“Water Mirrors” in Portugal

Emblematic Tangible and Intangible Projects in the Water Sector

This document synthesizes a portfolio of flagship projects, which are the fruits of the engineering merit and of the water governance model implemented in Portugal. They are evidence of the capabilities residing in the Portuguese water sector, that have supported the progress achieved over the last 25 years.

The Portuguese Water Partnership’s mission is to promote an effective link between professionals, institutions and companies in order to project the knowledge and skills of the Portuguese water sector in the world, and to catalyse opportunities in international markets and in the area of cooperation within the framework of the development of robust projects in line with the Sustainable Development Goals.

Portuguese Water Partnership

"WATER MIRRORS IN PORTUGAL"

EMBLEMATIC PROJECTS

Intangible Projects

- Management of transboundary basins - the "Albufeira Convention" between Portugal and Spain
- Systems for environmental regulation:
  - The National Water Resource Information System (SNIRH)
  - The planning and management of coastal zones
  - The Integrated Environmental Licensing System (SILiAmb)
- System for regulating the quality of urban water services

Physical Projects

- The multipurpose-use "Alqueva" dam – Europe's largest artificial water surface
- The "Castelo de Bode" complex – water for Lisbon and energy for the whole country
- The "Lever" water supply complex – the support pillar for Portugal's second largest metropolitan area
- The "Alcântara" wastewater treatment system – combining economies of scale with inner-city area constraints
- The "Odelouca" Project – a Taylor made solution to a unique region in Portugal
- The hydro-agriculture system of "Vale do Sorraia" – a case study of subsidiarity in water governance

- **The *"Portuguese Miracle"***

The last 25 years in figures

MANAGEMENT OF TRANS-BOUNDARY BASINS

THE "ALBUFEIRA CONVENTION"

More information at:
www.cadc-albufeira.eu/pt

Luso-Spanish relations in the field of joint water resource management have been regulated over time by various bilateral legal instruments.

The "Convention on Cooperation for the Protection and Sustainable Use of Water in the Luso-Spanish Hydrographic Basins" (**Albufeira Convention**) was signed by Portugal and Spain at the Albufeira Summit on the 30th of November 1998 and entered into effect in January 2000.

The Convention sets standards for the protection and sustainable development of transboundary waters and established the Commission for the Implementation and Development of the Convention (CADC), which is the committee suitable for coordinating the management of the water resources related to the rivers shared by Portugal and Spain.

Principles of the "Albufeira Convention"

- Extension of the territorial scope and reference material of the agreements in effect.
- Global perspective of cooperation and respect between the Parties.
- Coordination of water planning and management by river basin.
- Respect and compatibility with existing situations and those derived from agreements in effect.

In pursuance of the objectives of the Convention, two bilateral bodies of equal composition were established to carry out the functions of management and control of compliance with the Albufeira Convention:

- The Conference of the Parties, composed by representatives nominated by the Governments of the Parties under the presidency of a Minister from each State;
- The Commission for the Application and Development of the Convention (CADC), composed by delegations nominated by each Party.

The compliance with the flow regime agreed under the Convention is being ensured, and in the case of potential drought situations, Portugal and Spain implement the measures that are considered necessary to minimize their effects.

AGÊNCIA PORTUGUESA DO AMBIENTE

Photo from: Iago Pillado

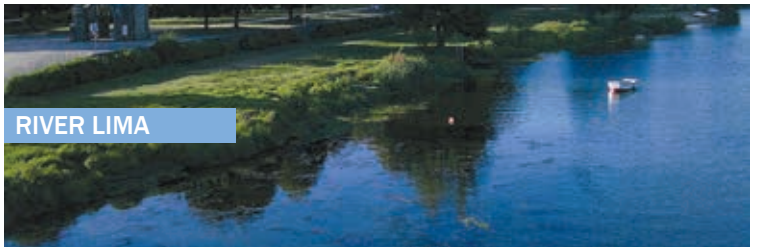


Photo from: Carlos Luis M C da Cruz

Photo from: Pedro Sousa

Photo from: M. Pereira

Photo from: Francisco Antunes

ENVIRONMENTAL REGULATION BY APA

THE NATIONAL WATER RESOURCE INFORMATION SYSTEM (SNIRH)

More information at:
http://snirh.apambiente.pt

The National Water Resource Information System, SNIRH, (http://snirh.apambiente.pt) was created in 1995, integrates databases with models fed through the network of water resource monitoring stations in Portugal.

