TREND REPORT

REPORT ON TRENDS IN Southern European countries (case of Portugal)

TECHNEAU

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Colofon

Title
Report on trends in Southern European countries (case of Portugal)

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Executive Summary

Introduction
This report aims at identifying the main trends related to drinking water which characterise the Portuguese situation, as a paradigmatic example of a Southern European country. It uses the structure of the factor form and contains a qualitative assessment of each main item, identifying only one key aspect per factor and the corresponding trend. Although partially based on the information sources listed in the factors form information, it nevertheless conveys a subjective assessment by the author and other collaborators.

Importance
The collection of reports characterizing the current situation relating to drinking water in Europe and analyzing the trends for the coming 10-20 years is crucial for the identification of the R&D needs in this domain, particularly for TECHNEAU. This report is the only one referring to a Southern European Country. Although the information collected is country specific, trends can be in some cases extrapolated for the region.

Approach
The approach adopted in this research was based on the experience gathered while establishing a common factors form to be adopted by all partners, followed by its fulfillment. The sources of information used included literature reviews, official and non-official statistical data and reports, interviews, and a direct knowledge of the sector by the author and other contributors. The factor form focuses on the characterization of the current situation and short term trends. The longer term trends presented are based on the critical analysis made on this information.

Result
Key results are:

Region:	Southern Europe
Covering country:	Portugal
Population	10 500 inhabitants

Factors:	Key aspect:	Trend:
Socio-cultural factors	Awareness of the population with regard to drinking water quality and environmental problems	Very significant increase
Economical factors	Regulatory framework	Increase of the geographical scope and of the national regulator enforcing authority
	Rehabilitation investment needs	Investment needs are still very significant
Political factors	Promotion of solutions for a more flexible and effective utility management	Increase of the options offered to the municipalities
	Decision making process for innovations	There are visible trends in the decision making processes for innovation
Technical factors	Technological solutions	Adoption of solutions previously used in other countries
Environmental factors	Wastewater treatment in general: influence on surface water quality	Improved efficiency of treatment plants; minimisation of spills during rain events.
Demographical factors	Population distribution	Concentration in the coastal areas and in "predominantly urban areas" / desertification of some areas of the eastern interior areas
Organizational factors	Management flexibility	Increasing adoption of more flexible and efficient management and organisational solutions
Risk-related factors	Water availability and systems reliability	Increasing awareness and mitigation; progressive development and implementation of water safety plans and contingency plans.

More information
Sources used are identified in the Annex of this report.

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TKI Categorisation

Classification									
Supply Chain		**Process Chain**		**Process Chain (cont'd)**		**Water Quality**		**Water Quantity (cont'd)**	
Source	X	**Raw water storage**		**Sludge treatment**	X	**Legislation/regulation**	X	- Leakage	
- Catchment		- Supply reservoir		- Settlement		- Raw water (source)		- Recycle	
- Groundwater		- Bankside storage		- Thickening		- Treated water			
- Surface water		**Pretreatment**		- Dewatering	X	**Chemical**			
- Spring water		- Screening		- Disposal		- Organic compounds			
- Storm water		- Microstraining		**Chemical dosing**		- Inorganic compounds			
- Brackish/seawater		**Primary treatment**		- pH adjustment		- Disinfection by-products			
- Wastewater		- Sedimentation		- Coagulant		- Corrosion			
Raw water storage	X	- Rapid filtration		- Polyelectrolyte		- Scaling			
- Supply reservoir		- Slow sand filtration		- Disinfectant		- Chlorine decay			
- Bankside storage		- Bank filtration		- Lead/plumbosolvency	X	**Microbiological**			
Water treatment	X	- Dune infiltration		**Control/instrumentation**		- Viruses		**Consumers / Risk**	
- Pretreatment		**Secondary treatment**		- Flow		- Parasites			
- Primary treatment		- Coagulation/flocculation		- Pressure		- Bacteria	X	**Trust**	
- Secondary treatment		- Sedimentation		- pH		- Fungi		- In water safety/quality	
- Sludge treatment		- Filtration		- Chlorine	X	**Aesthetic**		- In security of supply	
Treated water storage	X	- Dissolved air flotation(DAF)		- Dosing		- Hardness / alkalinity		- In suppliers	
- Service reservoir		- Ion exchange		- Telemetry		- pH		- In regulations and regulators	
Distribution	X	- Membrane treatment		**Analysis**		- Turbidity	X	**Willingness-to-pay/acceptance**	
- Pumps		- Adsorption		- Chemical		- Colour		- For safety	
- Supply pipe / main		- Disinfection		- Microbiological		- Taste		- For improved taste/odour	
Tap (Customer)	X	- Dechlorination		- Physical		- Odour		- For infrastructure	
- Supply (service) pipe		**Treated water storage**						- For security of supply	
- Internal plumbing		- Service reservoir				**Water Quantity**	X	**Risk Communication**	
- Internal storage		**Distribution**						- Communication strategies	
		- Disinfection				**Source**		- Potential pitfalls	
		- Lead/plumbosolvency				- Source management		- Proven techniques	
		- Manganese control				- Alternative source(s)			
		- Biofilm control				**Management**			
		Tap (Customer)				- Water balance			
		- Point-of-entry (POE)				- Demand/supply trend(s)			

Classification									
Supply Chain		**Process Chain**		**Process Chain (cont'd)**		**Water Quality**		**Water Quantity (cont'd)**	
		- Point-of-use (POU)				- Demand reduction			

TKI Categorisation (continued)

Contains		**Constraints**		**Meta data**					
Report	X	Low cost		*Author(s)*	X				
Database		Simple technology		*Organisation(s)*	X				
Spreadsheet		No/low skill requirement		*Contact name*	X				
Model		No/low energy requirement		*Contact email*	X				
Research		No/low chemical requirement		*Quality controller name*	X				
Literature review	X	No/low sludge production		*Quality control organisation*	X				
Trend analysis	X	Rural location		Source					
Case study / demonstration		Developing world location		*Date prepared*					
Financial / organisational				Date submitted (TKI)					
Methodology				Date revised (TKI)					
Legislation / regulation									
Benchmarking									

Contents

1 General Description

This report aims at identifying the main trends related to drinking water that characterise the Portuguese situation, as a paradigmatic example of a Southern European country. It uses the structure of the factor form and contains a qualitative assessment of each main item, identifying only one key aspect per factor and the corresponding trend. Although partially based on the information sources listed in the factors form information, it nevertheless conveys a subjective assessment by the author and other collaborators.

When compared to Europe as a whole, the South of Europe is characterized by a warmer climate, a higher number of sunny periods and a rather irregular precipitation regimen. Dry areas, normally affected by water stress, coexist with other regions where the average annual water availability is not a matter of concern. However, as precipitation tends to be concentrated in short periods of high intensity, rather unevenly distributed in the year and from year to year, even the regions without water stress face significant challenges in terms of water resources management. Drinking water quality needs to be analysed in this context.

From the social cultural viewpoint, the Southern European countries are often seen by the rest of Europeans as having warm peoples, characterised for their joy, enthusiasm and imagination, but often relegating for a second plan the need for long term planning and efficient organisational solutions. Although this is not the dominant situation, some degree of reality is encompassed in this simplified assessment, as reflected, for instance, by poor urban planning in some areas and a lack of a clearly defined long-term strategy for agriculture. One of the current trends is a change of culture and behaviour in this respect. Among the aspects considered in the factor form, the following tables summarises the results of the research carried out.

Socio-cultural factors	
Key aspect	Awareness of the population with regard to drinking water quality and environmental problems in Portugal
Trend	Very significant increase
Driving forces:	▪ Very high quality information on the service is now being produced; ▪ Consumers are much more aware of their rights (e.g. the number of complains received by IRAR, the Regulator, increased from ~30 in 2002 to >500 in 2005, although the quality of service has improved during this period; ▪ The average degree of education of the population increased significantly in Portugal during the last 2-3 decades; ▪ Media and particularly internet play a key role.
Economical factors	
Key aspect	Regulatory framework
Trend	Increase of the geographical and enforcing authority limits of the national regulator
Driving forces:	▪ The activity of IRAR, the Portuguese regulator, has caused major positive impacts in the water supply industry in the last 4 years; ▪ IRAR regulates the drinking water quality in the whole country, but is the economic and quality regulator for a limited number of utilities (the municipal services are not regulated); ▪ There is a consensus among every key stakeholder that the role of IRAR should be similar for all utilities, regardless of their institutional framework.
Key aspect	Rehabilitation investment needs
Trend	Investment needs are still very significant
Driving forces:	▪ In recent years Portugal has invested very heavily in new drink water assets, mainly for production and bulk transmission; ▪ The new National Strategic Plan for 2007-2013 points out the need to continue this effort, now more focused on the distribution systems; ▪ As for the existing assets, average investment will in general be below the recommended values; ▪ A sustainable infrastructure management would require that investments are of the same order of magnitude as depreciation; ▪ The need for new assets will continue to deviate funds for the rehabilitation of existing assets.
Political factors	
Key aspect	Promotion of solutions for a more flexible and effective utility management

Trend	Increase of the options offered to the municipalities
Driving forces:	▪ The average size of the water distribution network is too small to allow for a good technical management; ▪ PEAASAR 2007-2013 promotes new institutional models allowing for scale effects and more flexible management environments.
Key aspect	Decision making process for innovations
Trend	There are visible trends in the decision making processes for innovation
Driving forces:	▪ The establishment of the multimunicipal bulk companies had a significant leverage effect in terms of technological innovation; ▪ The scale effect created allowed to create specialization within the companies, previously limited to the bigger urban centres; ▪ IRAR, the Regulator, is playing a key role in terms of promoting a higher quality of service to consumers, including drinking water quality.

Technical factors	
Key aspect	Technological solutions
Trend	Adoption of solutions previously used in other countries
Driving forces:	▪ Water treatment equipment manufacturers are almost inexistent in Portugal; ▪ The sector is conservative due to its inertia, but new companies tend to be more open to innovation; ▪ There is more room for the adaptation and improvement of the technologies available on the market than for the implementation of completely new technologies.
Environmental factors	
Key aspect	Wastewater treatment in general has an influence on surface water quality
Trend	Improved efficiency of wastewater treatment plants; minimisation of spills during rain events.
Driving forces:	▪ Need to comply with current and emerging legislation; ▪ Current poor efficiency of a good number of treatment plants; ▪ High frequency of spills during rain events (high intensity of rain during periods, with a order of magnitude of the urban basins concentration time, is frequent in Mediterranean countries).
Demographical factors	
Key aspect	Population distribution
Trend	Concentration in the coastal areas and in "predominantly urban areas"
Driving forces:	▪ Portugal is undergoing an accelerated process of urbanization, even though from the point of view of the landscape it is 'rurality' which is predominant. ▪ 70% of the population lives in the Predominantly Urban Area (APU); ▪ Sprawling areas are a challenge; ▪ Rural population is aging; ▪ In some rural areas, there is an increasing number of permanent residences converted into weekend/holiday houses (this is an issue for urban infrastructures).
Organizational factors	
Key aspect	Management flexibility
Trend	Increasing adoption of more flexible management and organisation solutions
Driving forces:	▪ Most water utilities are public; ▪ Many different organization solutions coexist (state-owned bulk companies, municipal services municipal services concessions, PPP solutions, etc.);

	▪ Municipal services tend to face difficulties in terms of management flexibility; ▪ There is a trend to adopt progressively more flexible management solutions (a slow process).

Risk- related factors	
Key aspect	Water availability and systems reliability
Trend	Increasing awareness and mitigation
Driving forces:	▪ Portugal faces relatively frequent droughts; ▪ A recent drought had a significant leverage effect with regard to contingency planning, which is currently a major issue for some bulk water companies; ▪ The risk associated to technological asset failures is also being considered in the contingency planning; ▪ Water quality safety planning is also an emerging priority for some utilities; ▪ Terrorist attacks are not a significant issue in the agenda of Portuguese water utilities.

