Techneau,
November 2006

TREND REPORT

REPORT ON TRENDS IN CENTRAL EUROPE (GERMANY / SWITZERLAND)

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Techneau Report On Trends In Central Europe
(Germany / Switzerland)

Author(s)
Steffen Zuleeg, Eawag

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Executive Summary

Introduction
An evaluation of current trends in water supply in Germany and Switzerland was carried out using the SEPTED - factor matrix to find out the most important trends for the near future.
Therefore a questionnaire for each country was filled in to identify the main current factors leading to change in the water supply sector.
Twelve main trends were figured out which may lead to change in the water supply sector in the next 5-20 years.
This is the basis to be able to develop adaptive strategies to cope with future trends in the water supply sector.

Importance
It is eminent to develop adaptive strategies to cope with the future challenges to ensure safe and sustainable water supply.
Therefore it is necessary to find out which factors may or will lead to change in the next years. In that way it is possible to define major trends which may or will be responsible for partial or even fundamental changes in the world of water supply.
Because of the regional dependency of many factors it is necessary to evaluate the factors and trends in specific regions on a common base like the SEPTED - factor matrix to be able to compare the results of the different regions and to find out the main common trends.

Approach
To each country a questionnaire was filled out following the SEPTED factor matrix. SEPTED is a matrix which covers the dimensions in which factors may lead to changes in the water supply sector. The dimensions are socio-cultural, economical, political, technological, ecological and demographical. The main factors are identified and used to evaluate the main trends. Also two meetings were held to exchange the opinions and the knowledge among the other partners involved within WA1 during the ongoing progress.

Result

The following main trends are identified which may lead to partial or even general changes in the water supply sector in Germany and Switzerland as examples of Central European countries:

1. Increasing bottled water consumption
2. Decreasing tap water consumption
3. Privatization and centralization
4. Energy costs
5. Political autonomy of Switzerland
6. Progresses in technology development
7. Ecological awareness
8. Increasing thresholds
9. Climate change
10. Effect of agriculture
11. Decreasing population
12. Urbanization and migration

The trends are further evaluated and described.
Driving forces are figured out and implications for the water industry are specified. Adaptive strategies are proposed which may cope with the trend and which have to be evaluated further in the next step.

More information
The overview and results can be found in the report on trends in Central Europe (Germany / Switzerland), deliverable number D 1.1.5b.

Name of author(s): Steffen Zuleeg, Maryna Peter, Wouter Pronk
Organization: Eawag
Department SWW
Überlandstrasse 133;
P.O. Box 611
8600 Dübendorf
Switzerland
Telephone number: +41 44 823 5048
Email: Steffen.Zuleeg@eawag.ch

TKI Categorisation

Classification									
Supply Chain		**Process Chain**		**Process Chain (cont'd)**		**Water Quality**		**Water Quantity (cont'd)**	
Source		**Raw water storage**		**Sludge treatment**		**Legislation/regulation**		- Leakage	X
- Catchment		- Supply reservoir		- Settlement		- Raw water (source)	X	- Recycle	
- Groundwater		- Bankside storage		- Thickening		- Treated water	X		
- Surface water		**Pretreatment**		- Dewatering		**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		- Rapid filtration		- Polyelectrolyte		- Scaling			
- Supply reservoir		- Slow sand filtration		- Disinfectant		- Chlorine decay			
- Bankside storage		- Bank filtration		- Lead/plumbosolvency		**Microbiological**			
Water treatment		- Dune infiltration		**Control/instrumentation**		- Viruses		**Consumers / Risk**	
- Pretreatment		**Secondary treatment**		- Flow		- Parasites			
- Primary treatment		- Coagulation/flocculation		- Pressure		- Bacteria		**Trust**	
- Secondary treatment		- Sedimentation		- pH		- Fungi		- In water safety/quality	X
- Sludge treatment		- Filtration		- Chlorine		**Aesthetic**		- In security of supply	
Treated water storage		- Dissolved air flotation(DAF)		- Dosing		- Hardness / alkalinity		- In suppliers	
- Service reservoir		- Ion exchange		- Telemetry		- pH		- In regulations and regulators	
Distribution		- Membrane treatment		**Analysis**		- Turbidity		**Willingness-to-pay/acceptance**	
- Pumps		- Adsorption		- Chemical		- Colour		- For safety	
- Supply pipe / main	X	- Disinfection		- Microbiological		- Taste		- For improved taste/odour	
Tap (Customer)		- Dechlorination		- Physical		- Odour		- For infrastructure	
- Supply (service) pipe		**Treated water storage**						- For security of supply	

- Internal plumbing		- Service reservoir				**Water Quantity**		**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)	X		
		- Point-of-use (POU)				- Demand reduction	X		

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 controlerl 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

The report overall shows within the out filled factor form of the questionnaire the main factors leading to change in Germany and Switzerland regarding the SEPTED dimensions. From that twelve main trends across all of the dimensions could be identified to have the potential to change the behaviour of the drinking water supply during the next 5-20 years.

1.1 Germany

Germany is a country in Central Europe with an area of about 357,031 km^2.
It has 82.4 million inhabitants; the population density is about 231 inhabitants per km^2.
The political system is a democratic-parliamentary federal state (since 1949), the capital is Berlin and it is subdivided into 16 states. It is a member of the European Union.
The gross national income is about 2,251.17 billion Euros, the gross domestic product about 2,247.40 billion Euros.
Germany is situated in a temperate climate zone; its annual average temperature is about 9 °C.
The longest rivers are Rhine (865 km), Elbe (700 km), Danube (647 km), the largest lake is Lake Constance (572 km^2).
Water is extracted mainly from ground water (65 %). The other resources are spring water (8 %), bank filtrate (13 %) and surface water (13 %).
In Germany there are about 5000 water suppliers, circa 100 of them deliver half of the drinking water in Germany. 61 % of the water suppliers are under public law, 39 % under private law.
In Germany are about 6000 sewage disposal companies, from that around 11 % are under private law.
The connection rate on public water supply is 99 %, on public sewage disposal 97 %. The water losses in the grid are very low, 7.3 %.
Annually 2.5 billion Euros are invested in the water supply sector, 5.5 billion Euros in the sewage disposal.

1.2 Switzerland

Switzerland is also a Central European country with an area of about 41,285 km^2. It has 7.5 million inhabitants; the population density is about 234 inhabitants per km^2.
In Switzerland the political system is a strong direct democracy. The capital is Bern. Switzerland is divided into 26 cantons.
Switzerland is a political independent state with a foreign policy on the basis of strict neutrality.
The gross domestic product is about 455.6 billion Swiss francs, which is ca. 285 billion Euros.

Water is extracted mainly from spring water (44 %). The other resources are ground water (39 %) and surface water (17 %).
There are around 3000 water suppliers and around 1000 sewage disposal companies, all of them under public law.
The connection rate on public water supply is nearby 100 %, on public sewage disposal also 97 %. The water losses in the grid are around 13 %.
Annually 600 million Swiss francs are invested in the water supply sector, which is around 375 million Euros.

1.3 Trends

The trends which may lead to change in the water sector are the following:

1. Increasing bottled water consumption
2. Decreasing tap water consumption
3. Privatization and centralization
4. Energy costs
5. Political autonomy of Switzerland
6. Progresses in technology development
7. Ecological awareness
8. Increasing thresholds
9. Climate change
10. Effect of agriculture
11. Decreasing population
12. Urbanization and migration

2 Summary of the questionnaire

2.1 Socio-cultural factors

The willingness to pay in Germany and Switzerland is generally high, although Germany has one of the highest water prices within Europe.
The information level of the public is high but not sufficient yet, concerns regarding tap water quality still exist.
Mainly in Switzerland the appreciation of tap water is generally high, but contrarily to this the bottled water consumption is still increasing, mainly due to concerns about tap water quality.
Ecological awareness in these countries is also high, but in Germany economical stress in the municipalities as well as in the private households counteracts this trend.
In Switzerland public opinion is considered as the main driving force for changes in the water sector.

2.2 Economical factors

There is an ongoing privatization trend in Germany due to financial pressure on the municipalities. Privatization is not the case in Switzerland where it is prevented by the public. Extent end effects of privatization in Germany are very difficult to predict depending on the policy of the private water suppliers.
Energy prices are rising but depending on political decisions regarding the energy sector and new energy saving and recovering technologies it is highly uncertain to predict the changes and the influence of the energy costs.

2.3 Political factors

In Germany the new drinking water regulation came into force 2003 and brought European drinking water regulations in national law. Therefore new thresholds have to be met now by the drinking water supply.
Also the European water framework directive has influence on the water sector.
The political autonomy of Switzerland requires cross-border agreements with the EU to protect common river basins.

2.4 Technical factors

New technologies like membrane filtration or new monitoring/sensor technologies are continually implemented to increase drinking water quality and to avoid contamination.

Water saving and recycling systems are increasingly installed which led to a decreased tap water consumption.
Mainly in Germany POU-systems like AC-filters etc. are increasingly used to improve tap water quality.

2.5 Ecological factors

Generally the high ecological awareness is high in both countries, but in Germany economical stress in the municipalities as well as in the private households counteracts this trend.
Due to the European water framework directive in Germany and similar regulations in Switzerland the thresholds regarding environmental pollution increase. Monitoring programmes like NADUF and NAQUA in Switzerland are implemented to ensure environmental protection.
Climate change has a certain impact on the water supply sector. More and severe natural disasters like floods, droughts and storms are expected.
Also agriculture influences water quality due to intensive use of fertilizers and pesticides. In Germany further noticeable nitrogen pollution as well as increasing emissions of phosphorus is expected, also due to the long retention time of the substances in the soil.

2.6 Demographical factors

In Germany generally and depending on the immigration rate in Switzerland too there is a decrease and an ageing of the population expected which will occur new challenges for the water supply sector like oversized infrastructure or a higher sensitivity of the public regarding drinking water quality. Also urbanization and migration within the countries will contribute to this trend, but these factors are highly region dependent and thus also possible driving forces for causing the countertrend in special areas.

3 Top 10 trends

3.1 Increasing bottled water consumption

3.1.1 Introduction

The increasing bottled water consumption is a socio-cultural trend.
The consumption of mineral or purified bottled water in Germany increased from 40 litres per year and person in 1980 till 128 litres per year and person in 2005, although the bottled water price is 1000 times higher than tap water.
The bottled water consumption in Switzerland is also on a high level (104 lt/p/y).
This occurs (mainly in Germany) from the lacking knowledge of and the trust into tap water quality (concerns about possible contamination).
Also bottled water is assumed as a lifestyle product provoked by the bottled water producers.
Depending on the ecological (and economical) awareness of the consumers and on the publicity activity of the water suppliers regarding tap water quality and safety the trend can continue or the countertrend can occur.

3.1.2 Definitions

In figure 1 the change in bottled water consumption is shown (Verband Deutscher Mineralbrunnen e.V.; VDM).

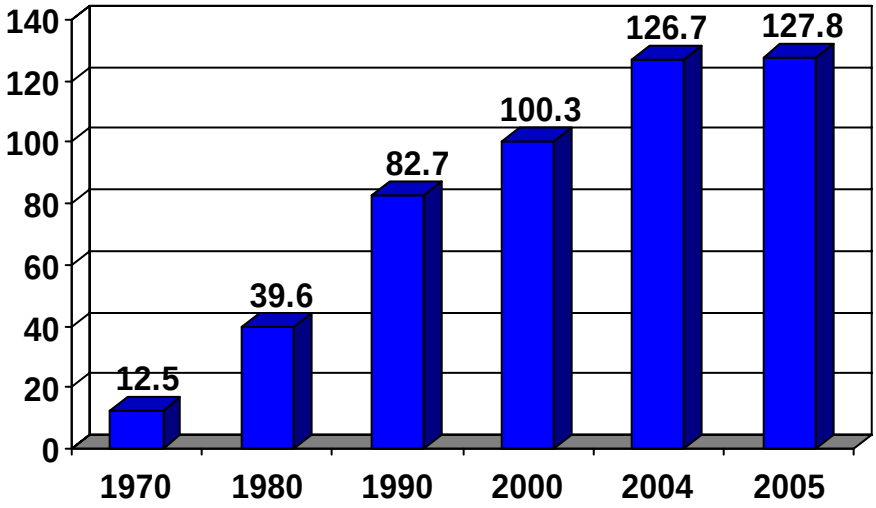


Figure 1: Bottled water consumption in Germany (litres per person and year)

Trend: Due to rising concerns about tap water quality the bottled water consumption will increase further.