This system stores and makes available:

- hydro meteorological data;
- water quality data (surface, groundwater and coastal).

The SNIRH data is collected though a network composed of monitoring stations, both conventional and automatic:

- hydrometric (installed in rivers and reservoirs);
- weather;
- udometric;
- piezometric, and
- of water quality parameters.

On its website, SNIRH also provides thematic summaries, technical reports, cartography, legislative (national, European and worldwide) and documents and photographs related to water resources.

SNIRH received in 1997 the Descartes Prize awarded by the Instituto de Informática.

The Rios-SVARH program received the 3rd Prize, in the Management category, from the Microsoft Software Competition in 2003.

SNIRH integrates

A **Water Resource Surveillance and Alert System (SVARH)**, which measures in real time the hydrological state of the country's rivers and reservoirs (water levels, flows and stored volumes), and compares the observed values with historical values in order to forecast the evolution of levels, flows and volumes stored, in the case occurrence of intense precipitation.

This system is intended primarily for entities with responsibilities for water resource management in the event of floods and pollution incidents, and is essential to carry out coordinated and integrated control of the volumes flowing to the different reservoirs, with flood control capacity, aiming at minimization of overflows near critical areas (urbanized, or with essential assets and strategic infrastructure).

A **National Information System for Coastal Water Resources** which provides data from the stations monitoring coastal water resources and other information related to coastal infrastructure, beaches, and the quality of coastal and transitional waters.

A **"Junior version"** of the National Water Resource Information System dedicated to the youngest.

Sistema Nacional de Informação de Recursos Hídricos
snirh.pt

AGÊNCIA PORTUGUESA DO AMBIENTE

ENVIRONMENTAL REGULATION BY APA

PLANNING AND MANAGEMENT OF THE COASTAL ZONES

APA – the Portuguese Environment Agency, has specific responsibilities in the **management of the coastal areas** of mainland Portugal, namely at the level of **planning, land use regulation and coastal risk management.**

In coastal risk management (i.e. coastal erosion, cliff instability, coastal flooding), APA has been responsible for planning and implementing coastal protection/ defense interventions to safeguard people and property.

Areas of activity include:

- coastal zone land use planning;
- rehabilitation and management of beaches;
- erosion process control and other coastal engineering interventions;
- protection of coastal ecosystems;
- port engineering.

Examples of APA interventions in coastal areas

AGÊNCIA PORTUGUESA DO AMBIENTE

ENVIRONMENTAL REGULATION BY APA

INTEGRATED ENVIRONMENTAL LICENSING SYSTEM (SILIAMB)

More information at:
https://siliamb.apambiente.pt

As an online platform - **SILiAmb** - allows:

- **making licensing requests** (including a wide range of uses of water resources allowed by law);
- **Following-up the licensing process and monitor uses;**
- communicate with the **APA and Hydrographic Region Administrations** (send and receive messages).

SILiAmb was developed by APA and was implemented in October 2012.

Functionalities

- Reception by the technician responsible for the analysis of the request within a maximum of 24 hours.
- Harmonized analysis procedures at national level, allowing the inclusion of exceptions.
- Use of geoprocessing tools for immediate evaluation of the environmental constraints and other existing uses.
- Automatic update of characterization data via connection to a GIS.

Advantages

- Access through the Internet, without the need of special technological resources.
- Friendly and unique interface at national level.
- Consolidated platform covering several domains (water resources, solid waste) using the same usability standards and taking into consideration the different types of users.
- Dematerialization of administratively heavy processes.
- Facilitating connections, both internally and externally.

What does it represent for the user?

- Less time to formulate the request and to receive the requested answers.
- Easier interaction with APA.
- Harmonization of procedures at national level.
- Greater transparency and coherence.

What does it represent to technicians?

- Greater ease in interaction with applicants.
- Analytical tools and systematization of the procedures to be used, which reduces the time needed for application analysis.

Allows the loading of data for self-control and connection with the Economic and Financial Regime.