2 Summary of the questionnaire

2.1 Socio-cultural factors

Willingness to pay for drinking water	Drinking water represents currently ca. 2.7% of the family budget. Tariffs are not established on the willingness to pay. They have being established on a municipal basis. Legislation with general principles and guidelines will be published in 2007.
Level of information of the consumer with regard to drinking water	The level of consumer education and awareness is increasing. In Portugal there are some legal requirements on the minimum information that utilities have to make public. Results of all analytical tests required by law are part of this information pack.
The appreciation of drinking water	In general, the population trusts the water supplied by public water utilities, seeing it as safe. Consumption of bottled water has increased, but mainly due to marketing/commercial reasons, as well as, in some cases, for taste preferences.
Environmental awareness	Environmental awareness is increasing, although the population in general still has a limited awareness with regard to some of the problems affecting drinking water. Focus has been put mainly on land use / development strategies, air pollution and water bodies' degradation, as it is conveyed by NGOs and media.

2.2 Economical factors

Financing models	In Portugal the water assets are publicly owned and the great majority of water utilities in Portugal is publicly managed. There are some PPP examples, although in a very limited number. However, it is likely that this situation will change in the short run, with the implementation of PEAASAR 2007-2013, the National Strategic Plan for water and wastewater.
Maintenance / renovation of infrastructure	The investments in new water infrastructures assets were very high in the last 3 decades. Maintenance and rehabilitation of existing assets has had insufficient investments. There is a clear need to change the way the rehabilitation of water and wastewater infra-structures is handled in Portugal, which is clearly inadequate. There are good signs in this direction.
Energy costs and energy consumption	Portugal imports most energy used in the country. Energy costs represent in general the second highest item of the utilities running costs, after the manpower

	costs. There is therefore the need and awareness to adopt low energy consumption technologies.
The role of decentralized systems	In Portugal there has been a significant centralization of water supply systems in the past 15 years, with the establishment of new multimunicipal bulk water companies. A number of decentralized municipal-systems remains, but the trend is that they are absorbed by bigger systems. The role of decentralised systems is basically limited to isolated houses, out of the urban settlings.

2.3 Political factors

Decision making process for innovations / investments	Large investments and the establishment of the multimunicipal bulk companies had a significant leverage effect in terms of technological innovation.
The role of NGO's and lobby organizations	NGO's have a relevant role in the country. Quercus and GEOTA are the most visible and active environmentalist ones. APESB and APRH are technical and scientific associations, promoting the debate and awareness on technical issues. APDA, AEPSA and ANMP are the main lobby organizations.
Administrative procedures	Administrative procedures are sometimes complex and bureaucratic, particular in the municipal services. However, the situation is improving. The new bulk companies, although publicly owned, have a much more flexible legal framework to comply with.
The role of political parties	A new water law was published in 2005, voted almost unanimously by the Parliament, showing a political consensus among political parties in the technical issues. A different situation regards the institutional organization of the water supply sector, for which there are different political positions.
Changes in water quality standards	Portuguese legislation regarding water quality standards essentially corresponds to the direct transposition of the European Directives.
Other Political Aspects	Portugal has one of the few national regulators in Europe, with rather positive impacts.

2.4 Technical factors

Which breakthrough technologies are expected to be	Technology to minimize bromate formation or for its removal, as well as to eliminate cyanotoxins, are key for Portugal.

introduced in to practice in the time frame of 10-20 years?	
Which technologies are emerging?	Chlorine is being replaced by ozone as the primary disinfectant in a number of treatment plants. Unit processes for the removal of disinfection by-product precursors and micropollutants are being installed in many treatment plants.
Point of use treatment systems	Point of use systems are not popular in Portugal, except for some activated carbon filters devices used by a very small part of the population at the taps.
Water recycling systems	Water recycle: there is room for improvement but it is already a practice in many instances. Water reuse: the use of treated wastewater for irrigation is increasing a lot, particularly in golf courses.
Water saving technologies	There is an on-going National Program for the Efficient Use of Water (PNUEA), for the urban, agricultural and industrial sectors in Portugal, envisages contributing to the rational utilization of water. The promotion of water saving technologies is part of it.

2.5 Environmental factors

Emerging pollutants	Emerging pollutants are still a matter primarily dealt with at the scientific level.
Accumulation of pollutants in the environment	Accumulation of pollutants in the environment is currently not negligible. However, it is unlikely to become a serious and generalized problem in Portugal, as the environmental awareness is increasing and more stringent regulations and control are enforced.
The effect of more stringent thresholds and pollution control	The enforcement of more stringent thresholds and pollution control measures is on the way and is expected to prevent any serious and generalized pollution problems in Portugal.
General quality / composition changes in water resources, e.g. due to climate changes	Warming and increased nutrient concentrations are likely to promote algal bloom events, hence aggravating the cyanotoxin problem. Such situation may be particularly significant in Portugal, where surface water predominates (60 %) as a source of drinking water and the solar irradiation is one of the highest in the world.
Region-specific contaminants?	The official drinking water reports show a slight increase of arsenic from 2003 to 2004 in a small number of locations. This may be due to a real increase or – more likely – to a more effective monitoring. Another problem is the occurrence of cyanobacterial blooms in some surface water sources.
Influence of water framework	The on-going implementation of the water framework directive is expected to have a positive impact on the

directive	raw water quality.
Trends in resource water	The current proportion is slightly above 60% of surface water and below 40% of underground water. It is likely this proportion is roughly kept in the medium term.
How does agricultural use of water influence resources?	Nitrate pollution is a current problem in Portugal. Although LNEC could not access to any reliable source with this regard, it seems that there is a trend for improvement with the establishment of protection areas and use of alternative agriculture procedures.
Industry in general: increase / decrease	Portugal has never been a country with heavy industry and there is not any apparent trend for increase.
Wastewater treatment in general: influence on surface water quality	Critical aspects are: need for improvement of existing treatment plants; minimisation of spills during rain events; elimination of cross wrong service connections in separative sewer networks.

2.6 Demographical factors

Distribution of population (Rural areas / cities)	Ca. 70 % of the population lives in "Predominantly Urban Areas". The demographic data shows a strong contrast between the younger urban settlements and the aged of the majority of the rural places. The moving out of the cities by the rich people (as predicted by the Burgess Concentric Zone Model) is not a relevant phenomenon in Portugal.
Age distribution / life expectancy	In the last decade, Portugal has been a moderate growth of population, mainly due to immigration. Close to 16% of the population are 0–14 years old, 67% are 15-65 years, and 17% are elder than 65 years old. Life expectancy is 78 years.
Education level	According to the official statistics, in 1985/86 the education rate for the university level was only 6%, with reference to a 100% for the fist cycle of basic education. In 2003/2004 the same indicator had increased to 27.3%. In 1990, the expected education duration for the 6 year old children was 12.5. In 2000, it was 14.8 years.
Other Demographical Aspects	The main causes of death in Portugal (2004) are diseases of the circulatory system (34,1%) and malignant neoplasms (18,9%).

2.7 Organizational factors

Privatization (different models)	The current participation of the private sector as operators started just in the late 90's and is still rather limited. The National strategic Plan PEAASAR 2007-1013 promotes the creation of multimunicipal distribution companies, which operation is expected to

	be dominantly carried out by private operators.
Centralization / Regionalization	As referred above, the establishment of the bulk water systems corresponded to centralization of the management and of the technical solutions adopted. A future trend is not obvious.

2.8 Risk- related factors

Risk of terror attacks	More than the risk of terror attacks as such, there is some risk of vandalism.
Risk of technical failure: one-step versus multi-barrier systems	Portuguese water utilities are starting to develop water safety plans and contingency plans (e.g. in case of drought).
Optimization of Risk versus Water Quality	In Portugal, chlorine is used almost exclusively as residual disinfectant, as a protection to possible contaminations. The risk of terrorist attacks is not a motivation to increase concentrations of disinfectant residual.
Risk of water availability / drought / climate change	There is a significant risk of droughts (and floods) in Portugal. In 2005 the country suffered the effects of a severe drought.

3 Top 10 trends

3.1 Socio-cultural factors

3.1.1 Introduction and definitions

In social-cultural terms, the main trend identified is the increase of public awareness:

Key aspect	Awareness of the population with regard to drinking water quality and environmental problems Portugal
Examples	▪ Greater interest in the published reports on drinking water quality tests ▪ Youngsters education on the water cycle and their role in preventive measures ▪ Better education to understand the technical basics of the drinking water production and supply.
Trend	Very significant increase
Countertrend	There is some risk that news on emerging pollutants and treatment by-products may lead to a lack of trust in the drinking water even though its quality improves.

3.1.2 Driving forces

The main driving forces are:

- Very high quality information on the service is now being produced;
- Consumers are much more aware of their rights (e.g. the number of complains received by IRAR, the Regulator, increased from ~30 in 2002 to >500 in 2005, although the quality of service has improved during this period;
- The average degree of education of the population increased significantly in Portugal during the last 2-3 decades;
- Media and particularly internet play a key role.

3.1.3 General implications

The added awareness and the population needs to correspond to an enhanced social responsibility.

3.1.4 Implications for the water industry

The main consequence of this trend for the water industry is an increased pressure of the public on the utilities for a better service and a good communication of these with the users.

3.1.5 *Adaptive strategies*

Strategies will continue to be:

- Improvement of communication channels within the organisation and between the utility and the society;
- Better information systems integration;
- Use of the technologies with an optimized cost-benefit ratio;
- Prevent the media pressure to create a bias on the fundamental decisions.

3.1.6 *Conclusion*

Increased public awareness will have a positive impact on the drinking water quality. Measures need to be implemented in order to minimise bias in the information conveyed to the public.

3.2 Economical factors (1/2)

3.2.1 *Introduction and definitions*

In economical terms, the identified main trends are associated to the national regulator increase in geographical scope and authority. Being an economic and quality of service regulator, aiming at a balance between the consumers' interests, the operators' sustainability and the environmental sustainability, it puts a high economic pressure on the regulated entities:

Key aspect	Regulatory framework
Examples	▪ The pressure of the regulator had a major positive influence in the preparation of the water monitoring plans all over the country. ▪ The implementation of performance indicators to regulate the quality of service of the bulk companies and the private operators, as well as the public availability of the results, are being well accepted by all the stakeholders and having a positive impact. ▪ Several stakeholders, including the National Municipalities Association, is requesting the increase of geographical scope and political independence (i.e. nomination by the Government Council for a period different from the political elections cycle).
Trend	Increase of the geographical scope and of the enforcing authority of the national regulator.
Countertrend	There is the risk that governments may not wish an independent regulator and do not support the current consensus of the society with this regard.

3.2.2 *Driving forces*

The main driving forces are:

- The activity of IRAR, the Portuguese regulator, has caused major positive impacts in the water supply industry in the last 4 years;
- IRAR regulates the drinking water quality in the whole country, but is the economic and quality regulator for a limited number of utilities (the municipal services are not regulated);
- There is a consensus among the key stakeholders that the role of IRAR should be similar for all utilities, regardless of their institutional framework.

3.2.3 General implications

Added transparency of the water supply activity and improved protection of the consumers' interests.

3.2.4 Implications for the water industry

The main consequence of this trend for the water industry is the stimulation for an increased efficiency, effectiveness and transparency.

3.2.5 Adaptive strategies

Strategies will have to include:

- Technical support to the smaller utilities so that they can create the information mechanisms involved in a regulated framework:
- The continuation of encouragement measures rather then a fully penalty-based system;
- Promotion of the use of more modern and effective technologies;
- Training of the human resources.

3.2.6 Conclusion

A fair regulatory system, with the same approach so far adopted by IRAR, but applied to every utility regardless of its institutional framework, is felt necessary and will have a significant impact on the water industry in Portugal in terms of the efficiency and effectiveness of the service provided.

