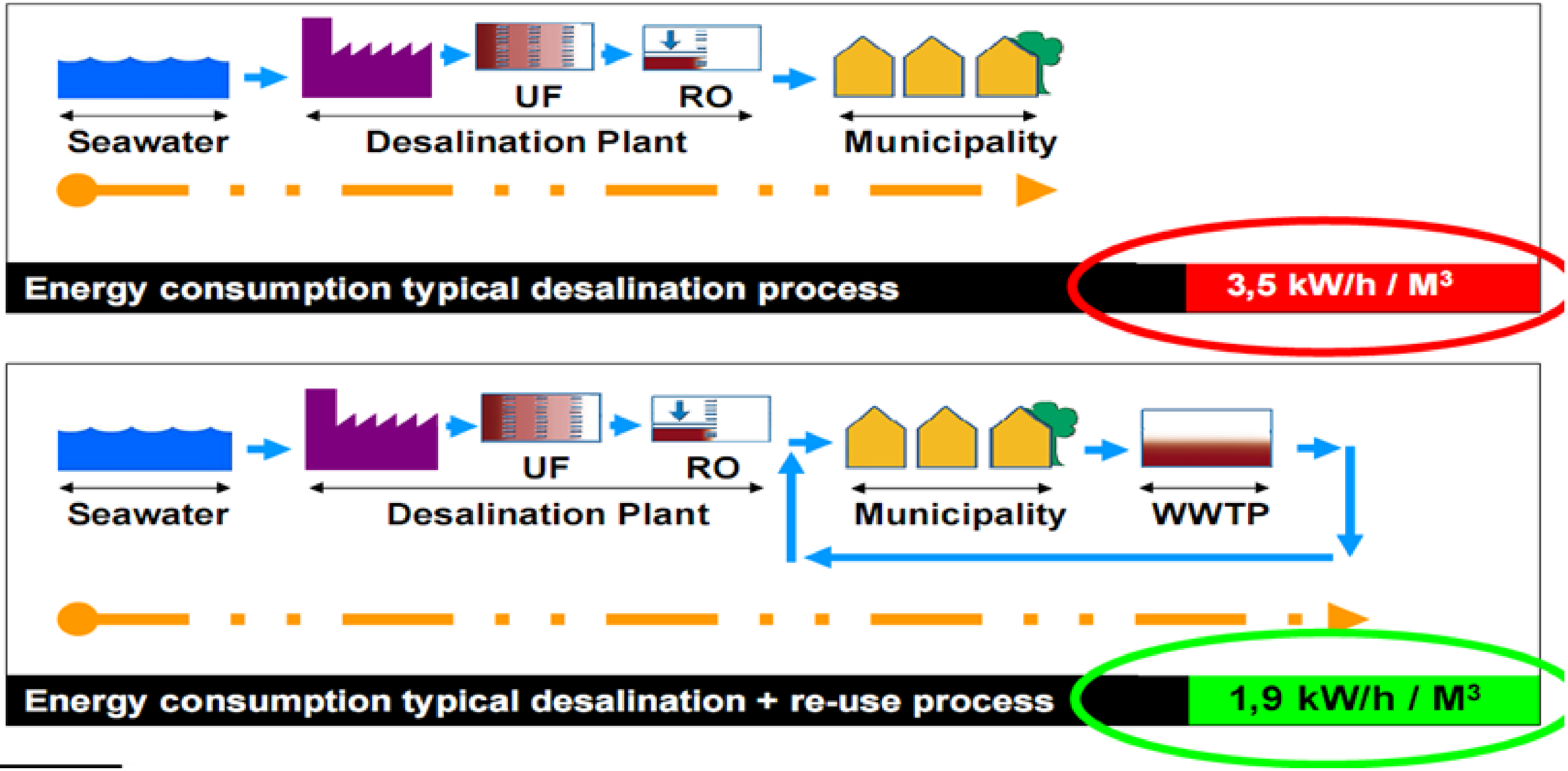
In urban areas where many surfaces are sealed by buildings and paving, natural infiltration is limited. Instead, drainage networks consisting of pipes and culverts, divert surface water to local watercourses. In some cases, this has resulted in downstream flooding and deterioration in river water quality caused when foul sewers are overwhelmed by surface water leading to a release of dirty water into rivers.