SILiAmb

AGÊNCIA PORTUGUESA DO AMBIENTE

REGULATION OF URBAN WATER SERVICES BY ERSAR

QUALITY OF SERVICE EVALUATION SYSTEM

More information at:

www.ersar.pt

https://www.oecd.org/governance/observatory-public-sector-innovation/innovations/page/ersarmobileapp.htm

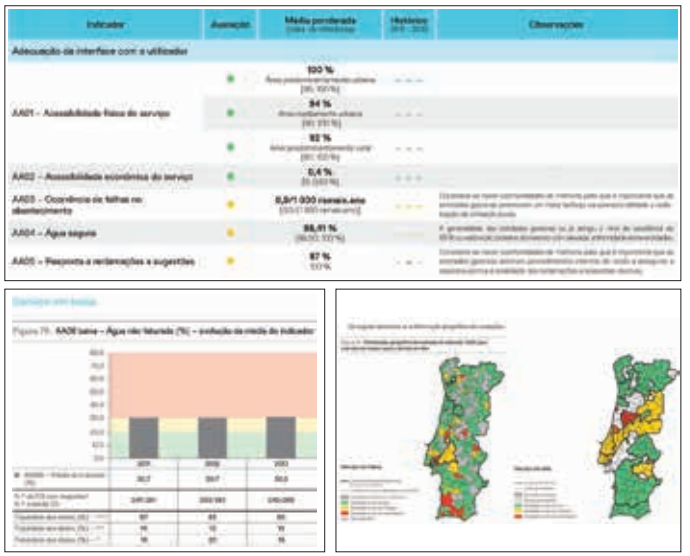
The **regulation** of quality of service aims to improve the effectiveness and efficiency with which urban water services are provided and is carried out by means of an **evaluation of the performance of the service providers.**

To this end, ERSAR – the Portuguese **Regulatory Authority for Water and Waste Services**, has implemented a system for assessing the quality of service provided by operators which comprises **14 indicators** for each of the regulated services and therefore allows **regulation by benchmarking.**

The indicators that make up the system for evaluating the quality of service provided by these utilities are divided into three groups:

- **End-user interface adequacy** — this group of indicators aims to assess whether the service provided to users is adequate, particularly in terms of physical and economic accessibility to service provision and the quality with which it is provided;
- **Sustainability of service provision** — this group of indicators aims to assess whether measures are being taken to ensure that the provision of the service is sustainable in both operational and financial terms;
- **Environmental sustainability** — this group of indicators intends to evaluate the level of safeguarding the environmental aspects associated with the activities of the operator.

The information collected, after being audited and validated by the regulator is published in the Service Provision Annual Report (RASARP) and the ERSAR website and it constitutes the reference source of information for the sector.



Having the Portuguese urban water service sector in the palm of your hand.

ERSAR annually collects a large number of data (about 900 thousand) from the regulated entities, which are relevant to characterize the water and wastewater services provided to consumers.

This is an impressive source of information that ERSAR wants make available and easily accessible to all stakeholders.

ERSAR has also developed the ERSAR App, a digital communication platform accessible for free on any smartphone.

The ERSAR App was recognized by the OECD - Organization for Economic Cooperation and Development as a case of innovation success in water service regulation.

AGÊNCIA PORTUGUESA DO AMBIENTE

THE MULTI-PURPOSE-USE "ALQUEVA" DAM

EDIA

More information at:
www.edia.pt/pt

Alqueva is based on the concept of **multiple purposes** and **integrated management** of its strategic water reserve.

From Alqueva, there are multiple emergent paths for water usage: roads leading to the **public water supply**, with the reinforcement of 5 dams that supply about 200 thousand inhabitants; for agriculture, with an irrigated area of about 120 thousand hectares and which will be increasing to 170 thousand in the coming years; for industry; for clean energy production (540MW) and for tourism.

This is a project centered on the **Alqueva dam**, Europe's largest strategic water reserve with 4 150 hm^3 of capacity, from which 68 dams and reservoirs are interconnected to ensure the **availability of water**, even in periods of extreme drought, to an area of approximately **10 thousand km^2.**

The Alqueva Multipurpose Project is a **structuring project** in the south of Portugal, which has become an **anchor investment for regional development,** where up to now the lack of water had been one of the main constraints to its development, standing in the way of the **modernization of agriculture and the sustainability of public water supply.**

Alqueva has opened up unique perspectives for the **relaunch of economic and social development**, creating conditions for an **effective increase of the Regional and National Gross Domestic Product.**

EDIA Empresa de Desenvolvimento e Infra-estruturas do Alqueva, S.A.