Counter-trend: Due to rising ecological and economical awareness and increased information policy of the water suppliers the bottled water consumption will decrease and the use of tap water for drinking purposes will therefore increase.

3.1.3 Driving Forces

Trend: Due to the concerns of the public regarding tap water quality the trend will continue and even become stronger, if cases of contamination of tap water occur. Also more investments of the bottled water industry into marketing in contrast to almost no public awareness of the drinking water suppliers will strengthen this trend.

Counter-trend: If the public awareness regarding the ecological and economical advantages of drinking tap water rise (promoted by public services, NGO's etc.), no cases of contamination occur and the water suppliers achieve to become more public regarding safety and quality of tap water, the counter-trend will occur (in that case all doubts regarding possible risks have to be eliminated permanently).

3.1.4 General Implications

The bottle production and transportation causes further environmental pollution (CO_2-emission etc.).

3.1.5 Implications for the water industry

With the continuing of the trend the tap water may not longer be considered as food and may implicate a lowering of the public interest regarding tap water quality and safety and therefore lead to more problems of activating the public to invest more into drinking water treatment and supply.
Without any actions of water suppliers, political parties or environmental protection organisations /NGO's regarding the ecological and economical issues of bottled water consumption the trend will continue.
The trend will also continue, if there are any public doubts remaining regarding the tap water quality and safety.

But if the water suppliers are able to create a sustainable trust of the public into tap water quality and safety then it's possible to initiate a countertrend to drink tap water instead of bottled water. Then all the arguments regarding the ecological and economical benefits of drinking tap water are easily to bring to the public. Then a sustainable lifestyle may become more popular

than the lifestyle actually promoted by the bottled water industry and the trend can change quite rapidly towards its countertrend.

That would implicate a great opportunity for water suppliers to improve public awareness regarding drinking water and also environmental water related issues. This can lead to more pressure on politics and industry to strengthen the efforts to prevent environmental water pollution and to boost sustainable solutions.

3.1.6 Adaptive Strategies

The best strategy to cope with this trend is to get more public with information regarding tap water quality, also objective comparisons with and explanations to statements given by the bottled water industry advertisements.

3.1.7 Conclusion

It is to aim at improving the trust of the public into tap water quality and safety. If that can be carried out it should be easy to use the economic benefit due to drinking tap water instead of bottled water to invert the trend to its countertrend. The reason why this should be forced by the drinking water suppliers is that it is not only the rational aspect of less environmental stress due to decreasing bottled water consumption. The public opinion regarding drinking/tap water is also a very important driving force to push further developments regarding safe and sustainable water supply (mainly in Switzerland public opinion is the main driving force leading to changes in the drinking water sector (Manso)).

3.2 Decreasing tap water consumption

3.2.1 Introduction

The decreasing tap water consumption is also a socio-cultural trend.
In Switzerland the daily tap water consumption per capita decreased from 180 litres in the early eighties to 162 litres nowadays.
In Germany the tap water consumption decreased from 147 lt/c/d in 1990 to 127 lt/c/d in 2004. Even worse this trend became in the eastern part of Germany, where the combination of several factors like available water saving technologies, rising of ecological awareness, increasing water prices, massive decline in the birth rate coupled with a high emigration rate etc. the tap water consumption decreased to about 90 litres per person and day.

3.2.2 Definitions

Trend: The tap water consumption will further decrease due to ecological and economical reasons.

Counter-trend: Due to wellness activities and decreasing ecological awareness the tap water consumption will remain on the current level or even increase.

3.2.3 Driving Forces

Trend: The intention to save money, ecological arguments and ongoing emigration in some regions will lead to further decrease of tap water supply.

Counter-trend: The trend to pay more attention to its own well-being and body care and the decrease of the importance of ecological issues in public mind and/or the understanding that further water saving will not lead to noticeable economical benefit will lead to persisting or increasing of current tap water consumption.

3.2.4 General Implications

No general implications expected.

3.2.5 Implications for the water industry

The water supply will become more challenging to the water suppliers due to the over dimensioned infrastructure and treatment facilities. The water supply was designed for a daily tap water consumption of 150-250 litres. So the long retention times of the water in the grid lead to possible contamination/microbial growth. To prevent this water suppliers will have to flush the grid more frequently or even to use disinfectants to maintain drinking water quality. The flushing will lead to more (unpaid) water consumption and the use of disinfectants may lead to a decreasing acceptance of the tap water quality due to possible disinfectant residuals.
This can result in an increased switch to substitutes like bottled water etc. and therefore strengthen the trend of bottled water consumption.
If there is a stronger decrease in tap water consumption water suppliers may have to reduce dimensions of the infrastructure or even to switch to decentralized water supply which leads to additional costs.

3.2.6 Adaptive Strategies

A possible adaptive strategy in order to stabilize the tap water consumption on the current level could be the implementation of an alternative tariff strategy. For example, the first 100 litres per capita and day could be included in the basic fee, and beyond this amount the water price should rise progressively. This has to be supported by informing the public about the general economic aspects and reasons for this strategy.

3.2.7 Conclusion

If the trend continues the water suppliers will have more efforts to maintain the high tap water quality. The additional costs will lead to rising resentment of the public due to rising water prices if the full price recovery principle has to be continued. But this is difficult to convey to the public, also because in some regions in Germany it is still necessary to reduce water consumption at specific times during water stress situations due to climate change.
Overall it is necessary to make the system of water supply transparent to the public to increase understanding of sustainable water consumption (e.g. by explaining when how much water can/should be used etc.).

3.3 Privatization and centralization

3.3.1 Introduction

Privatization and centralization is an economical trend.
In Germany, mainly due to financial problems of the municipalities, there is a trend of rising privatization.
This due to public pressure didn't happen in Switzerland till now and is also not expected to change in the future. The political/societal system in Switzerland which esteems water as a public good which not has to be given into private hands (regarding the privatization cases and results in England etc.) will probably prevent this.
In Switzerland nowadays regionalisation can be registered caused by an increasing number of inter-municipal collaboration.
Due to the financial pressure on the German water suppliers also a partial centralization is expected in the organizational sector. Depending on future developments in the technological sector and in the consumer's behaviour centralization of water supply (infrastructure and treatment facilities) will increase or decrease. It is expected in the mid term more to increase. But if the tap water consumption decreases further significantly, there may be a rapid switch to decentralized technologies, because then it is to expensive to maintain the centralized system. But this is expected to be highly unlikely in the investigated timeframe.

3.3.2 Definitions

Trend: Due to financial pressure the privatization in Germany will rise.

Counter-trend: In Switzerland the water supply sector will remain in public ownership.

3.3.3 Driving Forces

Trend: The financial pressure on the municipalities due to the public dept is the main driver for privatization in Germany.

Counter-trend: Public pressure and public opinion in Switzerland is the driving force to prevent privatization and to maintain the status quo.

3.3.4 General Implications

No general implications expected.

3.3.5 Implications for the water industry

For the Swiss water industry no changes are expected.

Effect predictions for the German water sector due to ongoing privatization are highly uncertain. Depending on the financial management of the private water suppliers regarding new investments and an adequate O&M or pure absorption of money for the benefit of the shareholders the acceptance of the public will change.
The effects can range from a light decrease of water prices during remaining water quality and safety to a strong increase of the water price combined with decreasing water quality and safety due to reduced O&M expenses.

3.3.6 Adaptive Strategies

In case of further or even general privatization in Germany it has to be assured that the drinking water quality and the safety of supply remains on the high level of service nowadays provided by the water sector.
Therefore it is necessary to implement any kind of control or monitoring of the service of water supply like a surveillance authority or some similar.

3.3.7 Conclusion

In Switzerland privatization in the water sector isn't an issue.
In Germany privatization occurs and will continue whereas extent and effects are highly uncertain to predict.
Anyway quality assurance regarding drinking water service has to be implemented to assure the high level of drinking water supply presently existing in Germany.

3.4 Energy costs

3.4.1 Introduction

This is an economical trend within the SEPTED dimensions.
The changes and effects on the water supply sector are highly uncertain to predict, too.
In the past the energy price generally increased.
Thereby in short terms the energy price changes very varying due to the fuel price changes, but in a mid term it is rising.
So the trend is to switch to alternative energy sources.
In Germany renewable energies are subsidized massively.
But also nuclear power comes again up for discussion after the resolution of 2000 to abandon nuclear energy. The current discussion is about the extension of the operating term of the existing nuclear power plants.
In Switzerland the main energy source is hydroelectric power (60 %) followed by nuclear power (36 %) (Federal Office for Water and Geology).
The development of energy saving devices and technology as well as the development of energy saving O&M procedures and processes may initiate overall a decline of energy costs for water supply.

3.4.2 Definitions

Trend: The energy costs for the production of drinking water will rise due to higher energy prices.

Counter-trend: The energy costs for the production of drinking water will decline due to lower energy consumption and stable energy prices because of alternative energy sources.

3.4.3 Driving Forces

Trend: The energy costs will rise due to rising fossil fuels prices.

Counter-trend: An implementation of energy saving technologies and the use of alternative energy sources will lead to lower energy costs. So the political strategy regarding nuclear power also is a factor.

3.4.4 General Implications

Higher energy costs will lead to higher production costs in the industry. So they have to reduce other costs, which may lead to a reduction of jobs.
In the private sector the energy costs will become a higher amount of the household budget and therefore other expenses have to be reduced and the buying power decreases.

3.4.5 Implications for the water industry

The rising energy price due to the fuel price changes will lead to higher energy costs and therefore to higher operational costs for the drinking water production.
That has to be covered by either a higher water price (lowering the acceptance to pay) or the reduction of operational or even investment costs. That may lead to lower water quality and safety of supply and thus worse the public opinion regarding drinking water issues.

3.4.6 Adaptive Strategies

The optimization of the water treatment processes regarding energy consumption is essential. Also the use of energy saving or even recovering devices is a possibility.

3.4.7 Conclusion

The water suppliers have to take measures to counteract the rising energy prizes. But also if the energy prizes remain on the current level due to the use of alternative energies energy saving and recovering options have to be used to raise efficiency of water supply and to lower energy costs.

3.5 Political autonomy of Switzerland

3.5.1 Introduction

The political autonomy is a political trend which is specifically for Switzerland.
The aim of Switzerland was and is to keep political independence and to maintain neutrality within Europe.
In Switzerland the political system is a strong direct democracy, where also the public has the possibility to cancel a new law enacted by the government via referendum. The government acts on the principle of cooperation, not government/opposition.
The universality of the Swiss foreign policy to protect Swiss interests, its neutrality, also the fact, that Switzerland has no colonial past and pursues no power politics causes that Switzerland is accepted worldwide as an "honest broker" (www.eda.admin.ch/eda/g/home/recent/focus/050524.html).
In the recent years bilateral treaties were signed to improve the relations between Switzerland and the European Union.
Actually there is a study ongoing to evaluate the impact of a possible accession of Switzerland to the EU. That will be the basis for decision of the further European policy of Switzerland.