3.3 Economical factors (2/2)

3.3.1 Introduction and definitions

The second main trend identified in economic terms is the increase of investment in rehabilitation:

Key aspect	Rehabilitation investment needs
Examples	▪ In the long run, investments in rehabilitation, renovation included, has to be of the order of 1 / average useful asset life. The investment in new water and wastewater assets in the period 2000-2013 (approx. 8 000 million euro) corresponds to an added responsibility of around 160 million euro per year in rehabilitation if the average asset life were 50 years. This is a figure which utilities and politicians do not seem to be aware of.
Trend	Rehabilitation investment will need to increase
Countertrend	There is the risk that the current situation of insufficient investment in rehabilitation proceeds, with the corresponding impact on the lack of sustainability of the service provided.

3.3.2 Driving forces

The main driving forces are:

- In recent years Portugal has invested very heavily in new drink water assets, mainly in production and bulk transmission assets;
- The new National Strategic Plan for 2007-2013 points out the need to continue this effort, now more focused on the distribution systems;
- As for the existing assets, average investment will in general be below the recommended values;
- A sustainable infrastructure management would require that investments are of the same order of magnitude as depreciation;
- The need for new assets will continue to reduce funds available for the rehabilitation of existing assets.

3.3.3 General implications

Sustainable investments in rehabilitation will have a positive impact in the long terms but may cause the increase of water tariffs.

3.3.4 Implications for the water industry

The main consequence of this trend is the need for a better asset management, based on sound technical information and decision making.

3.3.5 Adaptive strategies

Strategies will continue to be:

- R&D in asset management tools;
- Awareness of the utilities for this need;
- Implementation of economic and legal incentives by politicians and regulators.

3.3.6 *Conclusion*

An adequate investment policy in rehabilitation, including the renovation of treatment facilities, will lead to better servicing and water quality at the consumers' tap.

3.4 Political factors (1/2)

3.4.1 *Introduction and definitions*

In political terms, one of the two main trends identified is the adoption of more flexible and effective utility management solutions[1]:

Key aspect	Promotion of solutions for a more flexible and effective utility management
Examples	▪ Creation of regional companies, with a technical and economical attractive size, responsible for the distribution systems of several small adjacent municipalities. The new companies, PPP based, will have clear contracts to comply with, but a more flexible management structure than the municipal services, in aspects such as bureaucracy, legal constraints and human resources management.
Trend	Increase of the options offered to the municipalities
Countertrend	There is some risk that these new models considered in the PEAASAR 2007-2013 are not adopted by the municipalities.

3.4.2 *Driving forces*

The main driving forces are:

- The average size of many water distribution networks is too small to be competitive and allow for the level of technical management, which is required to comply with regulations;
- PEAASAR 2007-2013 promotes new institutional models allowing for scale effects and more flexible management environments.

3.4.3 *General implications*

Improved quality of service.

[1] This is also an organisational factor.

3.4.4 *Implications for the water industry*

If this new model is adopted by a significant part of the Portuguese municipalities, as it currently seems to be the case, it will have major impacts of the sector as a whole.

3.4.5 *Adaptive strategies*

Planned strategies include:

- Adaptation of the current legislation in order to accommodate the new institutional models;
- Creation of incentives to the municipalities;
- Establishment of requirements for the applications to the new cycle of EU cohesion funds that may assist the PEAASAR objectives.

3.4.6 *Conclusion*

Portugal needs to find management solutions that are more flexible and allow for a more efficient management of the municipal water distribution systems. There are good signs that this will occur in the coming years.

3.5 Political factors (2/2)

3.5.1 *Introduction and definitions*

The other key trend identified in political terms is the promotion of innovation:

Key aspect	Decision making process for innovations
Examples	▪ Use of modern technological solutions in most of the bulk water supply systems recently built (e.g. IT, monitoring, treatment, condition and performance assessment, etc.). ▪ Creation of high level modelling skills within the utilities with the support of LNEC, in the scope of the project INSAA – National Initiative for the Simulation of Water Supply Networks, concluded in September 2006.
Trend	There are visible trends in the decision making processes for innovation
Countertrend	Portugal has a very limited production of equipment for the water supply sector, in particular for water treatment and control.

3.5.2 *Driving forces*

The main driving forces are:

- The establishment of the multimunicipal bulk companies has a significant leverage effect in terms of technological innovation;
- The scale effect created allowed to create specialization within the companies, previously limited to the bigger urban centres;
- IRAR, the Regulator, is playing a key role in terms of promoting a higher quality of service to consumers, including the drinking water quality.

3.5.3 General implications

Better quality of service.

3.5.4 Implications for the water industry

Need for the adaptation to new technologies.

3.5.5 Adaptive strategies

Strategies will continue to be:
- R&D activities well adapted to the real needs;
- Response capacity of the manufacturers;
- Effective transfer of knowledge between researchers and practitioners.

3.5.6 Conclusion

A good number of water utilities in Portugal are open to innovation, provided that the technologies have proven to be adequate and effective and are well adapted to their situation. The foreseeable evolution of the sector identified in the previous section is an added factor to this spirit of receptivity to innovation. However, the lack of local manufacturers is a constraint.

3.6 Technical factors

3.6.1 Introduction and definitions

In technical terms, the main trend identified is use of innovative technical solutions:

Key aspect	Technological solutions
Examples	(see previous trend)
Trend	Adoption of solutions previously used in other countries
Countertrend	Not relevant.

3.6.2 Driving forces

The main driving forces are:

- Water treatment equipment manufacturers are almost inexistent in Portugal;

- The sector is conservative due to its inertia, but new companies tend to be more open to innovation;
- There is more room for the adaptation and improvement of the technologies available on the market than for the implementation of completely new technologies.

3.6.3 General implications

Need for a good coordination between utilities, researchers and technology providers.

3.6.4 Implications for the water industry

Need for awareness and training on innovative technology that is reliable and adequate for the local conditions and needs.

3.6.5 Adaptive strategies

As already referred in the previous tend, strategies contemplate:
- R&D activities well adapted to the real needs;
- Response capacity of the manufacturers;
- Effective transfer of knowledge between researchers and practitioners.

3.6.6 Conclusion

It should be noted that sometimes research results are not adopted by the industry simply because sometimes they do not fit the actual needs or present practical shortcomings developers were not aware of, due to a lack of practical experience and know-how. A good cooperation between developers and end-users is therefore a critical aspect for the acceptance of innovation.

3.7 Environmental factors

3.7.1 Introduction and definitions

In environmental terms, the main trend identified is the improved efficiency of treatment plants; minimisation of spills during rain events:

Key aspect	Wastewater treatment in general: influence on surface water quality
Examples	▪ Treatment plants designed exclusively for wastewater, which have a very poor efficiency when it rains. ▪ Frequent spills for low return period rain events. ▪ Untreated storm water discharges polluted with wastewater due to incorrect service connections construction.
Trend	Improved efficiency of treatment plants; minimisation of spills during rain events.
Countertrend	There are technical difficulties that prevent a full eradication of cross connections between the stormwater and the wastewater systems.

3.7.2 Driving forces

The main driving forces are:

- Need to comply with current and emerging legislation;
- Current poor efficiency of a good number of treatment plants;
- High frequency of spills during rain events (high intensity of rain during periods of the order of magnitude of the urban basins concentration time is frequent in Mediterranean countries).

3.7.3 General implications

There is a need for added responsibility of the society, and especially of property owners and construction companies.

3.7.4 Implications for the water industry

Utilities need to define medium term strategies that lead to cross connection eradication and to an integrated urban water management.

3.7.5 Adaptive strategies

Strategies will continue to be:

- Creation of legal, financial, and technical incentives to the municipalities for the establishment of eradication plans; priority should be given to the cases where the discharge of polluted water may affect drinking water sources;
- Promotion of better operation practices of the treatment plants;
- Implementation of source control solutions whenever feasible;
- Implementation of stormwater storage capacity when feasible and appropriate.

3.7.6 Conclusion

Discharge of untreated or inadequately treated water is still a risk factor in terms of drinking water sources. Southern European countries, where intensive rain events are frequent, are more exposed to this risk. Mitigation measures need to be implemented. Although prevention is a priority, drinking water treatment cannot ignore this problem.

3.8 Demographical factors

3.8.1 Introduction and definitions

In demographic terms, the main trend identified is the increase of concentration in the coastal areas and in "predominantly urban areas":

Key aspect	Population distribution
Examples	▪ Many houses in small villages of the interior of Portugal are being rehabilitated for week-end and holiday properties. ▪ Many elementary schools in these regions are closing for lack of students. ▪ Construction and operation of infrastructures is more expensive (€/inhabitant). ▪ Construction of new houses in the costal area proceeds, showing this movement is not stabilised yet.
Trend	Concentration in the coastal areas and in "predominantly urban areas"
Countertrend	This trend has been rather intensive for the past 30 years. It is foreseeable that the situation gets stable in the medium term. Central and local politicians try to invert this trend, but so far without significant success.

3.8.2 Driving forces

The main driving forces are:

- Portugal is undergoing an accelerated process of urbanization, even though from the point of view of the landscape it is 'rurality' which is predominant.
- 70% of the population lives in Predominantly Urban Area (APU);
- Sprawling areas are a challenge;
- Rural population is aging;
- In rural areas, there is an increasing number of permanent residences converted into weekend/holiday houses (this is an issue for urban infrastructures).

3.8.3 General implications

The general implications of this trend is an unbalanced use of the country land; poorer quality of life.

3.8.4 Implications for the water industry

The main consequence of this trend for the water industry is high costs of the infrastructures at the areas that are being abandoned as primary living place, the low economical condition of the elderly people who stay, and the problems related to the urban infrastructures in sprawling areas.

3.8.5 Adaptive strategies

Strategies will continue to be:

- Water utilities will have to continue looking for technical solutions that are adequate for low densely populated regions; decentralised solutions are promising, although they often present also significant shortcomings.

3.8.6 Conclusion

The internal migration flows occurring in Portugal for the past decades are impacting the water industry. In parallel to the political measures that may be taken to change this trend, there is a need for the water industry to adapt itself to this situation. Another aspect that needs to be accounted for is the fact that the new holiday inhabitants, although staying for short periods, have service expectations higher than the local populations.

3.9 Organizational factors

3.9.1 Introduction and definitions

In organizational terms, the main trend identified is the increase of adoption of more flexible management and organisation solutions. This trend is very similar to the one presented in 3.4 - Political factors (1/2), seen from the organisational viewpoint:

Key aspect	Management flexibility
Examples	(see 3.4.1)
Trend	Increasing adoption of more flexible management and organisation solutions
Countertrend	(see 3.4.1)

3.9.2 Driving forces

The main driving forces are:

- Most water utilities are public;
- Many different organization solutions coexist (state-owned bulk companies, municipal services municipal services, concessions, PPP solutions, etc.);

- Municipal services tend to face difficulties in terms of management flexibility;
- There is a trend to adopt progressively more flexible management solutions (slow process).

3.9.3 General implications

(see 3.4.3)

3.9.4 Implications for the water industry

(see 3.4.4)

3.9.5 Adaptive strategies

(see 3.4.5)

3.9.6 Conclusion

(see 3.4.6)

3.10 Risk- related factors

3.10.1 Introduction and definitions

In terms of risk, the main trend identified is the increase of risk awareness and mitigation with regard to water availability and systems reliability:

Key aspect	Water availability and systems reliability
Examples	▪ The 2005 drought showed that big and complex systems depending on a very limited number of sources (e.g. Algarve bulk supply system) are too vulnerable; a contingency plan was in the meantime elaborated and mitigation measures are being implemented; ▪ Failures in critical assets, regardless of its cause, may have great impacts on the water quality; critical assets need to be identified and risk mitigation measures identified and implemented.
Trend	Increasing awareness and mitigation
Countertrend	Risk assessment and mitigation became a 'fashionable' topic. There is some risk that 'fashion' changes.