Alqueva dam

- Height – 96 m
- Total capacity – 4 150 hm^3
- Useful capacity – 3 150 hm^3
- Water mirror – 250 km^2

Alqueva Hydroelectric Power Plant
Installed power – Alqueva I and II – 2 x 260 MW
Total: 520 MW

Pedrógão dam
(against reservoir of Alqueva)

- Height – 43 m
- Total capacity – 106 hm^3
- Useful capacity – 54 hm^3
- Water mirror – 11 km^2

Pedrógão Mini Hydropower Plant
Installed power – 10 MW

Global Irrigation System

- Area – 119 thousand ha
- Primary network extension – 382 km
- Secondary network extension –1 620 km
- Dams, Reservoirs and Weirs – 69
- Pumping stations– 47
- Mini Hydropower – 5 with installed power 9,6 MW

THE “CASTELO DE BODE” COMPLEX

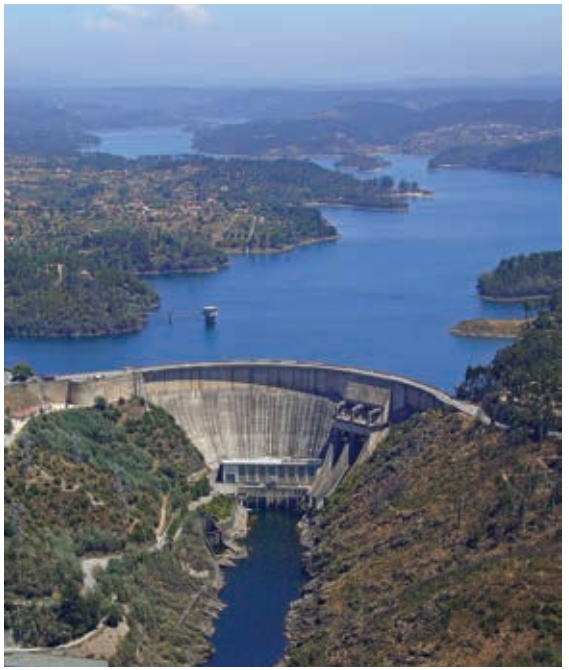
EPAL

More information at:

www.epal.pt

www.a-nossa-energia.edp.pt

http://snirh.apambiente.pt



The Castelo de Bode dam is one of the most important Portuguese dams, located on the river Zêzere, a tributary of the right bank of the river Tagus.

It is an infrastructure that supports:

- Water supply
- Hydroelectric power generation
- Flood defense
- Recreational activities

Castelo de Bode dam

- Height – 115 m
- Total capacity – 1 095 hm^3
- Useful capacity – 902.5 hm^3
- Water mirror – 32.9 km^2

Hydroelectric power generation

- Startup in 1951 and renewed in 2004
- Total installed power: 159 MW

Water supply

In operation since 1987, the “Castelo de Bode” subsystem, designed to capture, treat and transport water for human consumption from the Castelo de Bode reservoir, is the largest water supply project in Portugal.

The water is treated at the Asseiceira Treatment Plant, a plant that annually produces more than 180 million m^3: 80% of all water produced by the EPAL system, which supplies about 3 million people in the greater Lisbon area.

Asseiceira‘s Water Treatment Plant is one of the largest in Europe and a benchmark in the sector for its production capacity and employed technology.

It comprises two independent lines: Line 1 equipped to treat up to 500 thousand m^3 / day and Line 2 with up to 125 thousand m^3/day, with the ability to recycle all the liquid effluent resulting from the process. The innovative sludge park has allowed the reuse of sludge for the development of new products and the creation of economic and environmental value. With the ongoing implementation of the 0% Energy Project, the water treatment plant of Asseiceira will be the first self-sustainable water treatment installation.