3.5.2 Definitions

Trend: Switzerland will keep autonomy within Europe.

Counter-trend: Switzerland will join the European Union.

3.5.3 Driving Forces

Trend: The public opinion (pride) about the independence of Switzerland will strengthen the political decisions towards keeping the status quo.

Counter-trend: Economic and political pressure of the EU and the change of the public opinion regarding joining the EU due to economical and political arguments can cause a close relationship or even a joining to the EU.

3.5.4 General Implications

A close relationship or an EU-joining will cause heavy impact on all scopes in Switzerland.

3.5.5 Implications for the water industry

The keeping of the independence of Switzerland will have no significant implications for the water industry. There are just the common efforts to raise efficiency of the water suppliers. Also the thresholds will further be similar to the EU regulations.

There are implications expected when the countertrend occurs.
The EU politics and the Water framework directive have to be implemented in Switzerland. That will have a certain impact on the water supply sector, mainly on the decision making process and the organizational/administrative level.
The question of liberalization and privatization will become an issue again.

3.5.6 Adaptive Strategies

Even if Switzerland remains independent, the thresholds have to meet the EU guidelines and cross-border activities regarding protection of the (river) catchment areas have to be improved.

3.5.7 Conclusion

When the political independence of Switzerland remains then no significant changes in the water supply sector are expected. The water supply will remain as a public good with strict municipal responsibility. Due to the direct democratic system the public opinion will remain the main driver for changes or obstructions within the water supply sector. Cross-border agreements have to be reached to improve catchment area protection.

3.6 Progresses in technology development

3.6.1 Introduction

This is a technical trend within SEPTED.
It involves the developments of new technologies regarding and supporting the water supply sector.
In Germany and Switzerland in the recent years an increasing implementation of proven and newly developed membrane technologies took place (Rothenberger, Eawag), so e.g. the largest German UF-drinking water treatment in Roetgen with a capacity of 6000 m^3/h.

Also decentralized POU systems are increasingly used, mainly in private households as after-tap treatment due to concerns about drinking water quality.

3.6.2 Definitions

Trend: There is an ongoing implementation of newly developed technologies in water supply (UF-filtration plant in Roetgen).

Counter-trend: The implementation of new technologies isn't an issue. New investments are only used for remaining the status quo and to patch the existing system.

3.6.3 Driving Forces

Trend: New and more stringent thresholds need new treatment and monitoring technologies.
Due to a high ecological awareness of the public and therefore of the policy there is a sufficient financial support of R&D within the water sector.

Counter-trend: Political decisions and lacking of investments into R&D due to financial gaps in the municipal budget lead to the remaining of the status quo.

3.6.4 General Implications

Generally new technologies will improve standard of living. But also new technologies can lead to job losses and thus to a decreasing living standard of the affected people. Technologies developed to prevent environmental pollution will improve the well-being of the environment and the natural habitats. New communication and entertainment technologies may strengthen the individualization of the people.

3.6.5 Implications for the water industry

The Water industry has to invest a sufficient amount into new technologies to cope with future challenges regarding water quality and quantity and the safety of water supply.
New technologies allow to improve the performance and efficiency of water supply. A combination of new monitoring, sensor and communication technologies will lead to better and faster reactions regarding water polluting threats and failures. With this also the efficiency of O&M can be improved and optimized.

A better water quality can be achieved (micro pollutant removal, desalination etc.). Nutrient cycles can be closed via nutrient recovery in waste water treatment.

3.6.6 Adaptive Strategies

The development of new technologies which improve the performance of the water supply has to be encouraged by financial and political support.
New technologies should be faster approved formally by the technical associations like DVGW or SVGW and implemented in state-of-the-art rules.

3.6.7 Conclusion

The development, approvement and implementation of new technologies have to be continued and improved to be able to cope with future challenges within the water supply. Drinking water quality (improved treatment) and water price (cost covering principle) are key issues for the public acceptance. So efficiency rising and quality improving technologies are essential for the economical and also ecological demands within the water supply sector.

3.7 Ecological awareness

3.7.1 Introduction

Within the SEPTED dimensions this is an ecological trend.
In the recent decades there was and is a rising ecological awareness of the public regarding environmental issues and emerging pollutants.
In Germany and Switzerland trends increase to live in a sustainable way to reduce the environmental impact of artificial use of natural resources.
Occurring incidents and disasters strengthened this process (e.g. Schweizerhalle 1986, floods (e.g. Germany 2002), drought 2003 etc.).
The public concerns activated political forces, environmental and ecological issues became more and more popular in political discussions.
So the environmental protection became a political issue and therefore also political decided financial support from the governments.
Environment protection laws are being implemented and will be implemented further, with stronger restrictions and penalties (in Germany e.g. EU water framework directive, new drinking water regulations, ecological tax reform etc.).

3.7.2 Definitions

Trend: The ecological awareness will increase due to increased understanding of the importance of the environmental protection for the next generations. The public understand that it is better to protect environment at this (already late) stage than to invest huge financial amounts to cope with the consequences of environmental disasters.
So also the protection of the water resources remains an important issue.

Counter-trend: Due to rising economical stress the ecological awareness decreases and the public opinion and therefore the policy switches to strictly short-term economical issues.

3.7.3 Driving Forces

Trend: The ecological awareness directly increases with the amount of data regarding environmental issues provided by the media and the politics. The better the people are informed the better they understand the need for solving the environmental problems which exist now due to anthropogenic influence. Also disasters increase (more on a short term) significantly the ecological awareness.

Counter-trend: Economical problems can exceed the ecological awareness and the public are more interested to remain their economic status than to take care for rather distant problems. If the financing of environmental issues will cause a clear lower personal quality of life the people scarcely will accept this.

3.7.4 General Implications

Due to rising ecological awareness the environmental protection will increase and therefore the pollution of the environment will decrease and the environmental situation will get better. Due to better water quality and less environmental pollution also the public health will increase.

3.7.5 Implications for the water industry

The rising ecological awareness will lead to increased water source protection. When the pollution of the water resources becomes lower the treatment of the raw water to product drinking water becomes less complicated. This can result in lower treatment and operation costs.
It is possible to produce (and to advertise) more near-natural and safe drinking water. That will also improve the trust of the public into tap water quality.

3.7.6 Adaptive Strategies

The information policy regarding environmental issues and problems should be continued and improved further to keep the environmental protection as an important issue in public mind.

3.7.7 Conclusion

The ecological awareness is an important factor for initiating and improving of environmental protection measures. That's why it is important to keep the ecological awareness on a high level to assure public acceptance regarding living in a sustainable way and regarding financing the protection and regeneration of natural resources. If the ecological awareness due to insufficient information and/or economical stress decreases the environmental protection will get neglected in aid of the individual economic benefit.
Anyway, in case of incidents and disasters the ecological awareness will rise definitely (again).

3.8 Increasing thresholds

3.8.1 Introduction

This is also an ecological trend, mainly based on the trend before.
In Germany currently the implementation of the EU Water framework directive into national legislation is a prior attempt. Also the new drinking water regulations and more stringent regulations on trace pollutants specify increasing thresholds to be met in drinking water quality and surface and groundwater quality and will lead to challenges for the water suppliers and even for private house owners.
In Germany the water suppliers are responsible for drinking water quality till the POE, and e.g. new limits of lead content (November 2003 and November 2013) will very probably latest in 2013 cause a replacement of lead-containing household installations.
In Switzerland there is a comparable legislation.
There e.g. for drinking water also similar thresholds exist defined on basis of the food legislation in the "impurities and ingredients regulation".
There e.g. a lead content limit is already defined which will be implemented in Germany in 2013 (10 µg/lt).
Generally more stringent regulations and thresholds are expected in the future, also due to new emerging contaminants and more information about (eco)toxicity of perceived contaminants.

3.8.2 Definitions

Trend: The number and the limits of substances and parameters which will provoke measures will increase.

Counter-trend: The list of hazardous substances and parameters will remain on the current level or even become less extensive due to new political motivated argumentation or the lobby of the industry.

3.8.3 Driving Forces

Trend: New emerging substances due to new industrial activities or more sensitive measurement and new findings regarding (eco)toxicity will lead to more stringent thresholds. Public awareness is a key driver to improve this process.

Counter-trend: Economical pressure and pressure by the lobby of the industries can result in the remaining of the current status or even in lowering of thresholds (exceptions etc.).

3.8.4 General Implications

More stringent thresholds will lead to more efforts and measures for environmental protection and to a decline of environmental pollution.

3.8.5 Implications for the water industry

More stringent thresholds will lead to improved drinking water treatment and to implementation of new technologies which help to meet the thresholds.
New technologies and therefore additional investments (R&D etc.) are necessary to meet the required limits.
Also the waster water treatment has to be improved to reduce environmental pollution via the WWTP effluent.

3.8.6 Adaptive Strategies

New technologies have to be developed to cope with the trend. Reliable barriers (membranes etc.) have to be implemented to assure the required drinking water quality (also with regard to the actual discussion regarding micro pollutants etc.). The distribution system has to be maintained in a proper way to ensure water quality at the endpoints (POE). The monitoring of the water resources has to be continued and strengthened to prevent further environmental pollution (NADUF - National River Monitoring and Survey Programme, NAQUA - National Groundwater Quality Monitoring Network).

3.8.7 Conclusion

More stringent regulations and thresholds are expected in the future, also due to new emerging contaminants and more information about (eco)toxicity of perceived contaminants. New technologies have to be implemented to ensure that the limits of the contaminants are not exceeded. Monitoring is essential to survey water quality from source to tap.

3.9 Climate change

3.9.1 Introduction

Climate change is an ecological trend.
In the recent past a shift of precipitation from summer to winter was observed and higher evaporation, too.
Therefore more and severe floods and droughts are expected also in the near future. Already till now so called century events accumulate, e.g. the drought in 2003, the big floods in Germany 2002, Switzerland 2005.
In Germany water stress regions appear, e.g. along the Rhine in Cologne and Düsseldorf, or in Berlin.
In Switzerland a vanishing of the glaciers happens. Already till now a loss of 25 % of the glacial ice is registered compared to 1850 and even 75 % loss till 2030 and 95 % loss till 2100 are possible.
The predicted temperature increase of 3 °C will also result in a rise of the snow fall limit by 300-500 metres. The thawing of the perm frost soil causes erosion and therefore also the danger of further natural disasters like landslides etc. increases.

3.9.2 Definitions

Trend: There is a certain increase of number and magnitude of natural disasters. The seasonal weather conditions become more extreme.

Counter-trend: Unlikely.

3.9.3 Driving Forces

Trend: The increasing environmental pollution due to anthropogenic activity leads to climate change.

3.9.4 General Implications

Climate change will affect all aspects and scopes of living. Floods, droughts and other natural disasters occurring from climate change will aggravate the living conditions of the people. Huge economical efforts are necessary to cope with the consequences of climate change (flood protection, rebuilding costs, etc.).

3.9.5 Implications for the water industry

Measures have to be taken to protect the treatment utilities and the infrastructure against the impact of climate change like floods (contamination of water bodies, flooding of drinking water and waste water treatment facilities etc.), severe storms etc. (e.g. Cost Action C19). The impact of droughts has to be covered (higher water demand in contrast to reduced water resources).

3.9.6 Adaptive Strategies

Development of risk management plans to cope with the impact of climate change occurred disasters (e.g. RIMAX - risk management of extreme flood events in Germany) is essential to cope with this trend.

3.9.7 Conclusion

Climate change is a certain trend which will affect all aspects and scopes of living. More and severe natural disaster events are expected in the near future. Thus it is necessary to develop strategies to cope with this.
Measures have to be taken to protect the treatment utilities and the infrastructure.
Risk management plans have to be developed.