3.10.2 Driving forces

The main driving forces are:

- Portugal faces relatively frequent droughts;

- A recent drought had a significant leverage effect with regard to contingency planning, which is currently a major issue for some bulk water companies;
- The risk associated to technological asset failures is also being considered in the contingency planning;
- Water quality safety planning is also an emerging priority for some utilities;
- Terrorist attacks are not a significant issue in the agenda of Portuguese water utilities.

3.10.3 General implications

Society needs to be conscientious of the risks of water shortage, in order to collaborate in mitigation actions.

3.10.4 Implications for the water industry

Water utilities need to get know-how and to re-organise themselves in order support decision-making on a risk basis. The implementation of strategic infrastructure asset management, which aims at balancing performance, risk and cost in the long run, is fundamental. However, this is neither an easy nor a rapid task.

3.10.5 Adaptive strategies

Adaptive strategies are:

- Development and implementation of water safety plans;
- Development and implementation of contingency plans;
- Implementation of strategic infrastructure asset management.

3.10.6 Conclusion

Although there is an increasing awareness of some of the risks water utilities face, there is a long way in terms of adequate risk management. There is a lot of potential in TECHNEAU with this regard.

4 Conclusions

The drinking water sector in Portugal is a key issue in the country's political agenda. This will continue to be the case in the coming decade due to:

- Gap that still exists between strategic objectives and real situation, particularly in the lower densely populated areas of Portugal;
- Regulator's pressure;
- Increasing requirements in terms of European legislation;
- Still growing pressures on water resources;
- Climate change.

Although water supply and wastewater are typically conservative activities worldwide, in Portugal there is ground for significant innovation in the coming decades. The situation improved a lot in recent years with the establishment of new bulk water supply companies. This strategy led to major changes in drinking water sources, treatment facilities and technologies, and technical know-how to run these new facilities in an efficient and effective way. However, it has the disadvantage of creating a gap between production/bulk transport and distribution. Often there is a lag of adequate integration between the two types of system, and the (technical) communication between stakeholders is not as efficient as it is when the systems are ran as a whole. Conversely, the average small size of the distribution companies is a constraint for innovation. The vertical integration from source to distribution infra-structures and the change of scale in the water distribution activities that with occur with the implementation of the National Strategic Water and Wastewater Plan 2007-2013 will have major impacts in the long run.

On the one hand, the trend will be sophisticate the current treatment, O&M and monitoring technologies in order to cope with increasing requirements. On the other hand, there will be a need to establish novel solutions to deal with the low densely populated areas of the interior of Portugal that cannot be supplied by the existing bulk water systems due to technical and economic reasons, still presenting some basic water quality problems.

5 Appendix: Questionnaire

Matrix of Factors
Contribution from LNEC

5.1 General information

Region	**Southern Europe**
Covering countries	**Portugal**
Population (thousand people)	**10 356** (resident population, Census 2001) **10 536** (2004) (http://www.portugal.gov.pt/Portal/PT/Portugal/)

5.2 Socio-cultural factors

Willingness to pay for drinking water
Is drinking water an important part of the budget in general? How will this change and will this be accepted?
The water tariffs are currently defined by each individual municipally, and the average price presents a very high variance. A study promoted in 2004 by the Portuguese Waterworks Association (APDA, 2004) showed that the maximum unit cost is 29 times higher than the lowest. The average price is 0.698 EUR/cu.m for an annual consumption of 120 cu.m/year and 0.76 EUR/cu.m for an annual consumption of 200 cu.m/year. A recent study, elaborated in the scope of the preparation of the Water Supply and Wastewater National Strategic Plan 2007-2013, showed that in many cases the costs are not covered. The implementation of a national tariff regulation, currently in a final stage of development by IRAR (Portuguese Institute for the Regulation of Waters and Solid Waste) will contribute for a more coherent tariff setting and for a full cost coverage policy. On the other hand, this national tariff setting, to be implemented gradually, will also contribute inevitably to an increase of water tariffs. The Portuguese per capita GNP is 12 817 Eur (2004) (source: http://www.portugal.gov.pt/Portal/PT/Portugal/). This means that, in average, the water tariffs represent nowadays around 2.7% of the family budget, assuming a standard consumption of 120 cu.m/year/household and a standard size of 3.2 people per household. It is therefore a low value. The acceptance of the water tariff raise that will have to occur in the coming years in some regions of the country will depend very much on the public awareness policies to be implemented and on how gradual the process will be. There are very limited studies of the willingness to pay of the Portuguese population. The tariffs are not established on the basis of the willingness to pay, assessed on a reliable way. The wastewater bill is in general combined with the water bill, as a function of the water consumption, but clearly differentiating the two services. The wastewater bill is in general lower than the water bill. The trend is that both will increase, the wastewater reaching a value equal or greater than the water tariffs.
Sources:
APDA (2004). Abastecimento de Água em Portugal - O mercado e os preços, Comissão Especializada de Legislação e Economia da APDA, Associação Portuguesa de Distribuição e Drenagem de Água, ISBN 213719/04, Lisbon, Portugal.

Level of information of the consumer with regard to drinking water
Are people getting more educated or do they lose interest? This aspect is partially coupled with the demographic aspect of level of education
In Portugal there are some legal requirements on the minimum information utilities have to make public. Results of all analytical tests required by law are part of this information pack. The level of consumer education and awareness is increasing. There is not any systematic study with this regard, but it is clear that the Portuguese water utilities are

nowadays investing much more in consumer communication than some years ago, that the media publish frequently articles regarding water-related problems, that it is more common to see school children visiting water undertaking facilities or involved in water and environment activities, etc. Ease of access to web-based information is also a major factor for this evolution (e.g. www.portaldaagua.com, www.consumidor.pt, www.irar.pt).

IRAR is finalizing a "Customer Charter" template, in order to encourage the undertakings to adopt this type of tool.

IRAR is also publishing periodic reports on the water sector, including a detailed water quality and quality of service report.

The evolution of the level of education in Portugal also contributes to a higher level of information of the consumer with regard to water. According to the official statistics (see sources below), in 1985/86 the education rate for the university level was only 6%, with reference to a 100% for the fist cycle of basic education. In 2003/2004 the same indicator had increased to 27.3%. In 1990, the expected education duration for the 6 year old children was 12.5. In 2000, it was 14.8 years.

Sources:

Séries Cronológicas, Alunos (1985-2005), Ministério da Educação, published Feb. 2006, http://www.giase.min-edu.pt/content02.asp?auxID=pubs-online#0304, ref May 2006).

Sistema Educativo Português: Situação e Tendências 1990-2000, Ministério da Educação, published October 2004, http://www.giase.min-edu.pt/upload/docs/sep.pdf

The appreciation of drinking water

For example, water can be a life style product; especially this seems to be the case for bottled water (?)

According to Santos Silva (2002), the per capita bottled water consumption in 1999 was of 65 liters per year, 90% of which is still water. The total consumption of drinks (tap water excluded) was 402 liters per capita per year. A paper (non-identified author) made available at http://disciplinas.dcea.fct.unl.pt/hidraulica/a_textosapoio/hua/HU-2-4CONSUMOS-DIVERSOS.pdf, by the Hydraulics Group of Departamento de Ciências e Engenharia do Ambiente, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, shows a table with the evolution of bottled water consumption in Portugal from 1987 to 2002. The increase of bottled water was high: 26.9 liters per capita per year in 1987 to 80.7 in 2002. The statistics presented for 1999 is 68.6.

On the other hand, the official drinking water quality reports (IRAR, 2006) show a significant improvement of the drinking water quality in Portugal. The main problems are located in the smaller systems. The global incompliance rate was of 2.7 in 2004 (mainly regarding pH, microbiological parameters, iron, manganese and arsenic). The systems supplying more than 50000 inhabitants, which serve 43.1% of the total population, have a much lower incompliance rate.

The increase of bottled water consumption cannot therefore be objectively related to the tap water quality. It is basically a cultural change, derived from marketing and

publicity. In the bigger urban centers, the preference for bottled water tends to be justified by consumers as a taste matter (e.g. chlorine residual), and not as a matter of lack of confidence in the quality of the supplied water, in terms of health risk. However, an informal study held by LNEC in 2000 did not prove this justification. A group of 42 persons were subject to blind test including tap water and two popular bottled water brands. 58% of them preferred the tap water.

Sources:

Santos Silva, P. (2002). Inovação ambiental na gestão de embalagens de bebidas em Portugal, MsC dissertation, Universidade Nova de Lisboa, http://in3.dem.ist.utl.pt/master/thesis/00files/11thesis.pdf
IRAR (2006). RASARP 2005 - Relatório Anual do Sector de Águas e Resíduos em Portugal. Vol. 4 – Avaliação da qualidade da água para consumo humano, IRAR, Portugal. (http://www.irar.pt/presentationlayer/artigo_00.aspx?artigoid=84&idioma=1).

Environmental Awareness

Also awareness regarding emerging pollutants. Are trends visible?

Environmental awareness has increased very significantly in Portugal, similarly to the other European countries. Currently, the influence of environmental NGOs and of the media is high, particularly from claiming the enforcement of the environmental legislation, which, as a result of the transposition of the European Directives, is nowadays much more demanding than some years ago. On the other hand, interest and education with regard to environmental problems has improved significantly. In Portugal, the first university degrees in environmental sciences and engineering were launched in 1977/78. Nowadays there are more than 15 university degree courses, as well as a good number of master, specialisation and doctoral courses.

Nevertheless, presently public awareness seems mainly focused on land use / development strategies, air pollution and water bodies' degradation, as it is conveyed by NGOs and media. Sporadically, reported unspecific waterborne disease episodes or information on sanitary unsound waters are subject of concern, both relating to bathing and drinking waters. However, public awareness on emerging drinking-water-pollutants is far from apparent, contrarily to some existing concerns on chemicals (e.g., hormones) in food.

At the level of the Portuguese utilities, drinking water quality concepts chiefly relate to conventional and regulated aspects and major investments have been made to improve the quality of the water, namely to comply with the European Drinking Water Directive.

In spite of that, awareness on emerging contaminants is becoming apparent among the larger water companies. In particular, cyanotoxins are motif of concern and some utilities have or started the implementation of bloom and toxins monitoring programs.

Hence, among some of the larger utilities, efforts on the implementation of the monitoring of algal blooms and cyanotoxins are apparent. In addition to a systematic monitoring, whenever necessary the Algarve water company (e.g. Águas do Algarve, S.A.) applies activated carbon treatment for cyanotoxin removal.

Micropollutants from drinking water pipe leaching are other emerging contaminants of concern for some of the larger utilities, namely the Lisbon one (EPAL). The company monitors some of these compounds (e.g. epichloridrine) at a regular basis.

Therefore, while at least for now, there are no signs of a general public consciousness on the potential risks from micro-pollutants in drinking water, awareness is emerging among the larger utilities. However, such trend is not yet visible for smaller water undertakings and expectably will take some years to occur.

Sources:
Direct knowledge LNEC has of the sector. Cardoso V. (2003) Epicloridrina. Águas Livres. Maio, p. 4. Rosa, M.J., Cecílio, T., Costa. H., Baptista, R. and Lourenço, D.(2004) Monitoring of Microcystins at Funcho Dam Reservoir. Proc. 4th IWA World Water Congress.

Other Socio-Cultural Aspects

5.3 Economical factors

Financing models
Privately owned, fully state-owned and different participation models exist. What trends can be observed?
According to IRAR (2005), the situation by the end of 2004 was as follows: 14 bulk water supply companies (fully state owned) 1 multimunicipal concession (state-owned) 1 public company 209 multi-service municipal services 36 autonomous water and wastewater municipal services 9 municipal companies 21 concessions to private companies (for construction, operation and maintenance) If the existing draft of Water and Wastewater Strategic Plan for 2007-2013 is approved as it currently stands for, there will be a significant increase on the private operators' participation in the coming years. In the new institutional model considered as a complementary alternative municipalities are free to chose, the municipal infrastructures will be integrated into the bulk water system (state-governmental owned) and the rehabilitation, operation and management will be put on the market.
Sources:
IRAR (2005). RASARP 2004 - Relatório Anual do Sector de Águas e Resíduos em Portugal. Vol. 1 – Caracterização geral do sector, IRAR, 2005. (http://www.irar.pt/presentationlayer/artigo_00.aspx?artigoid=84&idioma=1).