Flood defense

Adequate management of the outflow at the Castelo de Bode dam allows, in conjunction with the management of existing facilities, namely in the Tagus basin (national and international), the mitigation of the effects of floods in the Zêzere and Tagus river basins.

Recreational activities

Numerous recreational and leisure activities are practiced at the Castelo de Bode dam, such as eco-tourism, windsurfing, sailing, rowing, as well as sport fishing.

THE “LEVER” WATER SUPPLY COMPLEX

ÁGUAS DO DOURO E PAIVA

More information at:
www.addp.pt

The Water Treatment Plant of Lever is integrated in a complex located in Vila Nova de Gaia, which, in addition to the water treatment plant, includes the following infrastructure:

- Intake wells;
- Pumping stations;
- Power substations;
- Surface water abstraction facility;
- Raw water reservoir and a treated water reservoir;
- Pre-treatment unit;
- Sludge treatment plant;
- Process laboratory;
- Environmental education center;
- Operations management building.

At Lever’s Water Treatment Plant, an average of **270 thousand m³ of water is produced per day** to supply the regions of greater Porto and part of the Vale do Sousa, covering **1,45 million people**. The water treated in this infrastructure is captured in the Crestuma-Lever reservoir (Douro river).

With the set of infrastructure that make up the Lever Complex, the **water supply is guaranteed in the necessary quantities**, through **efficient production processes that respect the highest social and environmental values and at a socially fair price**. In this way, the company contributes decisively to the **quality of life**, the **socioeconomic development** and the **environmental balance** of Greater Porto.

Lever’s Water Treatment Plant started its operation in March 2000, using the most modern technologies in the treatment process.
In 2007, an operations management facility was built

The **architectural project**, which privileged an adequate landscape integration of the building, was the authorship of the **architect Alcino Soutinho**.

ÁGUAS DO DOURO E PAIVA
Grupo Águas de Portugal

THE “ALCÂNTARA” WASTEWATER TREATMENT SYSTEM

ÁGUAS DO TEJO ATLÂNTICO

More information at:
www.aguasdotejoatlantico.adp.pt

The Alcântara subsystem is responsible for the treatment of urban wastewater produced by about 800 thousand inhabitants, serving part of the municipalities of Lisbon (western zone), Amadora and Oeiras.
The subsystem is constituted by:

- The Wastewater Treatment Plant of Alcântara;
- 11 pumping stations, located between Algés and Alfama;
- 25 km of interceptor system.

The **Wastewater Treatment Plant of Alcântara** is built under a green roof of about three hectares. This solution allows the **reduction of the landscape impact** of the existence of a large wastewater treatment plant in the middle of the city, next to a Natural Park, also benefiting from a **good thermal and acoustic** isolation and the reduction of the impermeable area to rainwater, thus contributing to flood mitigation.

This roof also lowers **global warming** as it absorbs the reflecting solar rays which would otherwise warm the atmospheric air.

The architectural project was the responsibility of architects **Manuel Aires Mateus, Frederico Valsassina and João Nunes.**

Wastewater Treatment Plant of Alcântara
Inaugurated in 1989 and extended in the decade of 2000-10, it is the largest covered wastewater treatment plant in Portugal.

General features:

- Qdim= 3,3 m^3/s (dry weather) + 3,3 m^3/s (humid weather);
- Secondary treatment;
- Disinfection by ultraviolet radiation;
- Mechanical dewatering of sludge in centrifuges for later use in agriculture;
- Deodorization system for the entire installation;
- Reuse of treated water in irrigation, in the treatment process, in the washing of streets, among other uses.

THE “ODELOUCA” PROJECT

ÁGUAS DO ALGARVE

More information at:
www.aguasdoalgarve.pt

Odelouca dam

- Height – 76 m;
- Total capacity – 157 hm^3;
- Useful capacity – 134 hm^3;
- Water mirror – 7.8 Km^2.

15% of the investment was dedicated to the environmental component and the valuation of cultural assets.
The compensation and overcompensation measures aimed at achieving the conservation objectives of the species and habitats directly affected by the project, in particular the Iberian lynx, the birds of prey (Bonelli’s eagle), the endemic species of ichthyofauna and the habitats of the riverside galleries.