3.10 Effect of agriculture

3.10.1 Introduction

The effect of the agriculture on the environment also is an ecological factor. In Germany and Switzerland there is a certain pollution of the environment with nitrate and phosphorus registered due to intensive fertilizer use and stock farming, and with pesticides.
In Switzerland due to the decrease of agricultural activities in the recent years a downward trend in nitrate contamination since 1997 is observed, also there is no further increase in phosphorus pollution measured (NAQUA).

But in Germany further noticeable nitrogen pollution as well as increasing emissions of phosphorus is expected, also due to the long retention time of the substances in the soil.

3.10.2 Definitions

Trend: The agriculture and therefore the pollution of the environment with fertilizers and pesticides will increase.

Counter-trend: Due to less agricultural activities and less use of fertilizers and pesticides the environmental pollution will decrease.

3.10.3 Driving Forces

Trend: Increasing use of fertilizers and pesticides will lead to a higher amount of contaminants in the water bodies.

Counter-trend: Less and sustainable agriculture will lead to a decrease of the pollution load in the ground and surface water.

3.10.4 General Implications

The pollution will lead to worse quality of the water bodies and therefore also affect the public health (e.g. bathing water quality).

3.10.5 Implications for the water industry

Further measures are necessary to meet the thresholds regarding nitrate and phosphorus. Additional treatment steps may be necessary to eliminate the micro pollutants (pesticides, veterinary pharmaceuticals etc.).

3.10.6 Adaptive Strategies

A decreased use of fertilizers, pesticides and veterinary pharmaceuticals should be promoted by the public and the policy (support of sustainable agriculture, e.g. EISA - European Initiative for Sustainable Development in Agriculture).

3.10.7 Conclusion

In Germany and also in Switzerland agriculture-born environmental pollution still is an issue. In Switzerland due to less agricultural activities

nitrate contamination decreases now and there is no further phosphorus pollution. In Germany further noticeable nitrogen pollution as well as increasing emissions of phosphorus is expected, also due to the long retention time of the substances in the soil. Sustainable agriculture can be the way to decrease the environmental agriculture-born pollution load.

3.11 Decreasing population

3.11.1 Introduction

The population growth is a demographical trend within SEPTED.
In Germany since 2003 there is a decline in the population due to decreasing immigration rate in contrast to an increasing death surplus. Nowadays the birth rate in Germany is about 1.4 children per woman. This is to be expected to continue and even to strengthen in the future. Depending on the immigration rate and the development of the death surplus the forecast for population decrease in Germany ranges from 3 - 25 % till 2050 (Federal Statistical Office Germany).
Therefore are also in the near future raising problems with oversized distribution systems and water supply works expected.
In Switzerland till now there is an increase in population growth, mainly due to the immigration rate. But also a birth surplus still exists, also due to the foreigners. The birth rate of foreigners is 1.9 children per woman in contrast to only 1.3 children per Swiss woman. Future scenarios show depending on birth and immigration rate a further population growth from +28 % till -13 % is expected (Swiss Federal Statistical Office), so that it is uncertain, if the trend or the countertrend occurs.

3.11.2 Definitions

Trend: In Germany and Switzerland the population will decrease.

Counter-trend: Depending on the chosen population growth scenario the population in Switzerland will increase.

3.11.3 Driving Forces

Trend: A declining birth rate and a low immigration rate will lead to a significant decrease of the population.

Counter-trend: A possible high immigration rate depending on the future immigration policy in Switzerland will lead to an increase of the population.

3.11.4 General Implications

A high immigration rate can cause several socio-cultural conflicts.
Also the low birth rate will lead to socio-cultural changes in the society (population becomes more and more elderly with all its social problems).

3.11.5 Implications for the water industry

Generally a decline in the population leads to a lower water demand and strengthens therefore the trend of decreasing water consumption with all its consequences mentioned above.
Also the ageing of the population may result in the change of consumption patterns and rising sensitivity regarding the drinking water quality.

3.11.6 Adaptive Strategies

It should be possible to stabilize the tap water consumption on the current level by informing the public about the general economic aspects to reduce the water consumption further. The change of consumption patterns and a possible rising sensitivity regarding the drinking water quality has to be observed; thresholds have to be adapted to these new conditions.

3.11.7 Conclusion

If the trend continues the water suppliers will have more efforts to maintain the high tap water quality. The additional costs will lead to rising resentment of the public due to rising water prices if the full price recovery principle has to be continued. But this is difficult to convey to the public, also because in some regions in Germany it is still necessary to reduce water consumption at specific times during water stress situations due to climate change.
Overall it is necessary to make the system of water supply transparent to the public to increase understanding of sustainable water consumption (e.g. by explaining when how much water can/should be used etc.).
A rising sensitivity regarding contaminants may also lead to more stringent thresholds in the near future.

3.12 Urbanization and migration

3.12.1 Introduction

This is a demographical trend and is very strongly region dependent.
E.g. in Germany there were built new oversized distribution systems (mainly in Eastern Germany) due to wrong consumption predictions and the ongoing migration of inhabitants to wealthier regions in Germany and abroad.
In these special regions it is more likely that the centralized system will break down and lead to new water supply structures. But the biggest problem then will be the financing of the replacement of the new built structure with decentralized systems.
The urbanization in Switzerland and Germany and the migration into densely populated wealthier areas may lead to overloaded water supply systems and require a fast expansion of the existing system or the implementation of decentralized water supply systems as temporary or even as long-term solution. But this is more unlikely due to the general decrease in tap water consumption mentioned before.

3.12.2 Definitions

Trend: The urbanization and the migration into wealthier regions will continue. This is quite certain, but the extent is insecure.

3.12.3 Driving Forces

Trend: The better chance to get a job in urban and wealthier regions and therefore to achieve a better economic status is the main driver for this trend.

3.12.4 General Implications

More socio-cultural conflicts may arise due to the higher population density in the urban areas and due to rising divide between the different social classes as well as between the different ethnic groups.

3.12.5 Implications for the water industry

The growing population in these regions has to be provided with a sufficient drinking water quantity and quality. So it is possible that the existing water supply and even the existing infrastructure may become under dimensioned

and have to get extended. Also the waste water treatment and sewer system capacity may have to be extended to cope with the higher influent.
But all this may also be (partly) covered by the trend of decreasing tap water consumption.

3.12.6 Adaptive Strategies

In regions were the water supply system becomes to oversized due to emigration and decreasing water consumption decentralized systems have to be evaluated and implemented. Suitable financial concepts have to be developed to afford this process.
If in urban areas overloaded water supply systems appear a fast expansion of the existing system has to be carried out or decentralized water supply systems as temporary or even as long-term solution have to be implemented.

3.12.7 Conclusion

Urbanization and migration is a certain but highly region dependent trend. Urban areas may be confronted with an overloaded water supply system due to massive immigration so that a fast expansion of the existing system has to be carried out or decentralized water supply systems as temporary or even as long-term solution have to be implemented. But this is more unlikely due to the general decrease in tap water consumption.
In regions were the water supply system becomes to oversized due to emigration and decreasing water consumption decentralized systems have to be evaluated and implemented and suitable financial concepts have to be developed to afford this process.

4 Conclusions

The increasing bottled water consumption and in contrast to that the decreasing tap water consumption are important trends which show the current public awareness of the water supply sector.
The public opinion is a main driving force leading to changes in the drinking water sector.
Therefore in the future it is to aim at improving the trust of the public into tap water quality and safety.
The privatization occurring in Germany is a certain trend due to the financial pressure on the municipalities, but the extent and the effects on the water supply sector are highly uncertain to predict depending on the policy of the private water suppliers and the privatization rate.
Energy costs are an important cost factor and therefore the water suppliers will have to invest in energy saving and recovering technologies to counteract rising energy prices.
The development of new technologies regarding and supporting the water sector is essential to cope with the future challenges regarding water quality and quantity and the safety of water supply. The drinking water quality and the price for water are key issues for the public acceptance and therefore efficiency raising and quality improving technologies will also improve the esteem of the water supply sector.
The ecological awareness is an important factor for initiating and improving of environmental protection measures. That's why it is important to keep the ecological awareness on a high level to assure public acceptance regarding living in a sustainable way and regarding financing the protection and regeneration of natural resources.
Increasing thresholds are expected to be quite sure due to new emerging contaminants and more information about (eco)toxicity of perceived contaminants.
Climate change is a certain trend which will affect all aspects and scopes of living. More and severe natural disaster events are expected in the near future. Thus it is necessary to develop strategies to cope with this.
Measures have to be taken to protect the treatment utilities and the infrastructure, risk management plans have to be developed.
Decreasing population, urbanization and migration are demographical trends, which will lead to region specific changes in water quality and quantity demand. Region specific future scenarios have to take into account these trends to ensure the future required water quality and quantity.

5 Appendix: Questionnaires

5.1 Germany

Matrix of Factors

General information

Region	**Central Europe**
Covering countries	**Germany**
Population	**82.4 Mio.**

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?	Source
The price for drinking water is 1.81 €/m^3 (2005). The percentage of drinking water on water services is 0.38 % of the household income. The price for waste water disposal is 2.14 €/m^3 (2003).	(Branchenbild deutsche Wasserwirtschaft 2005)
Ecological tax reform (ETR) The result of social study described by (Beuermann 2006) showed that the objectives of environmental protection, in particular climate protection, and decreasing unemployment are still priority issues in Germany. A great majority of the interviewees (interviews conducted in the frame of ETR study) were concerned about environmental degradation and about what ''we leave behind for our children and grandchildren''. Many were convinced that environmental protection is an important political task. Moreover, the majority of both business representatives and participants of the focus groups stated a willingness in principle to pay for environmental purposes, for the prevention of climate change, or the protection of natural resources. Therefore, the general framework conditions in German society for a continuation of ecological tax reform ETR seem still to exist.	(Beuermann and Santarius 2006) (Rothenberger 2003)
The prices of water in Germany are the highest in EU. Nevertheless "because of the prices there is no pressure coming from the customers. Sometimes this question appear in the frame of discussions between political parties, but they are finally not the consumers" (interview partner from the field of water supply and treatment enterprises, cited by Rothenberger). The reason for this can be found in the fact that a lot of end-users have no idea about the real price of the production of one cubic meter of drinking water. Also ca. 2/3 of the people don't know how much they pay per year for water supply and about 50 % don't know how much a cubic meter of drinking water costs and from them who think to know how much it costs the half quotes more than 165 % of the real price.	(Branchenbild deutsche Wasserwirtschaft 2005)

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	
Since a lot of years, most people have supported the ecological need to use natural resources in sustainable way. The concept of limited resources leaded at least in Germany to the changes in consumer behaviour concerning energy and water saving, even if the ecological conditions in both sectors were very different. For these changes in consumer behaviour an important role was played by the availability of information regarding ecological conditions of resources to general public. At present, Germany publishes a wide range of informational material on the promotion of sustainable consumption and production patterns. Apart from subject specific environmental reporting, the majority of available information is based on the work of Federal statistics Office and research programs. The general public also has access to diverse information on a variety of issues and instruments such as life cycle assessments, product-related eco-labelling and substance databases. Consumer protection agencies (e.g. Stiftung Warentest) are another reliable source of information on this subject.	(Rothenberger 2003) UNO

The appreciation of drinking water	
For example, water can be a life style product; especially this seems to be the case for bottled water (?)	
The most interview partners (interviews from Rothenberger) questioned about expectations as well as satisfaction of customers with drinking water management in Germany were sure in high levels of satisfaction. From the other site, a European investigation came to the result, that in Germany (as well as France) only 69% of population is satisfied with performance of water supply and 18% are not satisfied. In the frame of this study, the experts gave an opinion that a significant expectance of customers is a permanent availability of high quality tap water with adequate price and satisfied pressure. Generally the dominating will of the customers is that the water supply and waste water treatment must work in such a way that the customers do not have to think about it. Overall, customer's satisfaction was estimated quite high, while the customers' knowledge about coherences of water supply and water source was estimated lower. (This was found during the study in Leipzig in 2002, when 56 % of people did not know from where the water is coming to the tap). But also, when the customers estimate the water quality as good or very good, there is a prejudice to use tap water for drinking. The customers' uncertainty is proved also by the consumption behaviour: the consumption of bottled drinking water strongly increased during the last years. The consumption of the mineral or	(Rothenberger 2003)

purified bottled water increased from 40 litres per year and person in 1980 till 128 litres per year and person in 2005, although the bottled water price is 1000 times higher than tap water. Water from the tap is still often treated by customers as contaminated. Correspondingly, the foodstuff production companies (like Nestle) are very active on the market of bottled water. The disregard of the quality of tap water also has influence not only on the application for drinking purposes, but also on the general perception of water as a product. Therefore, environmental and consumers unions are worried, that this would have long term consequences on the requirements to tap water quality and also on exigency of water resources protection. About 80 % of the people drink water directly from the tap. The bottled water consumption is around 350 ml/d/p. In Germany the average of consumed beverages per day and person is around 1200 ml. That means 30 % of the consumed beverages are bottled water. Ca. 600 ml tap water is consumed per person and day, mostly in the form of coffee or tea. That means the consumption of bottled water is higher than drinking water directly from the tap.	