Maintenance / renovation of infrastructure
E.g. it is claimed sometimes that the renovation of e.g. distribution systems will require huge capital in the future
The investments in new water infrastructures assets were very high in the last 3 decades. The national strategic option of incrementing the level of service coverage associated with the EU policy of financing new assets and not the rehabilitation of existing ones contributed for an insufficient attention to the maintenance and rehabilitation needs. PEAASAR - the strategic plan for water supply and wastewater treatment for 2007-2013, developed by the Ministry of the Environment, Land Planning and Regional Development and presently under public consultation, defines as the main priority the improvement of the infra-structures and the exploitation of the municipal systems. This plan proposes a new institutional framework, which will coexist with

the present ones, and that the municipalities may adopt on a volunteer basis. This new model includes the vertical integration of the infra-structures (i.e., in the respective multi-municipal systems of Águas de Portugal) and, possibly, the contracting to third parties of the exploitation, including the operation, maintenance and rehabilitation. If the PEAASAR is approved by the government in these terms, the importance and visibility of rehabilitation will increase significantly. Also, this Plan stresses the need to guaranty the rationality and the sustainability of the solutions, the improvement of the efficiency and the quality of the service.

In addition, the government's program identifies the Technological Plan as a major factor for the development, and stresses the re-qualification of the human resources and the adoption of technological innovation that can contribute to the improvement of the productivity and the effectiveness.

IRAR, as a regulator of the quality of the services, has developed and put into practice a system of performance indicators that aims at promoting the sustainability of the infra-structures, among others.

In this context, there is a clear need to change the way the rehabilitation of water and wastewater infra-structures is handled in Portugal, which is clearly inadequate. This inadequacy is due to the lack of legal and institutional incentives and to the lack of knowledge and appropriate instruments for decision support. According to IRAR (2005), in 2004 the municipal services have high rates of failures in the pipelines (99 failures/100 km of pipeline/year on average, with values between 33 and 346), high water losses (18,6% inefficiency on the use of water resources, on average, with values between 8.4 and 40.8%). This low performance can be partly attributed to the low rehabilitation rates (on average 0.9% per year, with variations between 0 and 4%). Note that 0.9% would only be a sustainable rehabilitation rate if the average expected life of the pipelines was 111 years.

Sources:

IRAR (2005). RASARP 2004 - Relatório Anual do Sector de Águas e Resíduos em Portugal. Vol. 3 – Avaliação da qualidade do serviço prestado aos utilizadores, IRAR, 2005.
(http://www.irar.pt/presentationlayer/artigo_00.aspx?artigoid=84&idioma=1).

Energy costs and energy consumption

Which trends in energy prices are expected and how will this affect the drinking water situation?

Portugal imports most energy used in the country.

To the author's knowledge, there is not any representative statistics informing of the weight of energy cost within the O&M costs. However, there is a consensus that the energy costs represent in general the second higher item of the utilities running costs, after the manpower costs. In a study carried out by LNEC with 9 Portuguese water utilities, the median of the water energy costs with regard to the overall O&M costs is 11%, achieving values up to 26% (Alegre *et al.*, 2005).

This shows the relative importance that the energy increase may have on the global production costs. This affects the technological solutions preferred by the utilities (low energy consumption). However, there are other price drivers related to the capital investments needed that will continue to be more relevant in the coming

decade.

Sources:

ALEGRE, H.; FIGUEIREDO, R.; DUARTE, P. (2005) – Iniciativa PI-COMP: Comparação de desempenho entre entidades gestoras de sistemas de abastecimento de água – síntese de resultados para os participantes do projecto PI-Waters, ITH 43, LNEC, Lisbon (96 pág.).

The role of decentralized systems

How will this affect the costs distribution?

In Portugal the evolution of the water supply systems has been towards centralization, not decentralized systems. Fifteen years ago, the water supply sector was characterized by a very small average size of the systems and a poor quality of the water supplied in some regions (Alegre, 1994). In the 90's, major investments were made in the construction of multimunicipal bulk systems, which corresponded to a centralization of the systems and of the management. Nowadays 72% of the Portuguese population is supplied by these systems (IRAR, 2005a). However, IRAR (2005a) shows that, in 2004, there were 4078 supply zones with less than 5000 inhabitants, representing 92.7 the small systems. These systems quality of service in these cases, and particularly the water quality, are a problem that will be a matter of attention in the coming years, as stated in the draft of PEAASAR 2007-2013, previously referred.

Sources:

IRAR (2005a). RASARP 2004 - Relatório Anual do Sector de Águas e Resíduos em Portugal. Vol. 1 – Caracterização geral do sector, IRAR, 2005. (http://www.irar.pt/presentationlayer/artigo_00.aspx?artigoid=84&idioma=1).
IRAR (2005b). RASARP 2004 - Relatório Anual do Sector de Águas e Resíduos em Portugal. Vol. 4 – Avaliação da qualidade da água para consumo humano, IRAR, Portugal.
(http://www.irar.pt/presentationlayer/artigo_00.aspx?artigoid=84&idioma=1).
ALEGRE, H. (1994) – Instrumentos de apoio à gestão técnica de sistemas de distribuição de água, Vol. I of the series "Teses e Programas de Investigação LNEC", LNEC, Lisbon, ISBN 972-49-1608-1 (598 pp.).

Other Economical Aspects

5.4 Political factors

Decision making process for innovations / investments

Are trends visible in this process?

There are visible trends in the decision making processes for innovation. The establishment of the multimunicipal bulk companies had a significant leverage effect in terms of technological innovation. The scale effect created allowed to create specialization within the companies, previously limited to the bigger urban centers. In parallel, the improvement of the education level of the population allows the medium size undertakings to have a higher level of expertise than some years ago. An interesting indicator that shows this evolution is the number and quality of technical papers presented in Portuguese Conferences and seminars by water undertaking staff. Two decades ago, academics and researchers had almost the monopoly of these events. Nowadays the situation is completely different, with a very good participation of the industry professionals. However, there is still a long way to go. Water supply is typically an activity with a high inertia, and innovation is not easily incorporated in many situations.

Sources:

Direct knowledge LNEC has of the sector.

The role of NGO's and lobby organizations

NGO's have a relevant role and can be grouped into Consumers' Associations, Environmental NGO, Lobby Associations and Technical and Scientific NGO.

There are several consumers associations, DECO being the most relevant one.

According to the Instituto do Ambiente, 108 Environmental NGO and 43 equivalent organizations were recorded in Portugal in July 2005. Fro these, 13% have a national level, 20% a regional level and 39% a local level. The remaining 28% do not have geographical scope. Quercus and GEOTA are the most visible and active ones at national level.

Lobby associations act in the various economic activities: utilities, private operators, construction companies, manufactories and equipment and materials dealers. The most active ones are APDA (Portuguese Waterworks Association), ANMP (Portuguese National Association of Portuguese Municipalities), and AEPSA (Association of the Portuguese Companies in the Environmental Sector). APDA is simultaneously a lobby and a technical association.

Technical and Scientific Associations aim to be independent from the political parties and government policies, promoting the unbiased discussion of relevant themes, organizing technical and scientific meetings and publishing journals. The most relevant are APRH (Portuguese Water Resources Association), APESB (Portuguese Association of Sanitary and Environmental Engineering) and APDA (previously referred).

Sources:

Direct knowledge LNEC has of the sector, and

IRAR (2005). RASARP 2004 - Relatório Anual do Sector de Águas e Resíduos em Portugal. Vol. 1 – Caracterização geral do sector, IRAR, 2005. (http://www.irar.pt/presentationlayer/artigo_00.aspx?artigoid=84&idioma=1).

Administrative procedures
E.g. approval of new technologies for application in drinking water
The main mechanisms for the approval of new technologies in drinking water are: - Compliance with the legislation; - Compliance with existing standards, particularly with CEN standards; - Approval ("homologação") by an independent organization recognized by the Portuguese Quality Institute (e.g. LNEC); - Compliance with technical guidelines. Administrative procedures are recognized to be complex and bureaucratic in many cases, particular in the municipal services. The legal requirements applicable to public administration are sometimes inadequate for an efficient management of a water utility. However, the situation is improving. The new bulk companies, although publicly owned, have a much more flexible legal framework to comply with.
Sources:
Direct knowledge LNEC has of the sector (LNEC coordinates the standardization activities related to water and wastewater in Portugal).

The role of political parties
E.g. the Greens. These situations can change quickly, but are also more general trends visible?
The activity of activity political parties can be split into actions related to technical solutions and actions related to institutional and economic aspects. With regard to technical /technological solutions, political consensus is easier and political parties have not assume very different positions one from the others, contrarily to what happens with the wastewater and solid waste sectors. A new water law was published in 2005, voted almost unanimously by the Parliament. A different situation regards the institutional organization of the water supply sector. As mentioned previously, Portugal is still facing a high dynamics with this regard. The participation of private operators and the role of the state-owned companies are the most discussed topics.
Sources:
Direct knowledge LNEC has of the sector.

Changes in water quality standards
E.g. bathing water standards are prepared in different countries, which will affect the resource water quality. Also effluent quality standards are changing (?) for industry as well as community...
Portuguese legislation regarding water quality standards corresponds to the direct transposition of the European Directives. Only in very specific cases the nation legislation is more demanding, or complementary legislation exists (e.g. legislation regarding the monitoring of bulk water delivery, out of the scope of the European Directives).

Sources:
Direct knowledge LNEC has of the sector.

Other Political Aspects
It should be noted that Portugal has one of the three economic and quality of service regulators in Europe (along with OfWat and the Scottish Regulator). IRAR, this regulator, is currently the water quality regulator for the whole country and the economic and quality regulator for the multimunicipal companies and private concessions. Contrarily to what happens in other European countries, stakeholders and political parties are in favor of the increase of power of this Regulator, aiming to enlarge its scope for the whole country and transforming it into an independent regulator (now it depends on the Ministry for the Environment. Strategic planning: the most important National strategic plans in Portugal are the above referred PEAASAR and the National Water Plan. The latter, elaborated in accordance to the Decree-Law 45/94 , 22 February, defines the guidelines at national level for the integrated management of water, based on the diagnosis of the current situation and on the objective definition and target setting.
Sources:
Direct knowledge LNEC has of the sector.

5.5 Technical factors

Which breakthrough technologies are expected to be introduced in to practice in the time frame of 10-20 years?
Please provide report or reliable sources as a proof of reality of the technologies
Difficult, if not impossible, to forecast. On one side it is not easy to foresee which technological breakthroughs will be available. On the other, no seeming data is available to support any informed guess. Then, what can be advanced is that usually the Portuguese waterworks tend to follow the European main stream trends, but in general they are not pioneer in the type of solutions implemented. Technology to remove bromates and cyanotoxins are key for Portugal.
Sources:
LNEC knowledge of the sector.

Which technologies are emerging?
Some relations with environmental factors may exist - water quality deterioration and emerging pollutants
Increased occurrence of algal blooms plus source water shortages are likely to lead to increments in contaminant and natural organic matter (NOM) levels in catchments' water (predominantly surface water). In addition new (e.g., cyanotoxins, haloacetic acids) or more stringent (e.g., THM) thresholds are expected to be enforced. Accordingly, chlorine will be replaced by ozone as the primary disinfectant in a number of treatment plants and unit processes for the removal of disinfection byproduct precursors and contaminants are expected to be installed in most treatment plants. These may include "activated carbon filtration" and membrane filtration, probably in association with "enhanced coagulation".