The Odelouca hydraulic project

The reservoir of the Odelouca dam has as its objective the **public supply of water** to the Algarve Region under high standards of quality and reliability.
It is the main water source of the Algarve, in articulation with a set of other surface and underground water sources.
The Odelouca Hydraulic Project is composed, in addition to the dam, by the Odelouca-Funcho tunnel and a flow control structure, as well as a set of safety and operational installations, such as the surface discharger, the bottom and ecological flow dischargers, and two water intake structures.
The water stored in the reservoir is conveyed by the 8 km long Odelouca-Funcho tunnel to the Funcho-Alcantarilha pipeline, 200 meters downstream from the Funcho Dam, continuing for another 12 kilometers to the Alcantarilha water treatment plant, where it is subjected to an appropriate treatment process, so that it can then be distributed to the population.
The Odelouca dam ensures the continuous and regular supply of water for human consumption in the Algarve region, avoiding the constraints inherent to drought years.

ÁGUAS DO ALGARVE
Grupo Águas de Portugal

THE HYDRO--AGRICULTURE SYSTEM OF "VALE DO SORRAIA"

ARBVS

More information at:

www.arbvs.pt

http://sir.dgadr.pt/expl-lvt

http://snirh.apambiente.pt

The Vale do Sorraia complex is a hydro-agricultural system that benefits an area of 16 thousand hectares, including 15.4 thousand hectares at Vale do Sorraia, 535 hectares at the Paúl de Magos, 427 hectares for the defense of the fields of Salvaterra de Magos.

The system was inaugurated in 1938 and was expanded thereafter. In 1959, the management, exploration and conservation of the entire system was transferred to the Association of Irrigators and Beneficiaries of the Vale do Sorraia (ARBVS).

Associação de Regantes e Beneficiários do Vale do Sorraia

Infrastructure of the Vale do Sorraia

The system is constituted by 3 dams and 2 weirs:

- Maranhão dam;
- Magos dam;
- Montargil dam;
- Furadouro weir;
- Gameiro weir.

From which the following irrigation systems are developed:

- Channels and distributors (primary network) with 211.4 Km;
- 13 pumping stations;
- 171.6 Km of irrigation networks (secondary network);
- 292.9 Km of drainage networks;
- Protection works:
  - Mounds with a development of 24.5 Km;
  - Slope collectors with a total length of 17.1 Km;
  - Defense dykes with 12.8 Km
  - 5 drying stations;
- 3 Power plants:
  - 1 in the Maranhão dam;
  - 1 in the Montargil dam;
  - 1 in the Gameiro weir.

Remote management and control system.