Ecological Awareness	
Also awareness regarding emerging pollutants. Are trends visible?	
Ecological awareness regarding water consumption: In general the ecological awareness of German population has been proven by significant decrease of water demand within the last 15 years (from 6.52 billion m3 in 1991 to 5.41 billion m3 in 2001). Within11 years, Germany households need 1.1 billion m3 less water. In the period from 1990 to 2001 per capita water consumption decreased by 12.4%. The average per capita water consumption amounts to 127 litres per day. This corresponds to the specific water consumption at the beginning of the eighties. The decrease in water consumption is caused by a change in consumer behaviour. Households are much more aware of water-saving devices and industry has also increased its water efficiency, hence the water consumption of all production sectors (agriculture, service and industry) was reduced by 15% in the period from 1991 to 2001 (Federal Statistical Office, 2003, Haug, 2004). Moreover, it has to be considered that 80% of the water supply costs are fixed costs, so decreasing water consumption does not necessarily cause a similar reduction in the water price (BMU, 2001). ***Ecological awareness regarding water quality:*** See "the appreciation of drinking water"	(Kuckshinrichs 2005)

Economical factors

Financing models	Source
Privately owned, fully state-owned and different participation models exist. What trends can be observed?	
Status In general, the majority of water supply companies are publicly owned companies run by local governments or owner-operated municipal enterprises or special-purpose associations. Mixed forms, in which the water supply enterprise is an entity under civil law but is owned by the municipality, are gaining in importance. Purely private-sector enterprises, which assume the responsibility of water supply under license of cities and communities, continue to be the exception, but are generally the larger providers. ***Pricing*** Pricing of water supplies in Germany is based on the cost averaging principle. Cost consciousness suffers in this system because incurred costs can be passed on to the consumer in the form of higher charges. In addition, about 80% of the costs in water supply are fixed costs. Thus despite falling water consumption, the price per m3 of water rises, as was the case in Germany in the 1990s. From 1992 through 1999, drinking water prices in Germany have increased by 40% - although consumption declined by about 15% (compared with 1990). Despite the fact the rise in prices has continuously slowed in recent years, German drinking water prices are still the highest in Europe, as shown by various international price comparisons. Such comparisons, however, should be viewed with caution as important factors for drinking water prices, which can vary from country to country, are frequently not considered or not considered adequately. Among these are drinking water quality and consumption, the certainty of supply, the level of environmental standards, subsidies, taxes and levies, the percentage of the population that is served as well as the population distribution, the extent of water loss, and the condition of the infrastructure. ***Trends*** While liberalization of water supply in Germany is still being discussed, privatization is already common practice on a national, and especially on an international, level. According to Deutsche Bank Research, in the future more and more cities and municipalities will sell their holdings in their water supply operations to private companies, thereby securing private capital and know-how. This shows that the privatization process can be set in motion without governmental mandate and can no longer be halted. Privatization and liberalization trends are discussed in "Organizational Factors" in more details.	(Heymann 2000)

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

Status

The estimate of investments by the public water supply sector is based on data from BGW statistics (BGW, 2001). The BGW statistics cover 70% of the water sector investments transacted in Germany. The water supply companies invested € 28 billion in the period from 1990 - 2000, whereas € 20 billion was invested in west Germany and € 8 billion in east Germany. 64% of the investments were spent on maintenance and development of the pipelines. 8% of the investments were allocated to water extraction and water purification, respectively. 5 % was allocated to water storage and the remaining 15 % was allocated to water meters and other expenditures.

(Kuckshinrichs 2005)

Characteristics of German Water Investments

	in %	in million €
Water extraction	8	199
Water purification	8	199
Water storage	5	125
Network of pipes	64	1593
Water meters	2	49
Other	13	322
Total	100	2487

Source: STE 2005 based on BGW-Statistics, 2001

At present, there is also a problem of false estimates regarding water demand, which is very costly. The current water distribution networks were planned on the basis of demand prognoses which assumed a continual increase in water demand. This increase did not take place. The reasons for that were technological developments, among others. Examples are appliances (such as water-saving dishwashers, washing machines, toilets with a saving button, urinals, shower heads and washstand appliances in private households), but also the increased use of rainwater and greywater. In industry and business, the implementation of water-efficient technologies, the construction of water circulation systems, or even the substitution of water in production processes were promoted. Even the measures put into place by water utilities for the reduction of leakage - currently at about 9% - strengthen this effect. The general overcapacity that arises in the public water supply network results in part in drinking water remaining in the distribution network for long periods of time. In order to avoid adverse chemical, physical, and microbial effects to the water, measures are necessary for assuring the quality and partly for the disinfection of potable water, which may increase the necessity of investments.

(Trittin 2003?)

(Kuckshinrichs 2005)

Trends

The consequences of overcapacity of water supply networks due to false estimates regarding water demand in previous years may result in increase of investment needs.

Ewers et al. (cited in Kuckshinrichs) expect that in the next few years € 100-150 billion will have to be invested in the German water supply system. This investment level would clearly exceed current practice.

Nowadays the drinking water suppliers invest annually 2.5 billion €, the waste water sector 5.5 billion € annually.

The average renovation rate of the water grid is about 0.91 % (several Benchmark projects, 85 % of the grids of the evaluated companies are built after 1951).

Branchenbild

Energy costs and energy consumption	
Which trends in energy prices are expected and how will this affect the drinking water situation?	
Background and status After a relatively brief period, liberalization of the electricity market has had a tangible effect by melting down energy suppliers' previous "monopoly profits". Of all customer groups, industrial consumers have benefited the most from liberalization. By the end of 2000 German industrial electricity prices had dropped by an average of one quarter. From a location point of view Germany had made good progress. Formerly a high-price country, it moved to a position midway along the international scale by the end of 2000. In the meantime, however, the development of industrial electricity prices in Germany has again worsened. Private households benefited less from liberalization. By 2000 electricity prices had dropped by a mere 9%. In 2001, the year of the electricity price turnaround, prices both for industrial consumers and private households (12% and 3% respectively) rose for the first time since liberalization. In 2002, electricity prices increased further: for industrial consumers by an estimated 4% and for a three-person household by 13%. The driving force behind the turn-around in electricity prices is the significant rise in subventions and the many new special burdens, e.g. for promoting renewable sources of energy and CHP (combined heat and power) as well as the ecological tax reform. The state's share in electricity costs meanwhile totals 41% - back in 1999, this share only amounted to 30%. Half of the main driving forces in 2003 include the electricity tax hikes, the law on renewable sources of energy and the CHP law, albeit indirectly. The other half is made up of higher fuel costs and the fact that competition among producers has noticeably lessened. These political special burdens are increasingly undermining the core electricity business as they have the effect of reversing any trends which were originally expected, such as falling prices. This development is of concern because it may give the false impression that liberalization is not worthwhile in principle, i.e. in other markets as well. ***Trends*** The most recent price increase in the electricity sector marks the beginning of a medium-term upward trend. Up to now, the effect of liberalization has compensated for the increasing special burdens. So far just 4% of private households have switched to a different electricity supplier; 28% decided on cheaper offers from their current suppliers. If residential customers continue to be this unwilling to switch suppliers, one can expect energy suppliers to exploit the politically-initiated special burdens due to their stronger market power for even more price rises. ***Influence on drinking water sector*** *the increase of energy prices* • *may result in increase of water prices* • *may cause rising attention to energy factor during evaluation of drinking water treatment technologies* *The problems appear after liberalization of energy sector and increase of the prices after, may cause additional fears concerning water supply liberalization trend, may slow it down, in worse case to general deny.*	(Auer 2003)

Water framework directive	
Full cost recovery concept	
Background An important and central point of the EU-WFD (Water Framework directive) is the integration of economic aspects into water management and water policy by the establishment of a full cost recovery framework for the water price system (Hansjürgens, 2002 cited in Kuckshinrichs). Article 9 determines "Member States shall take into account the principle of recovery of the costs of water services, including environmental and resource costs … in accordance with the polluter pays principle" (EU, 2000). EU requires the development of an assessment framework for the inventory of damage caused by the lowering of the water level and by damming to determine the implications for nature and landscape. Afterwards the costs of water use have to be allocated to the individual users, when it is possible to separate and distribute the cost of water among users responsible. The point discharge polluters - industry and waste treatment plants - of the groundwater body are easy to identify in a monitoring procedure, whereas the identification of the diffuse discharge polluters such as agriculture and traffic can cause measurement problems. A strategy has to be developed for determining full cost recovery water prices for diffuse discharge polluters, in order to avoid lump sum prices for various polluters. The water prices are not specified according to concrete material damage but according to the probability of damage occurring. In this context it is very important to mention that price deductions for special customers such as big companies are no longer compatible with European water legislation. Water management organized in future along river catchment areas will lead to a stronger regionalization of the water prices (Hansjürgens 1999). ***Consequences*** Finally, it can be concluded that the introduction of the full cost recovery concepts for the determination of water prices placed water protection on an economically founded basis by charging the full costs of water use. This will probably ensure an ecological restoration of the European water system. This new water pricing policy will ensure an economically efficient use of water resources and thereby ensure that water remains a heritage which must be protected, defended and treated as such by economic means.	(Kuckshinrichs 2005)

The role of decentralized systems	
How will this affect the costs distribution?	
Regarding governance it is expected that the pressure to raise efficiency will be improved. That means that in the organisational sector the centralization rate will raise. Due to consumer's behaviour the rate of centralization is expected to become either higher or lower depending on what happens the next years (more reduction of water consumption due to rising costs and environmental awareness, water saving technologies, self supply of industry, but also rising consumption due to wellness etc.). An ongoing reduction of water consumption may on a long-term cause a radical decentralization due to the omission of the centralized systems, but that is expected to be highly unlikely in the investigated time frame. The same can be predicted for the technological progress (new small scale technologies, their reliability and maintenance).	Rothenberger

Political factors

The role of NGO's and lobby organisations	
Background and Past *The Rhine catastrophe in the fall of 1969, the persistent lobbying of German and Dutch Rhine waterworks, and the suddenly increasing interest in environmental issues in the 1970's all led to the investing of billions of Deutschmarks in the construction of WWTP's in municipalities and in industry. Environmental action groups denounced the discharge of pollutants along the Rhine in various campaigns. Wastewater pipes were walled up and polluting factories were demonstrated against. The discharge of pollutants from the chemical industry in particular stood at the centre of interest.* *The activities of environmental organizations were brought together Europe-wide in 1983 in the "International Water Tribunal": In Rotterdam, particularly spectacular cases of water pollution in Europe were handled by an international jury.* *The interaction of environmental activists and the press increasingly forced politics to act. Beginning in 1976, following the fourth amendment to the Water Management Act, legal limits ("monitoring standards" – "Überwachungswerte") were agreed upon for the first time for the discharge of pollutants by countless branches of industry. In 1986, within the scope of the fifth amendment to the Water Management Act, industry-specific monitoring standards for "hazardous substances" were considerably tightened. The framework wastewater administration regulations defined in particular heavy metals and organic chlorinated compounds as "hazardous substances" at that time.* *Citizens' action committees and environmental organizations also sought a better insight into the water permits of large-scale dischargers of contaminants. The set monitoring standards for the dischargers of contaminants were recorded in the "water books" of the upper water authorities. These "water books" were at first not accessible to the public. Authorities and emitters insisted on the protection of "corporate secrets". It took campaigns and court cases to abolish the secrecy provisions for the "water books" in the Water Management Act and in state water laws. Even though there are still restrictions in part, the activities from the 1970's until today have brought Germany quite far down the path to the "transparent wastewater pipe".* ***Present*** *The reassignment of permits for point sources today is negotiated at public debates. Other water body users as well as environmental organizations are able to view, comment on, and criticize the application documents.*	(Kuckshinrichs 2005) (Trittin 2003?)