Point of use treatment systems
Current expansion of point-of-use systems (?), trends in their efficiency, quality and control
Point of use systems are not popular in Portugal, except for some activated carbon filters use by a very small part of the population at the taps. Frequently their maintenance is not appropriate.
Sources:
Direct knowledge LNEC has of the sector.

Water recycling systems
Are drinking water application of recycled water likely. Will the use of recycled water be likely for applications which are usually supplied with water from the drinking water supply (like washing machine, toilet flush etc.)?
See "Water saving technologies" for more detail. It is important to distinguish water recycling from water reuse. Recycling (i.e. no change in the initial use) is a practice in many industries, in the treatment plants (e.g. water used to clean the filters is recycled) in some public consumptions (e.g. public fountains). Reuse is increasing in Portugal, particularly in the South. For instance in Algarve, the licensing of new golf courses requires that a significant part of the irrigation water is reused water. Irrigation is in fact the main use of treated wastewater.
Sources:
Resolução do Conselho de Ministros n.º 113/2005 - Programa Nacional para o Uso Eficiente da Água - Bases e Linhas Orientadoras (PNUEA) Baptista et al. (2001). Programa Nacional para o Uso Eficiente da Água, Ministério do Ambiente e Ordenamento do Território, www.maot.gov.pt. Meeting with Aguas do Algarve (Helena Lucas)

Water saving technologies
E.g. rainwater harvesting
Strictly speaking rainwater harvesting, desalination and use of treated urban wastewater, in compatible uses, are not water saving technologies but alternative water sources. The National Program for the Efficient Use of Water (PNUEA), for the urban, agricultural and industrial sectors in Portugal, envisages contributing to the rational utilization of water, to the minimization of water shortage risks, to the limitation of associated pollution discharges and energy consumption and, finally, to better cope with drought, by the implementation of a set of appropriate measures. The program identifies potential measures leading to the efficient use of water, sets priorities for the 87 measures to implement and delineates an appropriate implementation strategy (Melo Baptista *et al.*, 2001; Almeida *et al.*, 2004). The program was developed for a ten years horizon. The ultimate objective of this program is the improvement of the water use efficiency, *i.e.*, the level that the water captured in the nature is used in order to produce the desired service with effectiveness. A more detailed description of the program can be found in Almeida *et al.* (2004). The program was officially published as the ministerial resolution n.º 113/2005. **Measures to improve water use efficiency** Although some measures were defined for the agricultural sector they are not presented herein. Within the measures considered in the program, three levels of

priority were defined for application in a normal hydrologic situation, varying from 1 to 3 from the highest to the lowest priority. Those with higher priority, grouped according to the target users and types of use, are the following.

Urban use:

a) *Water supply systems*. Higher potential in this sector is expected from the application of an appropriated tariff structure, reduction of water losses and utilization of treated urban wastewater in compatible uses.

b) *Private distribution system, households or others*. The thermal insulation of hot water distribution system is the measure where higher savings can be expected.

c) *Domestic water devices and appliances* (tap, shower, washing machine, dishwasher, toilet, urinals, heating and cooling systems) and similar uses alike domestic ones but meant for collective use. Measures for each water device or appliance cover behavioral changes and technology upgrade individually. The selection of a water efficient models generally results in significant water savings without significant additional costs if substitution is planned or if premises are new or being renovated (e.g. toilet cistern with lower storage volume and dual flush). Behavior changes can also result in significant savings but are difficult to implement in the long term and verify.

d) *Outdoor uses* (including irrigation of gardens, public parks, golf courses and sportive areas; pavements cleaning and car washing; and filling of swimming pools, lakes or other water decorative features). Reduction of water used for irrigation can be achieved by measures addressing the irrigation procedures (e.g. proper management of watering, soil and plants) and irrigation methods (e.g. changing to drip irrigation). For car and pavement washing, the highest priority measures were related with the leaning techniques (e.g. changing to dry or high pressure cleaning). For swimming pools, lakes and similar features, measures were divided in those addressing technologies (e.g. installation of recirculating technologies with adequate treatment) and operation of the systems (e.g. development of maintenance programs for periodical check and repair of leaks in the systems).

Industrial use:

a) General measures. This group of measures includes adjustment in the water use procedures and water losses reduction in the industrial unity. These measures are applicable to all industrial sectors and unities.

b) Measures for industrial heat transfer systems. The measure with the highest priority in this group is water recirculation within the industrial cooling system.

c) Measures for washing of facilities and equipment. This group of measures includes adjustment in the waste management procedures and use of portable spray nozzles for washings.

Sources:

Almeida, M.C., Melo Baptista, J., Vieira, P., Ribeiro, R., Moura e Silva, A. (2004). Efficient use of water in Portugal: a national program. IWA 4th World Water Congress. Marrakech, Morocco. 19-24 September.

Resolução do Conselho de Ministros n.º 113/2005 - Programa Nacional para o Uso Eficiente da Água - Bases e Linhas Orientadoras (PNUEA)

Baptista et al. (2001). Programa Nacional para o Uso Eficiente da Água, Ministério do Ambiente e Ordenamento do Território, www.maot.gov.pt.

Other Technological Aspects

5.6 Environmental factors

Emerging pollutants
Governmental monitoring already exists?
Drinking water pollutants can be grouped into: legislated pollutants, non-legislated non-emerging pollutants and non-legislated emerging pollutants. Currently, the government and the utilities are still mainly concerned with the legislated pollutants. However, as described above, some utilities and the scientific community are aware of the importance of emerging pollutants. Therefore emerging pollutants are still a matter primarily dealt with at the scientific level. For the best of our knowledge, exploratory or mandatory governmental-monitoring does not exist, on a systematic basis.
Sources:
Direct knowledge LNEC has of the sector.

Accumulation of pollutants in the environment
Portugal has only compiled data on contaminated sites in a few industrialized areas (Setúbal Península; Estarreja, Palmeira lagoon). In addition to these polluted areas, a number of contaminated spots are likely to exist, including those due to uncontrolled waste deposits and leakage of hydrocarbons from service stations underground-tanks. Agricultural diffuse pollution may also contribute to pesticide accumulation. Nevertheless, as Portugal is far from being heavily industrialized, do not broadly practice intensive agriculture and is implementing measures to screen and manage contaminant fluxes (e.g., uncontrolled dumping is close to be eradicated , it is likely that, in general terms, the accumulation of pollutants in the environment will not be as serious as for industrialized countries in Europe. The fact that benzene have not been found in Portuguese drinking waters (1035 samples analyzed in 2004), pesticides were detected in only 0.3 % of the samples analyzed (2899 in 2002-2004) and hydrocarbons in 1 % (5051 samples in 2002-2004), may be a sign of that. Furthermore, except for diffuse pollution with "emerging" and unregulated contaminants (e.g., estrogens, pharmaceuticals, fragrances), accumulation of pollutants in the environment is unlikely to become a serious and generalized problem in Portugal, as the environmental awareness increases and more stringent regulations and control are enforced.
Sources:
Plano Estratégico de Gestão de Resíduos Industriais - PESGRI http://www.inresiduos.pt/portal/page?_pageid=53,31723&_dad=portal&_schema=PORTAL&id_doc=69&id_menu=93 Plano Nacional de Prevenção de Resíduos Industriais – PNAPRI (2000-2010) http://www.inresiduos.pt/portal/page?_pageid=53,31723&_dad=portal&_schema=PORTAL&id_doc=71&id_menu=94 Ferguson, C., C., (1999) Assessing Risks from Contaminated Sites: Policy and Practice in 16 European Countries. Land Contamination & Reclamation, 7 (2):33-54. J. Martins E. Silva, M. Fátima Reis. (2003) 1.º Encontro Nacional Dioxinas e Compostos Similares na Saúde e no Ambiente: uma abordagem intersectorial. RFML

Série III; 8 (4): 215-218.

IRAR (2005) Relatório trienal da qualidade da água para consumo humano. http://www.irar.pt/PresentationLayer/ResourcesUser/docum/Rel_trienal_2002_2004.pdf

The effect of more stringent thresholds and pollution control

As described above, widespread pollutant accumulation is not a seeming problem in Portugal. Nevertheless, plans for a strategic prevention of pollutant release are being implemented, along with the enforcement of the European regulations. The last, including those concerning the treatment of municipal and industrial effluents, will beneficially shape or add to the ongoing policies. Thus, the enforcement of more stringent thresholds and pollution control measures is on the way and is expected to prevent any serious and generalized pollution problems in Portugal.

General quality / composition changes in water resources, e.g. due to climate changes

As for most European regions, increases in the average temperatures and dryness are forecasted for the Iberian peninsula. Most General Circulation Models (GCMs) project a temperature increase of 4-7ºC for this region during the 21th century. In Portugal, current trends on summer droughts occurrence and desertification are likely to lead to increased water shortages in the southern provinces, although to a lower magnitude in Algarve. Seawater intrusion into fresh ground water may also worsen this scenario in coastal zones. Under such conditions, water resources quality is expected to be degraded. Warming and increased nutrient concentrations are likely to promote algal bloom events, hence aggravating the cyanotoxin problem. Such situation may be particularly significant in Portugal, where surface water predominates (60 %) as a source of drinking water and the solar irradiation is one of the highest in the world.

Sources:

Santos, F. D.; Forbes, K. ; Moita, R. (eds.). Climate Change in Portugal. Scenarios, Impacts and Adaptation Measures - SIAM Project". (2002) Gradiva, Lisbon, Portugal.

Levin, R. B.; Epstein, P. R.; Ford, T. E.; Olson; W. H., E.; Reichard; E.G. (2002) U.S. Drinking Water Challenges in the Twenty-First Century. Environ. Health Perspectives, (1)110:43-52.

Instituto do Ambiente (2003) Portugal's 2001 third national communication under the United Nations framework convention on climate change.

Region-specific contaminants?

E.g. Arsenic, Cadmium, Radioactive elements

Arsenic is a problem in some particular regions of the country. The official drinking water reports show an increase of arsenic inconformity with the legislation from 2003 to 2004. This may be due to a real increase or – more likely – to a more effective monitoring.
Another problem is the occurrence of cyanobacterial blooms in some surface water sources. The Portuguese climate and the agriculture practices contribute to this situation.

Sources:
IRAR (2005). RASARP 2004 - Relatório Anual do Sector de Águas e Resíduos em Portugal. Vol. 3 – Avaliação da qualidade do serviço prestado aos utilizadores, IRAR, 2005 (http://www.irar.pt/presentationlayer/artigo_00.aspx?artigoid=84&idioma=1).

Influence of water framework directive
The water framework directive was transposed into the Portuguese legislation by the Law 58/2005, 29 December. In order to assist the Portuguese undertakings identifying the main influence of this law on the water and wastewater services, IRAR (the regulator) prepared a document (Baptista et al., 2006) presenting the highlights of the new law and bringing the attention for the most relevant aspects the operators need to take into account. According to this document, the new water law brings modifications in terms of: (i) principles and concepts, (ii) water environmental objectives and monitoring, institutional framework (the new water law modifies significantly the organization of the governmental administration with regard to water resources management), (iii) plans and other instruments (some new mechanisms will be implemented), measures for the protection and enhancement of water resources (many new measures are legislated), (iv) water resources use (licenses and authorizations), (v) role of the state in the construction of hydraulic structures of public interest, (vi) economic and financial regime, (vii) public information and participation, (viii) inspection and auditing, and (ix) penalties.
Sources:
Baptista, J.M.; Pássaro, D.; Santos, R.F. (2006). A nova Lei da Água e os serviços de abastecimento público de água e de saneamento de águas residuais urbanas, IRAR, Lisboa, Portugal, http://www.irar.pt/PresentationLayer/ResourcesUser/docum/textreg1_2006.pdf.