Sustainable drainage systems aim to alleviate these problems by storing or re-using surface water at source, by decreasing flow rates to watercourses and by improving water quality.

Source: British Geological Survey

Desalination

Energy consumption desalination and reuse



Source: NORIT

Planned and constructed potable reuse projects

Source: EPA, 2017

Costs of potable water reuse

Table 11-1. Cost of alternative treatment trains for a 20 MGD facility (adapted from WRRF, 2014d)

Process		Ozone-BAF	Full advanced treatment with RO Concentrate Disposal		
Cost/Impact			Ocean Outfall	Mechanical Evaporation	Evaporation Ponds
Capital Cost (millions)		$91	$120	$172	$303
Annual O&M Cost (millions)		$4.2	$5.9	$10.9	$6.3
Annual Environmental Costs (millions)		$0.4	$1.6	$6.3	$2.2
Total TBL NPV (millions)		$173	$267	$533	$512
Cost of Water (including environmental costs)	$/AF	$386	$596	$1,190	$1,143
	$/1000 gal	$1.18	$1.83	$3.65	$3.51
	$/m^3	$0.31	$0.48	$0.96	$0.93
Power Consumption (MWh/year)		4,400	16,000	65,400	22,000
Chemical Consumption (dry tons/year)		1,770	1,860	3,020	1,860
Air Emissions (tons/year)	CO_2	2,900	13,400	44,200	17,200
	Other	11	30	150	49

Source: EPA, 2017

Activities developed

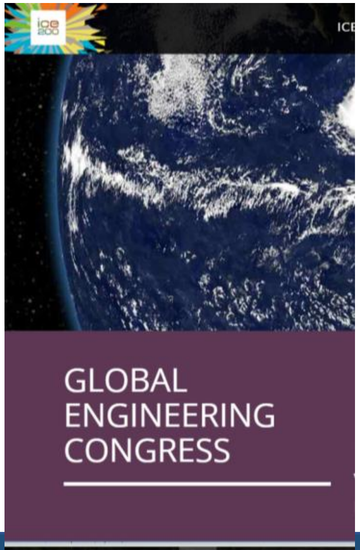
- Conference on river basin management plans (2015) under WFD (UE)
- 3 Conferences on sustainability dams and reservoirs SPANCOLD and ICCP, 2016 and 2017 (three days: economic sustainability, environmental sustainability, social sustainability). Document edited
- Conference on water. AICCP and IIE, 2017
- Workshop and Conference on SDG 6 and dams, SPANCOLD and ICCP, 2017. UNESCO participation. Document edited
- 4 workshop on SDG and sustainability of 2017, IIE (there were 4)
- Conference on SDG6, NM Portugal and Spain, March 2018, 50th Anniversary WFEO. UNESCO participation.
- Best Water Practices *M. Lorenzo Pardo Award.*
- *Declaration of Madrid*, March 1, 2018

WFEO, WCCE, FEANI, ECCE, CICPC-CECPC, OdEPortugal, CICCP, AICCP, IIE Spain
MADRID DECLARATION

WATER, THE FUTURE WE WANT

Activities in progress

- Year of the Climate Change in OdE Portugal (first event, 9th March; 27 events programmed this year)
- 8º World Water Forum, Brasilia, March 2018 (including CODIA events, Mediterranean events, Thematic Process, 20th Anniversary of Albufeira Agreement, several panelists and key-note speakers)
- Participation in UN Water discussions and reports.
- Conference presenting the new Special Plans for Droughts in Spain (Abril) in Colegio ICCP , Minister of Environment as key note speaker.
- Participation in GEC 2018 (jointly with WCCE), London, October 2018



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Water: The Future we want (Engineering contribution to SDG 6)

Thank you very much!

50th Anniversary
WFEO / FMOI
50 ACTOS CONMEMORATIVOS ANIVERSARIO FMOI
WORLD FEDERATION OF ENGINEERING ORGANIZATIONS
FÉDÉRATION MONDIALE DES ORGANISATIONS D'INGÉNIEURS