Furadouro weir

Height – 14 m

Useful capacity – 0.4 hm^3

Maranhão dam

Height – 49 m

Useful capacity – 180.9 hm^3

Magos dam

Height – 15 m

Useful capacity – 3 hm^3

Montargil dam

Height – 36 m

Useful capacity – 142.7 hm^3

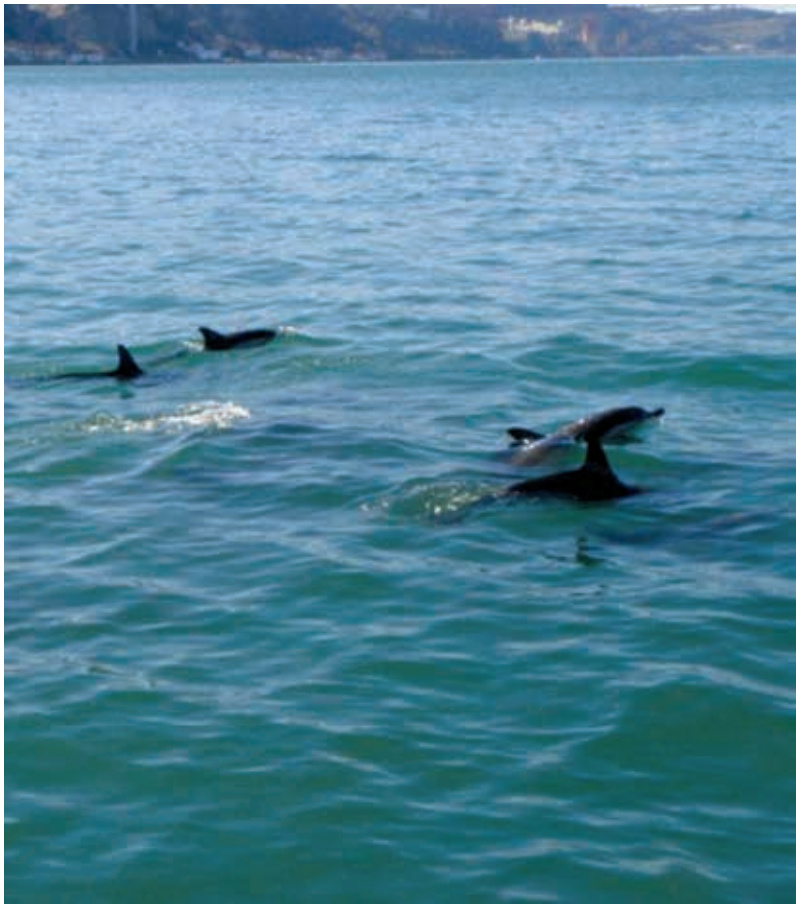
Gameiro weir

Height – 16 m

Useful capacity – 1.3 hm^3

THE "PORTUGUESE MIRACLE"

The last 25 years in figures



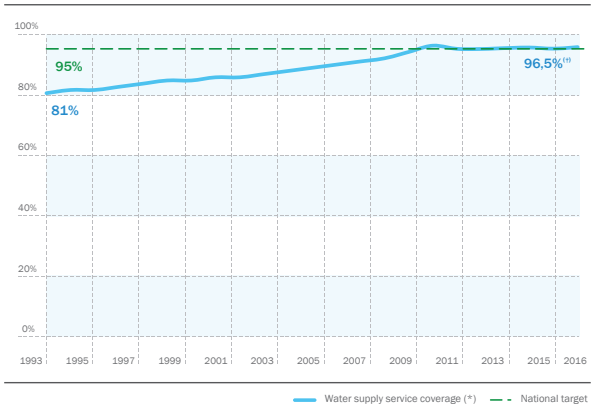
In the last quarter century Portugal has witnessed a remarkable development in the field of water resources, particularly in urban water services.

Paul Reiter, at the time Executive Director of the International Water Association, on occasion of the 2010 World Water Congress in Montreal, referred to the Portuguese case as ***"The Portuguese Miracle ..."***

It was not a miracle, but rather the result of the technical and institutional competencies that are resident in the vast group of companies and entities, public and private, that comprise the Portuguese water sector.

Access to drinking water supply services

Source: ERSAR | RASARP ("AA01 Retail" indicator)



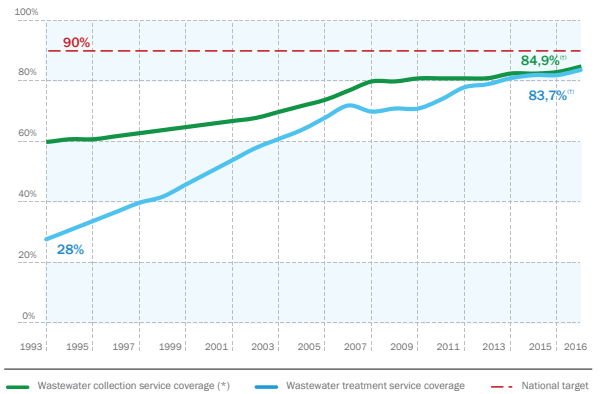
(*) Indicator defined as the percentage of the total number of households located in each operator's service area for whom drinking water supply infrastructure is available.
(†) Provisional data (July 2017).

96.5%
of households with access to the public water supply service

95%
national goal already achieved

Access to wastewater management services

Source: ERSAR | RASARP ("AR01 Retail" indicator)



(*) Indicator defined as the percentage of the total number of households located in each operator's service area for whom wastewater collection and drainage infrastructure is available.
(†) Provisional data (July 2017).