Other Environmental Aspects

Subfactor: Resources

Trends in resource water
Due to Political factors
E.g. NL: less groundwater use due to regulation on wetlands
Before the establishment of the multimunicipal bulk supply systems, underground water was the source of supply for most Portuguese municipalities, although Greater Lisbon, Greater Oporto and some other towns were already supplied with surface water. However, over-extraction and nitrate pollution were a problem in many cases. The relative weight of surface water increased a lot during the last decade after the new systems. Nowadays the great majority of the population is supplied by surface water, sometimes blended with small portions of underground water. According to PNA (2005), which uses data from ~2000-2001, the proportion is 60% of surface water and 40% of underground water. It is likely the difference at present is higher. The severe drought which occurred in 2005 showed that the new solutions, in some cases, were not sufficiently reliable and some underground water sources that had been inactivated had to be used again. This occurrence showed brought the attention of the undertakings for the need to keep operative alternative sources, to mitigate the

risk associated to natural phenomena, technological failures or human causes.

Sources:

Direct knowledge LNEC has of the sector.
MAOT (2005). Plano Nacional da Água, Ministério do Ambiente e Ordenamento do Território, www.inag.pt/inag2004/port/a_intervencao/planeamento/pna/pna.html.

Due to other factors

E.g. climate change, river restoration projects

During the last century, the average temperature increased 1.6ºC in the Iberic Peninsula (PNA, 2005), corresponding to an increase of 2º C in winter and 1.4º C in summer. The average temperature in the period 1961-1990 was 13.1º and the average rainfall 960 mm, varying from region to region within the range 500 – 3000 mm.

Rainfall decreased during the last century in the Iberic Peninsula, particularly in march.
These trends cannot yet be an exclusive consequence of human activity; it is likely they may be partially due to the natural weather variability of the region.

Sources:

MAOT (2005). Plano Nacional da Água, Ministério do Ambiente e Ordenamento do Território, www.inag.pt/inag2004/port/a_intervencao/planeamento/pna/pna.html.
INAG (2001a). Plano Nacional da Água. Parte I - Enquadramento e contextualização. Volume II - Caracterização e diagnóstico da situação dos recursos hídricos.
IRAR (2005). Avaliação do impacto das actuais condições climatéricas no abastecimento público de água em Portugal. Situação em Janeiro de 2005, IRAR Report 01/2005, Departamento de Qualidade da Água, Lisbon, Portugal, http://www.irar.pt/PresentationLayer/ResourcesUser/docum/relat1_2005.pdf

How does agricultural use of water influence resources?

E.g. overexploitation of resources or expansion of bio-technologies? How will the strong agricultural use of water influence the resources? Are there quality problems which will occur next time (e.g. nitrate pollution)? Are measures planned to reduce agricultural use or changes in irrigation management?

According to MAOT (2001), water demand in Portugal is estimated in around 7 500 x 10^6 m^3/ano.
Agriculture is the major consumer, with around 6 550 x 10^6 m^3/year (87% of the total). Drinking water consumption is around 570 x 10^6 m^3/year.

These figures show clearly that agriculture use of water influences the resources.

Nitrate pollution is a current problem in Portugal. Although LNEC could not access to any reliable source with this regard, it seems that there is a trend for improvement with this regard, with the establishment of protection areas and use of alternative agriculture procedures.

Sources:

MAOT (2001). Programa Nacional para o Uso Eficiente da Água, Ministério do Ambiente e Ordenamento do Território, http://www.inag.pt/inag2004/port/divulga/publicas.html#uso%20eficiente.

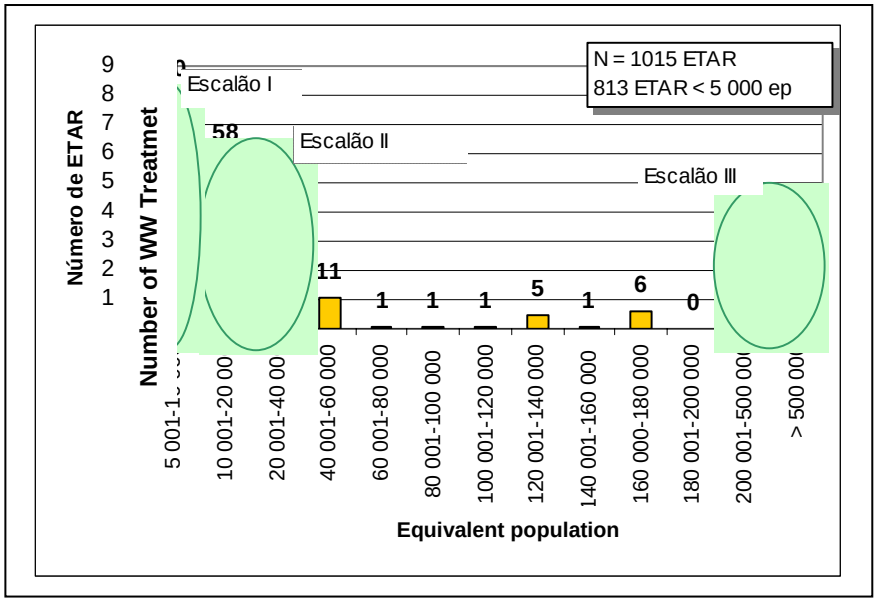
Industry in general: increase / decrease

E.g. heavy industry moving out of W-Europe

Portugal has never been a country with heavy industry and there is not any trend for increase.

Wastewater treatment in general: influence on surface water quality

The following figure shows the number of reported ETAR (Source: INSAAR – National Inventory of water and wastewater systems; ref. date of data: 2002) grouped by the equivalent population.



Major investments have been made in order to improve the levels of country coverage with treatment facilities. However, there is still a lot to do in terms of coverage and in terms of treatment efficiency. Complementarily to this, there are also relevant problems due to the spills to the receiving body of wastewater not submitted to any treatment. In Portugal, as in most European countries, combine sewers coexist with (pseudo-)separative networks. Spills from the wastewater network may occur during rainy periods, due to infiltration and to wrong connections of stormwater service pipes to the wastewater sewers. Conversely, spills from the stormwater system are also a pollution problem due to wrong connections of household wastewater service pipes to the stormwater network.

Sources:

INSAAR- Inventário Nacional de Abastecimento de água e de Saneamento de Águas residuais, INAG – National Water Institute, http://insaar.inag.pt/index2_noflash.htm.

MAOTDR (2006). PEAASAR 2007-2013 – Plano Estratégico para o Abastecimento de

Água e o Saneamento de Águas Residuais em Portugal (draft for public consultation), Misnistério do Ambiente, Ordenamento do Território e Desenvolvimento Regional, Feb. 2006, http://www.maotdr.gov.pt/MAOTDR/NOTCOM/NOTICIAS/PEAASAR+II.htm, ref. may 2006.

5.7 Demographical factors

Distribution of population (Rural areas / cities)

Trends in rural-urban migration of population: rich people are moving out of the cities, young people - in?

Considering the urban and rural patterns, the distribution of the Portuguese population is quite different from the rest of the European Countries: from the demographic and economic point of view Portugal is a country undergoing an accelerated process of urbanization, even though from the point of view of the landscape it is 'rurality' which is predominant.
In fact, while countries could differ in their definitions of urban, it's usual that the term "urban" refers to human settlements with 5.000 or more inhabitants. Taking into account this demographic standard, the urban population at Portugal in 2001 was 45,4% of the total residents.
But if we consider the population who lives in the areas designated as Predominantly Urban Area (APU), the urban population rises 70%.

Note: A *Predominantly Urban Area* could be composed by the following scenarios (cumulatively or not cumulatively):

a) *Urban "freguesias"* [borough] ("freguesias" with at least a density of 500 residents or more per square kilometer or that integrate a human settlement 5.000 or more inhabitants);

b) *Semi-urban "freguesias"* ("freguesias" next to urban "freguesias" with at least a density of 100 residents and less then 500 residents per square kilometer, or that integrate a human settlement with more then 2.000 inhabitants and less then 5.000 inhabitants, and related to an urban area by criteria of territorial functionality or management);

d) *"Freguesias" that are the seat of the municipal government*, under the following condition: the municipality should have at least 5.000 inhabitants.

In what concerns the trends in rural-urban migration of population, the combination of demographic and economic factors and the structure of human settlement on the coast account for the existence of various interconnected territorial sub-systems which are significantly interdependent in functional terms and involve a complex matrix of movements of people within them. By contrast, the inland areas contain no employment market areas of any significant size, and the inland areas of the country tend to operate on a territorially uncoordinated or marginal basis. So, the movements from the rural areas to the cities are not only characterized by age, but mainly by social class position, expecting those who migrate an opportunity to integrate the ascendant social mobility process. In this matter, genre is not an irrelevant variable, just because women tend to move to the big cities more and sooner then men.

Consequently, the demographic data shows a strong contrast between the younger urban settlements and the aged of the majority of the rural places. The moving out of the cities by the rich people (as predicted by the Burgess Concentric Zone Model) is not a relevant phenomenon in Portugal.

Sources:
Figures collected by INE (National Institute of Statistics), within Census 2001 procedures.
INE, Census 2001 and INE, Indicadores Urbanos do Continente (Urban Indicators and the Urban Areas Typology) – Tipologia de Áreas Urbanas 1999.

Absolute growth of population

In the last decade, Portugal has been a moderate growth of population, as demonstrated below. The ratio of natural increase (not presented in the Table) is even less than the figures of the net ratio of increase, which means that Portugal faces (a long time ago) a zero natural population growth tendency (i.e., a population in natural equilibrium, with a growth rate of zero, achieved when births equal deaths).

Year	*Resident population*	*Net ratio of increase*
1994	10 017 571	0,27
1995	10 043 180	0,26
1996	10 072 542	0,29
1997	10 109 697	0,37
1998	10 148 883	0,39
1999	10 195 014	0,45
2000	10 256 658	0,60
2001	10 329 340	0,71
2002	10 407 465	0,75
2003	10 474 685	0,64
2004	**10 529 255**	**0,52**

In terms of absolute growth, Portugal registered a difference of only one half million residents (511 thousand people) in ten years (1994-2004).

Using the results of the 2001 Population Census (www.ine.pt), and comparing them with the corresponding data for 1991, we can conclude that the country's moderate population growth over the last decade is the result of three quite distinct types of process:

- Areas of strong growth, in which growth in numbers of the resident population was accompanied by an increase in the number of families and in the housing stock. 35% of the more than 4,000 parishes (boroughs or "freguesias") in continental Portugal come under this heading, of which 23% are clearly in urban areas, 46% are in areas of the rural-urban type, 18% in semi-peripheral rural areas close to towns and 13% in marginal rural areas.
- Areas with declining population but which attract tourism and leisure-related business, or simply where there has been a tendency to build second homes in less densely populated areas. These are parishes in which the resident population has fallen, as has the number of families, but where the number of residential homes has increased. In some other cases this category includes areas where, despite the fall in population numbers, the number of families has increased and the growth in the number of dwellings is at least 20% higher than the growth in the number of resident families. These trends can be observed in 34% of parishes, of which 68% are marginal rural areas and 17% are semi-peripheral rural areas close to the towns and cities.
- Areas in which there is severe decline, that is, areas where population numbers have fallen as well as the number of families and residential homes, or where the

growth in the total number of residential homes was lower than that of families, with the population continuing to decline. Of the parishes in which this situation was found, 76% are marginal rural areas and 12% are semi-peripheral rural areas close to the towns and cities.

In summary, and despite the fact that there was a decline in population in some highly densely-populated urban areas, in general terms positive demographic trends over the last decade took place in a small number of urban-type areas. This increased the imbalance between the numbers living in urban areas and the geographical extent of rural space in Portugal.

Sources:

INE, Demographic Statistics, from 1994 to 2004; J. Ferrão *et al*. (2003) – Portugal: a brief profile, in 5th Framework Programme of the European Community for Research, Technology Development and Demonstration activities (1998-2002 - Key action "Improving the socio-economic knowledge base") – Final Report.