Administrative procedures	
E.g. approvement of new technologies for application in drinking water	
The legislator enacts general protection and safety goals. Technical associations like DVGW and ATV-DVWK define comprehensive bodies of legislation to concretize these goals. Via this these associations define state-of-the-art rules, which have to be met by the water suppliers. They also investigate new technological innovations and verify and certify new technologies. These comprehensive bodies of legislation also to some extent are a constraint for the approval of new alternative technologies. These technologies can just hardly be implemented, if there no rule or process sheet exists.	Rothenberger

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...	
New drinking water regulation New drinking water regulation came into force at 1.1.2003 and brought European drinking water regulations from 3.11.1998 in German national law. Comparing to former drinking water regulation the row of limit values was strengthened. One substantial aspect of new water regulation is the change in definition of drinking water in §3: drinking water is such water, which is used for drinking, cooking and preparation of food and drinks. Besides of this, water, which is used for body care and cleaning, cleaning of the things contacting with foodstuff according to their purpose, and in dishwashing machine is also drinking water. Therefore, toilet flush water is not drinking water. On the contrary, the residents decide themselves if they want to have water of drinking water quality level for example for laundry. The other innovation is the determination of the place to observe the water quality level. In the new regulation this place is in the point-of-use and no longer at waterworks. In general, drinking waterworks are responsible for observance of parameters till the main house faucet. In contrary, the responsibility for the pollution, which occurs through house installations, is on the owner of the house. This is especially important in combination with sharpening of lead limit value from November 2003 and following reduction of lead from 2013. This can result in the fact, that from 2013 the lead limit values can be hold only in case of change of all lead containing house installations. The other novelties of new drinking water regulation include: • In cases of microbiological loads the raw water must be treated, especially when there is a threat of any transmitting disease to appear. This means that disinfection technology alone will not be satisfying anymore and therefore for example a slow sand filter should be included in the beginning of the technological schema. • The owners of not-drinking water works must announce the first operation and changes in their water works. The Public Health Department (Gesundheitsamt) must control these works. It is still a question, if the local health authorities will manage additional work and expenses of periodic sampling of end-users'	(Rothenberger 2003)

water, instead of sampling only the water after treatment on waterworks. ***Consequences of new drinking water regulation*** Overall, it is of importance, that in future the house owners as well as companies providing planning and installation of infrastructure will be responsible for water quality at point-of-use. Through this, it is possible that new services from installation and water supply utilities will appear, for example, control of infrastructure in terms of hygiene, safety and function capability. It also seems possible in future that together with installation of house infrastructure the servicing contract would have to be concluded. *The strengthening of the limit values may result in increase of investment needs and necessity of development of new technologies which would be able to cope with increasing limit values.*	

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	Source
The intense innovative activity in all areas of the economy lead to a constant improvement of conventional technologies as well as to a rapidly growing number of new technologies. ***Membrane filtration*** Membrane filtration is a typical further development of existing approach to treat raw water to the high quality levels. The membrane technology is one of the innovations that may notably improve the performance of the drinking water treatment. At the same time, the membrane technology may be applied in small decentralized water works due to small size of installations in proportion to treatment capabilities. According to some experts (interview are cited by Rothenberger), the membrane technology may provide high levels of microorganisms elimination. As well, the appearance of new requirements for drinking water quality concerning micro- and emerging pollutants may result in increase of acceptance of membrane technology. Also this technology is getting more attractive not only because of its technical, but also economical performance. According to Rothenberger (citation from Gimbel), the costs of ultrafiltration membranes pro m^2 between 1991 and 2001 were reduced up to 90%. ***Disinfection with Ozone and UV*** The biggest producer of the UV technologies in Germany had counted the increase of the world market of UV technologies from 10% in 1997 to 30% in 2005 (WEDECO AG 2002) Other examples are innovations in sensor technology, information	(Trittin 2003?) (Rothenberger 2003)

and communication technology. ***Synthesis*** Ecological and economical sensitization of customers as well as their acceptance of new technologies is an important condition for interest in alternatives to present systems at all. At the same time, it is of importance that not only the end-users have this kind of interest, but also intermediate actors, such as architectures, planners, and etc. understand and accept this interest of their customers, that already in first planning phase the alternative systems can be integrated. An important condition for spreading of radical-innovative technologies is the technical development and associated with it further cost reduction of such technologies as membrane filtration, UV/ozone disinfection, water recycling or saving (the last two described further in technical factors). These technologies may affect further support of decentralized technologies either because of their reduced space requirements or remote operation monitoring. Also, the development of accordant process sheets in DVGW regulations is important to accept alternatives as a present situation in technology.	

Point of use systems	
Current expansion of point-of-use systems (?), trends in their efficiency, quality and control	
Decentralized technologies Decentralized technologies that are being increasingly used in households and businesses in Germany for the efficient use of water. They are often complex and require competent maintenance. Together with other equipment used in buildings for the generation of heat (heaters, warm water heaters, solar-powered systems, heat pumps), the generation of electricity (photovoltaic systems, in the future also fuel cells), lighting systems, and ventilation systems, water technologies are also a component of an increasingly complex housing technology. There are many possibilities in this area for water utilities to work together with other industries, such as power or gas utilities. They can, for example, build joint communication networks for the long-distance reading of consumption data, long-distance monitoring, and remote problem identification, thereby creating more customer-oriented services. Such a communication infrastructure is a prerequisite for the creation of new offers of service for the provision and reliable operation of decentralized (on-site) water technologies - a strategy that power utilities have already begun to implement in a similar way in their deregulated markets. These housing technologies use modern installation and building monitor technologies. The internet guarantees the functioning of decentralized facilities and permits remote monitoring, load management, and quick consumption monitoring and billing. Information and communication technologies enable an integrated management of the building with all its technical processes. Thus, water utilities could expand their fields of business, within the scope of contracting offers, by offering private households decentralized technologies, such as rainwater utilization and greywater processing, but also other water-conserving fixtures and sanitary systems (together with the corresponding services, including maintenance). The energy sector demonstrates that this is indeed possible. ***Results***	(Trittin 2003?)

Through such demand-sided measures, significantly more flexibility can be brought into the rigid, centralized design of water supply and wastewater disposal with respect to both changing customer needs and the integration of innovative technologies. This development would entail a new approach that could overcome the historic separation that has developed in Germany between the water supply and wastewater disposal sectors. Such new measures could also contribute to the development of synergies between both supply sectors (e.g. in the area of network management, the conceptualization of a comprehensive water management service sector) and thus increase the ecological efficiency of water consumption in human settlement areas.	

Water recycling systems	
Are drinking water application of recycled water likely	
In Germany there are some examples of application of water saving and recycling technologies. The most famous example is settlement *Flintenbreite* in Lübeck (www.flintenbreite.de) ***The example of water saving and recycling:*** "Flintenbreite" is the 5.6 hectare-large residential area with 12 duplexes, 45 townhouses, condominiums, and apartments, which was designed on the basis of integrated energy, wastewater and refuse system, structured around closed material cycles. The wastewater treatment provided in Flintenbreite was designed to use nutrients and energy content. In this case the separate gathering and handling of rainwater, greywater, blackwater, and organic refuse was envisioned. In the case of this settlement, while grey water was treated and led back into the natural water cycle, blackwater that had been gathered by means of a water-saving vacuum system was used together with organic refuse for biogas recovery. The biogas was used to run the housing development's own combined heat and power station. In general, the authors mentioned the reduction in "CO2 emission by 90% and operational costs in comparison to conventional housing developments were reduced by approx. 30%. *The area of the housing estate is not connected to the central sewerage system. The sanitation system consists mainly of the following components:* • *vacuum toilets with vacuum-sewer system and anaerobic digestion with co-treatment of organic waste in a semi-centralised biogas-plant, recycling of digested anaerobic sludge for agriculture with further storage for growth periods. Utilisation of biogas in combined power and heat generator (heating for houses/digestor and production of electricity) in addition to natural gas* • *decentralised treatment of grey water in vertical flown constructed wetlands (reed-bed filters) with interval feeding* • *· storm water retention and infiltration in a swale system.*	(Trittin 2003?) www. flintenbreite. de

Water saving technologies	
E.g. rainwater harvesting	
Rainwater harvesting Although the idea of gathering rainwater in reservoirs for use in dry times is as old as the human civilization, and although cisterns are used world-wide for balancing out rainy and dry periods, the utilization of rainwater was not a topic in Germany for a long time. In the course of growing environmental awareness and as an effort to conserve resources, the desire began to grow in many people to increase the use of rainwater and greywater. Since Germany is a country with a large degree of precipitation that in general has a sufficient supply of water at its disposal, this development was considered to be very controversial, in view of the hygienic and ecological risks. Therefore, the portrayal of the experiences in Germany and of the technologies developed here does not mean that their application is warranted. Rather, they are meant to demonstrate how Germany's instruments and technologies can stimulate ideas for problems in other countries. The substitution of rainwater for potable water, for example, as process water for toilet flushing, did not gain in importance until about 15 years ago. In the past few years, the necessary technology, particularly for toilet flushing using stored-up rainwater, reached a high technical standard as well as a good reliability of operation. The installation of rain water utilization systems is being supported by a growing number of municipalities as a measure for the management of rainwater. The utilization of rainwater, for instance, has been successful in ten public institutions in Hamburg, in the Frankfurt airport, at the Hessischer Rundfunk broadcasting company, at the UFA Film & TV Production Institute in Berlin, in the Weil municipal garden center, and in a car wash in Überlingen. Typical basic requirements for such systems are a large roof surface and, as much as possible, a regular consumption of water throughout the whole year. Such conditions allow for a large number of applications with economical potential, especially in the area of commerce (e.g. shopping centers, sports facilities, transportation centers). The *city of Bonn* (310,000 inhabitants) changed its fee schedule for the usage of public wastewater systems (sewer regulation) at the beginning of 1996 in order to promote rainwater utilization, rainwater seepage, the opening of scaled surfaces, and the introduction of "green roofs" (roofs covered with vegetation). In Bonn, wastewater fees are made up of a fee for rainwater and a fee for contaminated water (a split fee standard). Homeowners can now save up to 50% of their rainwater fees if they pave their driveways and sidewalks with water permeable surfaces, reduce the volume of rainwater runoff by installing "green roofs", dig seepage areas (depressions, ditches, ponds), or install rainwater utilization systems. Similar programs have been applied to numerous other municipalities, for example, within the scope of a joint research project by the Federal Ministry of Education and Research (Bundesministerium für Bildung, Wissenschaft, Forschung und Technologie)[36]. The city of *Frankfurt a. M.* (654,000 inhabitants) in 1992 set for itself the goal of reducing the current dependence upon long-range water supply through the efficient use of water in private households, public institutions, and businesses. Through a widespread campaign, water consumption in the year 2000 should be reduced by 20% in comparison to 1991/1992 (by changes in consumer behavior, upgrading of water-saving installations and fixtures, water-saving contracting, etc.). The use of rainwater in households (both in singlefamily homes and in multiple-family homes) for flushing the toilet, washing laundry, and watering the garden was promoted through a public subsidy program.	(Trittin 2003?)