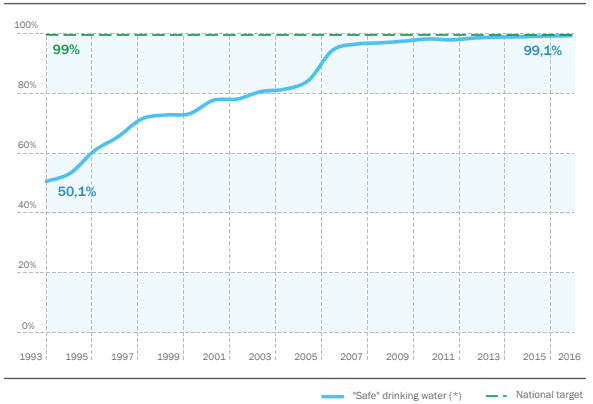
90%
national target for the coverage of collection and treatment of wastewater

84%
of households with access to public sanitation

28%
level of collection and treatment 25 years ago

Drinking water quality

Source: ERSAR | RASARP ("AA04 Retail" indicator)



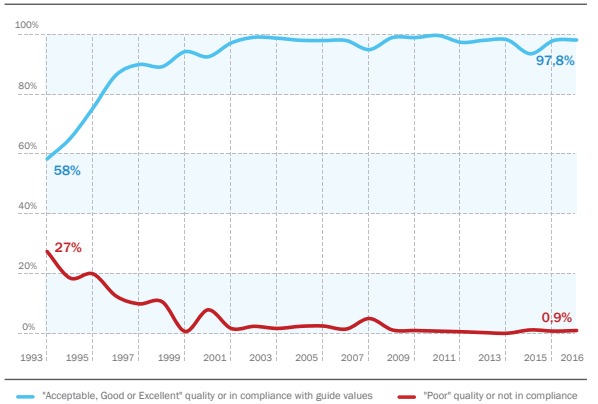
99%
of good quality water for human consumption

50%
of water which, 25 years ago, was either not of good quality or whose quality was not known

(*) Indicator defined as the percentage of drinking water which is monitored and of good quality.

Costal bathing water quality

Source: APA | REA (State of the Environment Report)

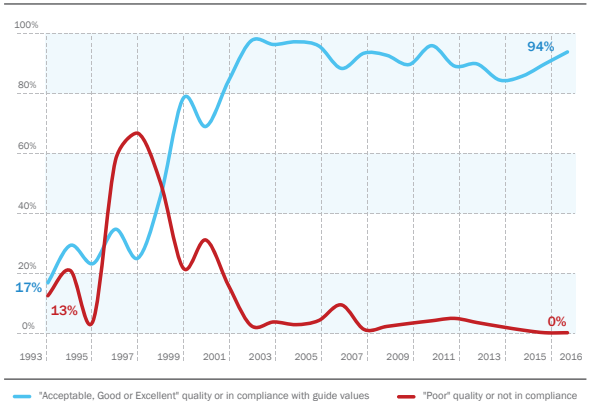


98%
quality in coastal bathing waters

15%
with quality unknown 25 years ago

Inland bathing water quality

Source: APA | REA (State of the Environment Report)

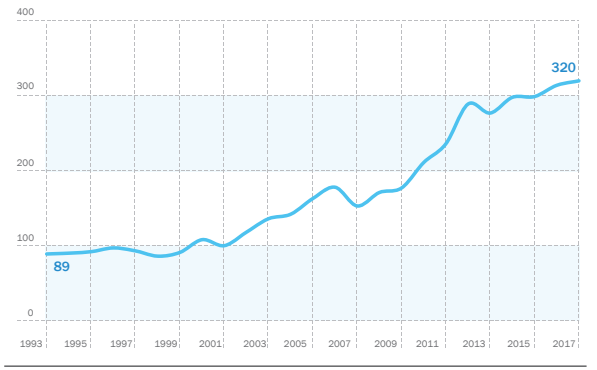


94%
quality in coastal bathing waters

70%
with quality unknown 25 years ago

Bathing zones with a Blue Flag

Source: APA | ABAE | FEE Portugal



320
beaches with "Blue Flag" status. More than 55% of Portuguese beaches

More information at:

www.ersar.pt/pt/publicacoes/relatorio-anual-do-setor

http://bandeiraazul.abae.pt

http://rea.apambiente.pt/ultima_edicao

"Whatever we possess becomes of double value when we have the opportunity of sharing it with others !"

JEAN-NICOLAS BOUILLY (1763-1842)

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