Age distribution / life expectancy

E.g. older persons are more sensitive to water contaminants

Resident population grouped by age, in 31 December 2004

ESTIMATES

Unit: 1 000

	TOTAL POPULAÇÃO	0 - 14 years	15 - 64 years	65 + years
Portugal	10 529.3	1 647.4	7 091.3	1 790.5
Mainland	10 043.8	1 554.4	6 761.1	1 728.2
North	3 727.3	620.5	2 556.8	549.9
Center	2 376.6	344.0	1 557.1	475.5
Lisbon	2 760.7	426.3	1 884.3	450.1
Alentejo	767.7	103.1	488.9	175.7
Algarve	411.5	60.5	273.9	77.1
Açores	241.2	48.2	162.9	30.1
Madeira	244.3	44.8	167.3	32.2

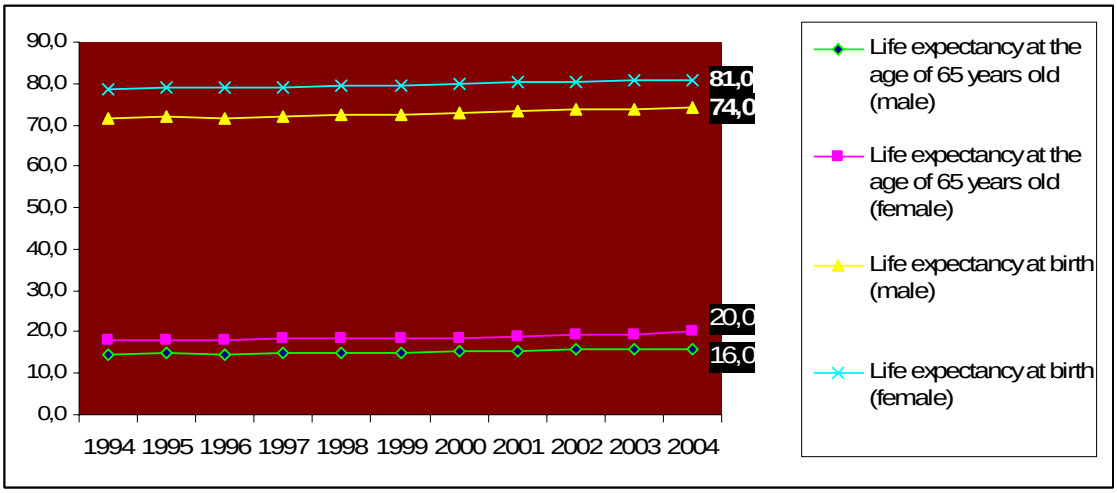
The evolution of the life expectancy in the last decade in Portugal can be observed below.

Year	*Live expectancy at birth (Male and Female)*
1994	75,0
1995	75,4
1996	75,3
1997	75,5
1998	75,8
1999	76,0
2000	76,4
2001	76,9
2002	77,1
2003	77,1

Age distribution / life expectancy

2004	77,8

Differences between genres must be underlined (see graphic below), both at birth as at the age of 65.



Sources:

Instituto Nacional de Estatística, http://www.ine.pt/prodserv/indicadores/xls/presiden.xls. INE, Demographic Statistics, from 1994 to 2004.

Education level

(see Social economic factors / Level of information of the consumer with regard to drinking water)

Health-related issues

Increase in immunocompromised persons

Note: we were unable to get information to reply to this question.

AIDS patients in certain regions strongly increasing (e.g. Africa?)

Evolution of AIDS (in Portuguese:SIDA), according to "Infecção VIH/SIDA. A situação em Portugal em 30 de Junho de 2003", Instituto Nacional de Saúde, Centro de Vigilância Epidemiológica das Doenças Transmissíveis, Doc. 130, http://www.insarj.pt/site/resources/docs/Documento_SIDA_Junho_2003.pdf :

Quadro 1- SIDA

Distribuição dos casos por data de diagnóstico e data de notificação

01/01/1983 – 30/06/2003

Ano	Casos por data de DIAGNÓSTICO	Casos por data de NOTIFICAÇÃO*
1983	1	0
1984	4	0
1985	29	18
1986	41	30
1987	81	47
1988	143	109
1989	200	154
1990	256	226
1991	307	246
1992	428	385
1993	560	465
1994	680	610
1995	795	692
1996	961	898
1997	958	895
1998	959	874
1999	1002	1014
2000	895	1124
2001	887	974
2002	716	1014
2003	145	330
Ignorado	57	0
TOTAL	**10 105**	**10 105**

Chronic diseases and water quality

There are not reported diseases due to water quality problems.

Sources:

"Infecção VIH/SIDA. A situação em Portugal em 30 de Junho de 2003", Instituto Nacional de Saúde, Centro de Vigilância Epidemiológica das Doenças Transmissíveis, Doc. 130, http://www.insarj.pt/site/resources/docs/Documento_SIDA_Junho_2003.pdf

Other Demographical Aspects

Deaths by some causes (percentage from the total)	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
Diseases of the circulatory system	38,5	37,6	37,6	36,3	36,3	35,5	35,5	35,1	34,7	34,1
Malignant neoplasms	17,3	17,3	17,1	17,6	17,8	17,7	18,6	18,9	18,8	18,9
Diseases of the respiratory system	6,4	6,9	7,2	7,8	8,1	9,5	8,9	7,7	7,8	7,9
Diseases of the digestive system	4,0	3,9	4,0	3,9	3,8	3,6	3,6	3,9	3,9	3,8
Diseases of the genitou-rinary system	1,2	1,3	1,3	1,2	1,3	1,3	1,4	1,6	1,8	2,0
Symptoms, signs, abnormal findings, ill-defined causes	10,4	10,3	10,7	11,1	11,3	11,3	11,4	10,3	8,5	9,0
HIV diseases	0,6	0,8	0,9	0,8	0,8	0,8	0,8	0,9	0,8	0,8

Other Demographical Aspects

Tuberculosis	0,2	0,3	0,2	0,3	0,3	0,2	0,2	0,2	0,3	0,3
Suicide	0,7	0,7	0,5	0,5	0,5	0,5	0,5	0,7	1,0	1,0
Other causes resulting from diseases	10,7	10,7	10,6	10,9	10,9	11,0	10,8	11,7	12,6	12,8
External causes	5,1	5,1	4,9	4,8	4,5	4,2	4,1	4,5	4,9	4,7
Transport accidents	2,1	2,2	2,0	1,8	1,7	1,5	1,3	1,6	1,9	1,7
Other external causes	3,0	2,9	2,9	2,9	2,8	2,8	2,9	2,8	3,0	3,0

Health indicators Unit: ‰	Infant mortality rate	Neonatal mortality rate	Mortality rate due to circulatory system diseases	Mortality rate due to malignant neoplasms	Incidence rate of notified cases of diseases of obligatory declaration
1994	7,9	4,7	4,3	1,9	1,1
1995	7,4	4,7	4,3	2,0	0,8
1996	6,8	4,1	4,4	2,0	2,1
1997	6,4	4,1	4,2	2,0	2,9
1998	6,0	3,7	4,2	2,1	1,3
1999	5,6	3,6	4,1	2,1	1,1
2000	5,5	3,4	4,0	2,1	1,3
2001	5,0	2,9	4,0	2,1	0,7
2002	5,0	3,4	4,0	2,1	0,6
2003	5,1	3,2	3,9	2,2	0,5

Sources:

INE - Health Statistics, 1994 to 2003

5.8 Organizational factors

Privatization (different models)
What is the actual size and size distribution of the water supply companies, how is the influence of privatization on this?
As shown in "Economic Models – Financing models", the most relevant types of water utilities are the multimunicipal bulk water companies (region scale, in total covering most of the country) and the municipal services (typical medium to small size). Infrastructures are in all cases publicly owned. The current participation of the public sector as operators started just in the late 90's and is rather limited. The National strategic Plan PEAASAR 2007-1013 promotes the creation of multimunicipal distribution countries, the operation of which is expected to be dominantly carried out by private operators. Differently from the current concessions, that includes investment in new assets, the new model points out to a different solution: the major investments in infrastructures will be kept public and operations and capital maintenance ill be delegated to private partners. Outsourcing has also a trend for increase in the existing multimunicipal companies.

Centralization / Regionalization
Is centralization of infrastructure expected?
(see Economical factors / Financing models) As referred above, there is a clear trend for increase of scale of the distribution water companies. In some cases this will lead to a centralization of infrastructures as well, but not inevitably. There will be a search for the most rational technical and economic solutions, which will depend on case to case. It is difficult to forecast whether the resulting trend is centralization or decentralization.

Other Organizational Aspects

5.9 Risk- related factors

Risk of terror attacks
(MEKOROT is also involved in this item within WA-4)
Risk of terror attacks, in spite of existing, is low with compared with many other countries and very low with compared with the technological and climate risks. More than the risk of terror attacks as such, there is some risk of vandalism.
Sources:

Risk of technical failure: one-step versus multi-barrier systems
Optimisation of (Risk/Cost) factor
Portuguese water utilities start to implement formal risk management plans and systems, with emphasis on the contingency plans (e.g. in case of drought) and water safety plans (e.g. Águas do Algarve, ref. IRAR, 2005). The IWA Bonn Charter is now available in Portuguese (IWA & IRAR, 2005), a guide on how to elaborate water safety plans is published. The proposal to establish the current COST Action C19 – Proactive crisis management of urban infrastructure (http://simba.ifak-md.de/cost_c19/) was a Portuguese initiative (in the first semester of 2001), which demonstrates the recognition of the interest of this matter for the country.
Sources:
IRAR (2005). Avaliação do impacto das actuais condições climatéricas no abastecimento público de água em Portugal - situação em Janeiro de 2005, IRAR Report 1/2005, IRAR, Lisbon, Portugal, http://www.irar.pt/presentationlayer/publicacao_01.aspx?publicacaoid=27. IWA & IRAR (2005). A Carta de Bona para o Abastecimento Seguro de Água para Consumo Humano, Portuguese version of "The Bonn charter for safe drinking water", authorized by the International Water Association to IRAR, http://www.irar.pt/presentationlayer/publicacao_01.aspx?publicacaoid=27.

Optimization of Risk versus Water Quality
For example, chlorine is added to the distribution net to anticipate to possible microbiological terrorist attacks, which deteriorates water quality.
In Portugal, chlorine is added to the distribution network to anticipate possible contaminations when, due to bursts and/or repair intervention, significant pressure drops occur. Note that when a sector is isolated by valve closure in order to allow any intervention, the network downstream may be subject to significant pressure drops. The general procedure is to clean and disinfect the isolated sector, not the whole area where pressure drop occurred. The risk of contamination exists. The risk of terrorist attacks is not a motivation to keep a disinfectant residual.
Sources:
Direct knowledge LNEC has of the sector.

Risk of water availability / drought / climate change
Also changes in water salinity
As referred in Resources / Trends in resource water /Other factors, the rainfall decreased in the last century in the Iberic Peninsula and the climate is characterized by a high variability. There is a significant risk of droughts (and floods). In 2005 the country suffered the effects of a severe drought. In this situations, there are relevant impacts on the raw water quality: - when the abstraction level at the dam lakes goes down, there is a higher salinity of the water - there may be the need for using alternative water sources, of poorer quality A related problem is the fact that treatment plants are prepared for a given range of raw water characteristics, and the conditions occurred, for instance, in 2005, forced some utilities to use waters of completely different characteristics.
Sources:
Direct knowledge LNEC has of the sector. IRAR (2005). Avaliação do impacto das actuais condições climatéricas no abastecimento público de água em Portugal - situação em Janeiro de 2005, IRAR Report 1/2005, IRAR, Lisbon, Portugal, http://www.irar.pt/presentationlayer/publicacao_01.aspx?publicacaoid=27.

Other Risk-related Aspects