Greywater use
Besides the substitution of rainwater for potable water, process water generated from domestic *greywater* is gaining in significance. Greywater is the runoff from the bathtub, shower, washbasin, or washing machine. In a water-conserving household, approx. 60 liters of greywater are generated per person daily. Since greywater is generated directly in every household in just about equal volumes every day independent of the weather, compared to runoff from roofs, it presents a constant resource. It is only slightly polluted; to a large extent free from feces, oily substances, and solid matter; only slightly bacterially contaminated; and furthermore has a usable temperature. First greywater processors are being used in both private households and in hotels. A hygienic risk can be excluded to a high degree. Treated greywater can be used as process water for flushing the toilet, for watering the garden, and for cleaning. Laundry washing with greywater is currently being tested.

Combination " green roofs" - greywater
A further possibility is the combination of the use of greywater with "green roofs" in single- or double-family houses. Through the retention of rainwater and the large degree of evaporation on the planted roof, rainwater is kept out of the sewer system. At the same time, the household's use of potable water is reduced by one third of the daily per capita consumption by using greywater as process water for flushing the toilet. In hotels and public establishments (sports facilities, swimming pools, residential and retirement homes), relatively large volumes of greywater accumulate with great regularity. There are practical examples of utilizing greywater in hotels, administration buildings, university campuses, etc. The payback period of the greywater reutilization system installed in 1996 in the four-star hotel Arabella-Sheraton (400 beds) in Offenbach, for example, is expected to be seven years.

Water saving devices
They start with modern fittings and lead to complex systems, as the following examples show.
Depending upon the construction and configuration of sanitary fixtures for the sink and shower, water consumption levels can greatly vary. Two-lever fixtures for the separate adjustment of warm and cold water in particular are out-dated because of the long period of time it takes for adjusting the right temperature and because readjustment of the combined hot/cold water is often needed. Single lever water fixtures have the advantage of a faster adjustment and readjustment time. Also, water can be turned on and off with one knob without changing the selected temperature.

Many quality fixtures already have integrated limits for volumes of water by which the flow rate per minute is reduced without noticeable loss of comfort. Conservation of up to 50% can be achieved by showers that have thermostats. They take only the absolutely necessary volume of cold water out of the water pipes, in order to bring the hot water to the preselected temperature. Variations in pressure and temperature in the water pipes are thereby equalized without the user noticing it.

Remote sensing sanitary fixtures, particularly in administration buildings and public institutions, significantly reduce water consumption and have a high payback rate. The same goes for self-stopping fixtures at public swimming pools or at other sport facilities, as well as for water-conserving urinals in public institutions, restaurants, and administration buildings.

Even the water consumption of washing machines and dishwashers has been dramatically reduced in the past few years. While the water consumption of washing machines in the mid 1980's was still between 100 to 120 liters per wash cycle, consumption of current models for a 40° C or 60° C bright-colors cycle is between 39 and 72 liters per cycle. Accordingly, the water consumption of dishwashers was able to be reduced to 17 liters per cycle - in the most conserving appliances it was even reduced to 15 liters per cycle. The reduction of water consumption also has the direct consequence of reducing energy costs, since less water needs to be heated. ***Trends*** Noticeable reductions in the volume of water consumed by private households can hardly be expected in the future; here much of the potential to reduce water usage has already been realized (for example, water-saving faucets, stop buttons on toilettes). In the long term, increased use of rainwater (e.g. for flushing toilettes) will help to reduce consumption. Profit-oriented water suppliers will hardly ask their customers to use an especially small amount of water. Exploitation of water resources, however, will be prevented by law or through monitoring by governmental agencies. Generally, a stagnation of per capita water use is likely at the current level, which is low by international standards.	

Ecological factors

Emerging pollutants	Source
Governmental monitoring already exists?	
Implementing the Water Framework Directive, a monitoring program has to be operational by the end of 2006, which focuses on water bodies at risk of failing the WFD objectives.	UBA

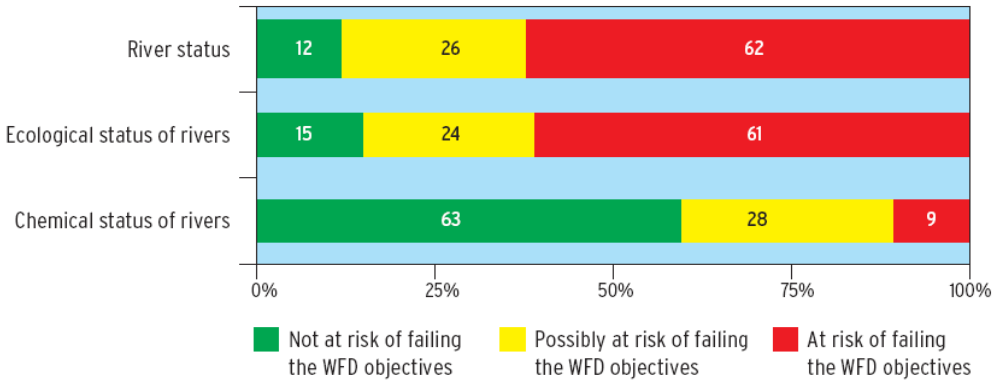
Accumulation of pollutants in the environment	
The mean residence time of nitrogen in groundwater results from excesses in agriculture and concentrations of nitrogen in rivers. It is between 10 and 20 years in the groundwater inflow to the Rhine, 20 years in the Danube River, and 30 years in the Elbe River Valley. The results were similar in a groundwater flow model in the plains in the Elbe River: Flow times ranged from 1.5 to about 500 years, with a median of 25 years. Because of these long residence times, after the inflow of nitrogen into the groundwater has been reduced from its peak in 1987, it will still last decades until the large rivers supplied by groundwater are relieved.	(Trittin 2003?)

General quality / composition changes in water resources, e.g. due to climate changes.	
Surface water	
Non-pollution pressures ***Background and Status*** In developed countries, non-pollution pressures such as water abstraction, water flow regulation and morphological changes often have a major impact on water body quality. In addition to modifying the landscape, such changes also rob aquatic organisms of their habitats and hence their means of survival. ***Water abstraction*** Water abstraction arising from the use of water for industrial processes or power generation is assessed according to varying criteria, e.g. the ratio of abstractions to flows within water bodies. The German states have rarely regarded lake and river abstractions as a significant pressure since they tend to have an impact in individual cases and on relatively small areas in the ecosystem. However, water abstraction for cooling processes can often be environmentally damaging by virtue of the fact that heated coolant water is discharged back into the water body. *For example, the warming of the Wupper (part of the Rhine river basin) provoked by heated coolant water from thermal power plants is currently subjecting the river to considerable environmental pressure.* ***Water flow regulation*** Water flow regulation is realized in Germany for purposes of flood protection, hydropower, commercial shipping and land reclamation, among other applications. Transverse structures that have used for flow regulation are deemed to exert considerable environmental pressure when they have more than 30 cm water level differences and thus impede the upstream migration of myriad fish species and other aquatic organisms. *The state of Hessen has 2,650 such structures distributed over approximately 8,440 km of watercourse, which translates into an average of one barrier every three km. The situation is similar in the Elbe, Mulde and Schwarze Elster catchment area, which contains approximately 2,160 significant transverse structures distributed over 6,720 km of watercourse.* In short, virtually all of Germany's catchment areas are studded with dams, weirs and the like, despite the various natural and use oriented features that dot the same landscape. Thus, migration barriers and altered ecomorphology constitute a significant risk factor for the ecological status of Germany's water resources. ***Morphological alterations*** The morphology of Germany's water bodies is in many cases the product of extensive socio-economic use. For example, rivers are truncated, riverbanks are built up, dams are constructed, water is diverted into canals, and dikes are built for purposes of flood protection. Larger rivers are used by commercial vessels and power generation, weirs and locks are built, and floodplains are for the most part segmented by dikes. Structures are also built on most small rivers and streams for power generation, flood protection and agricultural purposes. The results of the morphological investigations that have been conducted reflect these conditions. Of 33,000 km of watercourses assessed, only 20% are in a nearly natural state (ecomorphological classes 1, 2 and 3), while 33% are in a strongly or completely changed state (ecomorphological classes 6 and 7). The morphology of water bodies in urban and intensively cultivated areas has been most drastically changed. The hydromorphology of virtually all of the Germany's river basin districts have been altered by anthropogenic activity along broad stretches of watercourse. ***Assessment*** Impact assessment indicators and criteria were identified and recommended by	(Richert 2005)

LAWA; German Working Group of the Federal States on water issues (source: Kriterienpapier für Fließgewässer; status as at March 31, 2003)

Characterisation results

Approximately 9000 river water bodies were identified and assessed in Germany.
The assessment showed that 61% of the river water bodies investigated are at risk of falling to achieve good ecological status by 2015.
The results also showed that 24% of the water bodies assessed are possibly at risk of failing the WFD objectives, while only 15% are likely to achieve them (Figure). The good ecological potential of heavily modified and artificial water bodies was included in these figures.
The chemical status of the nearly 7,700 water bodies assessed by the German states yielded more positive results than the assessment of ecological status. It was found that approximately 63% of the water bodies assessed will probably meet the environmental objectives of the Directive, 28% are possibly at risk of failing the objectives (in some cases owing to a lack of data or the fact that the assessments did not include measuring data), and that only 9% of the water bodies assessed are at risk of failing the objectives.

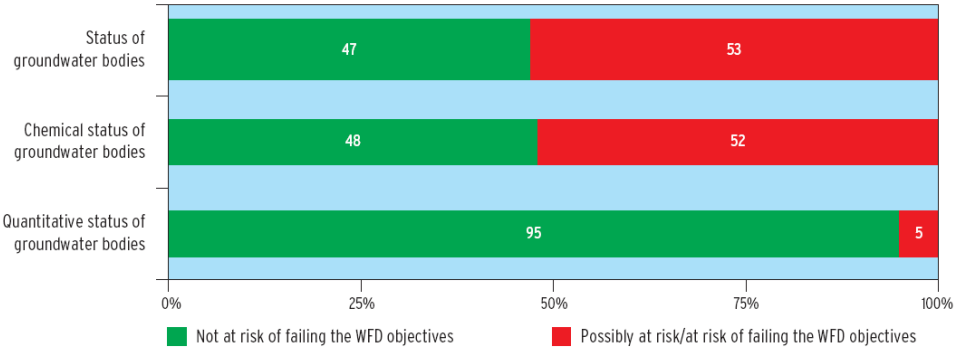


Approximately 800 bodies of still water, including some dams, weirs and artificial lakes, have been assessed thus far as part of the initial characterization. Of the lakes assessed, over 400 are located in the German part of the Elbe river basin district. 38% of the lakes assessed are not at risk to achieve good ecological status by 2015, for 24% the outcome is in doubt, and 38% are at risk of failing to achieve good ecological status (Figure).

Trends visible

Despite the diverse assessment methods employed by the various German states, it can be stated with certainty in regard to Germany's watercourses as a whole that a substantial proportion of the country's rivers and streams will probably fail the WFD objectives, particularly those pertaining to good ecological status, unless programmes of measures aimed at improving water body status are systematically implemented. In many cases, this failure to meet the objectives is mainly attributable to the irreversible effects of anthropogenic activity. Altered hydromorphology and deficient water body continuity constitute a particularly serious ecological problem in all German states and river basins. The initial characterization also showed that water bodies in densely populated areas are highly unlikely to achieve good ecological status by 2015. As anticipated, a substantial number of the water bodies in these regions were provisionally identified as "heavily modified". In Berlin, Bremen and Hamburg only about 1% of all water bodies are expected to meet the Directive's environmental objectives.
According to the characterization results for the water bodies assessed, the most severe environmental pressures currently facing Germany's water bodies are

engineering structures, insufficient water body continuity, and chemical inputs provoked by extensive agricultural activities. In most cases, the likelihood that a water body will achieve good ecological status is determined by the interplay between multiple environmental pressures.	

General quality / composition changes in water resources	
Ground water	
Background As the source of approximately 75% of Germany's drinking water and an integral component of the water cycle, groundwater is particularly deserving of protection. Moreover, since in most cases groundwaters and surface waters constitute an interdependent system, groundwater quality has a direct impact on surface water ecology. In addition, many terrestrial ecosystems such as wetlands are fed by groundwater that either emerges at the surface or originates in areas where the water table is very close to the surface. Polluted aquifers or excessive abstractions from them can have an adverse effect on such ecosystems. Thus, a key objective of sustainable water management is to maintain adequate quality and quantity while at the same time safeguarding groundwater resources against contamination. ***Results*** The assessment of groundwater status for all river basin districts revealed that approximately 95% of all groundwater bodies currently have good quantitative status, which means that Germany is assured of having adequate groundwater resources in the future. The situation is quite different when it comes to chemical status, however, since approximately 52% of the water bodies assessed are possibly at risk of failing the WFD objectives unless additional measures are realized (Figure 2). These water bodies comprise approximately 45% of Germany's surface area. **Figure 2: Characterization results for groundwater**  Most pressure on groundwater bodies stems from chemical inputs. Approximately 85% of the groundwater bodies that are at risk of failing good ecological status are subject to chemical pressures from diffuse sources, as well as pesticides. Inputs from former waste dumps and industrial sites are of lesser overall importance but in some cases are significant at the local level. For example, aquifers in the state of Berlin contain elevated sulfate concentrations from deposits of construction and demolition waste. Although quantitative pressures on groundwater bodies are not a widespread phenomenon in Germany, they reach significant levels in some regions owing to factors such as lignite mining. 95% of the water bodies in the Rhine river basin district have good quantitative status, although a few areas suffer from extremely low groundwater levels. Lignite mining has a major environmental impact on the Maas river basin	(Richert 2005)

district, 35% of whose groundwater bodies fail good quantitative status owing to incremental decreases in groundwater levels over a period of many years. 16 of 210 groundwater bodies in the Elbe catchment area are at risk, or probably at risk, of failing good quantitative status owing to lignite mining. ***Trends*** The requirements for German groundwater management will rise due to the European Union Water Framework Directive despite the high level of protection in Germany.	

Region-specific contaminants?	
E.g. Arsenic, Cadmium, Radioactive elements	
Pesticide problem in Stever River ***Status*** The main problem of the whole Stever River catchment area is high contaminationdue to agricultural overuse of problematic pesticide agents (currently isoproturone, chloroturone, bentazone, and in some cases terbutylazine). In order to further keep the expenses of water purifictation ata a low level the management of these contaminants will be the goal of the next few years. The report of the Institute for Water-, Ground-, and Air Hygiene at the Federal Environmental Agency (Umweltbundesamt) in Berlin already hinted at this strategy as a component of the Five Point Program. The reduction of isoproturone usage to 10% was not able to be implemented at the time because there were not enough alternatives. In the meantime, sufficient approved alternatives that are more compatible with water have become available on the market. The necessity of substitution is supported by the new authorization stipulations of 1999 for urea herbicides (like isoproturone and chlortolurone), which forbid the output of urea derivatives in the Stever River catchment area up to 90%. With regard to this, the cooperation in the Stever area has led to the necessary measures to comply with the new legal situation. In order to ensure an even better protection of surface water against pesticides in the future, an adaptation of the current licensing procedures is desirable, as it is also envisioned in the Five Point Program. ***Trends*** After the experiences of the last 10 years, there are warranted hopes that in the next decade the pesticide problems in the Stever River catchment area will be able to be resolved by following agricultural practices involving chemical pesticides while keeping the nutrient situation in the manufacturing-intensive region under control.	(Trittin 2003?)

Influence of water framework directive	
Development of a baseline scenario for forecasts of the economic drivers of water use The Water Framework Directive requires Member States to elaborate programmes of measures that will prevent an upward trend in environmental pressures on polluted water bodies and relieve these	(Richert 2005)

pressures so as to allow for the achievement of good ecological status. This means that in addition to managing water resources at an operational level, Member States are also required to develop a baseline scenario to interpret forecasts of key economic drivers that are likely to influence pressures and water usage. In analyzing the various river basin districts, drivers of water supply and demand were identified and scenarios were elaborated for all water uses that are likely to have a major impact on water body status. These scenarios also took into consideration water demand trends in the household, industrial and agricultural sectors, chemical pressures arising from wastewater discharges, and diffuse nutrient inputs from the agricultural sector. For Germany's public water utilities, the long-term evolution of supply and demand is a critical factor in maintaining an adequate supply of drinking water, as well as efficient wastewater management. During the characterization, efforts were made to forecast these trends by elaborating supply and demand scenarios for individual river basin districts. For example, water demand in the Elbe catchment area was simulated using three models based on various baseline assumptions. These simulations revealed that drinking water demand will probably stagnate in this region. Simulations for the Weser and Rhine regions based on per-person consumption and population trends likewise indicate that water demand in these regions will remain relatively stable over the next decade. The Danube catchment area constitutes an exception in this regard, however, in that population increases in the region could drive up water demand by 1.3% to 1.9%. Wastewater pressures from municipal wastewater plants are likely to remain at current levels as well. The characterization showed that there is unlikely to be any significant increase in environmental pressures from municipal wastewater treatment plants, thanks to clearer legal regulations, continuous optimization and modernization of wastewater treatment plants, the use of new technologies and the expansion of rainwater treatment capacities.	

Other Ecological Aspects	
Climate Change Among the potential negative impacts of climate change, the increased risk of flooding and the decrease in water supply during summer are of primary importance. These impacts are the result of an observed shift, which is expected to become more pronounced in future, of precipitation from summer to winter, as well as higher evaporation owing to increased temperature. Additionally, the probability of extreme rainfall events is increased particularly in winter and the duration of snow cover is projected to decrease. Presumably mostly in the months of winter and spring the risk of flooding increases across Germany. The Alpine region and highly built-up regions without sufficient retention areas are particularly at risks. It is as yet unclear to what extent the risk of summer floods will increase. Especially the central and eastern areas of Germany will suffer from a decreased supply of water in the summer months. The risk of drought increases and is accompanied by constraints in agriculture, forestry, energy supply and navigation, and possibly also in drinking water supply. A reduction of groundwater recharge is a further potential negative impact of climate change. Hitherto, constraints in drinking water supply due to	(Zebrich 2005)

climate change have not been expected, despite an increasing eutrophication in many areas. So far, the water sector is little adapted to the impacts of climate change. In the planning of flood protection the impacts of climate change find little consideration in most federal states. Therefore, we presently consider the vulnerability of the water sector as "high" across Germany (business-as-usual scenario, see chapter 2.8). As yet, water supply and distribution is not prepared for water shortages in summer. If no adaptation measures are implemented, the vulnerability of impacted regions (eastern Germany) will be "high". In the remaining areas, vulnerability to water shortages is "moderate". In general, the water sector should be able to adapt to future climate impacts, since a full range of sufficient adaptation options are available, even if their implementation is mostly considered to be complicated. Saving water and rebuilding natural rivers are considered to be most effective in adapting to a multitude of uncertain impacts of climate change. However, adaptation measures in water supply and distribution can presumably not be implemented without special support (particularly financial resources). If the necessary adaptation measures are implemented, a reduction to "low" vulnerability of the water sector to climate change can be expected.	

Subfactor: Resources

Trends in resource water	Source
E.g. climate change, river restoration projects	
Flood control and prevention The ecological catastrophes in the Rhine River gave water protection policies the necessary political power for the implementation of protective measures. In a similar way, this was also true for flood control. Flood control measures are now anchored in the Water Management Act (WHG, 1996). ***Results and status*** Whether the new regulations will be helpful in the identification of flood retention areas is still to be determined. Uncertainty continues to dominate in the dispute over the identification of flooding regions. For the administration of water management, the identification of flooding areas is still coupled with lengthy disputes. Wherever flooding areas are to be identified, subjective interests are vehemently made known – *"Flood control should be everywhere, but not here with us!"* At every respective location, there are always *"very special and unique reasons"* seen subjectively from the point of view of those affected for forbidding the definition of a flood plain. This goes to show that the administration of water management must follow a policy that favours protecting national over individual interests. In many places, sceptical citizens complain of a lack of information from the administration. Not enough transparency in the decision-making processes leads to a growing mistrust by affected citizens. Awkward maneuvering on the part of agencies strengthens the opposition. Ultimately, the necessary flood control measures, such as retention polders and the repositioning of dams, are often not able to be politically executed.	(Trittin 2003?)

How does Agricultural use of water influence resources?	
E.g. overexploitation of resources or expansion of bio-technologies?	
Diffuse sources Diffuse sources play a more significant role than point sources in terms of nutrient (particularly nitrogen), pesticide, and other forms of pollution. In Germany from 1998-2000, nitrogen accounted for approximately 80% of all inputs, while phosphorus accounted for approximately 70%. The inputs are particularly high for areas in which large animal stocks are kept on soils that are especially susceptible to discharges. Despite substantial emissions reductions, nutrient concentrations in water bodies are still unduly high. In carrying out the characterization process, the German states placed particular emphasis on the assessment of inputs from nitrogen, phosphorus and pesticides, all of which stem mainly from intensively cultivated farmland. Large amounts of phosphorus have accumulated in agricultural fields in the last several decades through mineral fertilization. Over 60% of the fields are sufficiently or even excessively supplied with phosphorus today. Since 1980, German agriculture has reacted to this by reducing the use of mineral fertilizers (1980:29.9 kg P/ha; 1995: 14.4 kg P/ha). Nutrient emissions from agriculture have decreased due in part to the following factors: the realization that a reduced usage of chemicals is economically advantageous, that the phosphate content of agricultural fields is sufficient or too high, and an increasing environmental awareness on the part of farmers, as a result of public debate and ultimately the EU agricultural reform. ***Status*** Preventable nutrient pollution from agriculture is to a large extent the result of the separation of livestock-poor regions (such as industrial fruit farms) from regions with large quantities of livestock (such as feed production enterprises) and industrial livestock farms. Due to this separation, fertilizers containing nitrogen (solid and liquid manure) need to be disposed of in regions rich in livestock, leading to excessive nutrient emissions in water bodies. In livestock-poor regions, large amounts of inexpensive mineral fertilizers are used to supply fields with nitrogen, with the same negative results for water bodies. Very few farms have an ecologically balanced system by which the excess of nitrogen from livestock farming is applied on-site to supply nitrogen in the cultivation of fields. ***Status of pollution prevention*** The amount of total nitrogen emitted into the river catchment areas of Germany was approx. 820 kt N/yr from 1993 to 1997, which was 25% less (266 kt N/yr) than a decade earlier. Nevertheless, the international goal of reducing nutrient emissions into the oceans by half from 1985 to 1995 was not reached. All states bordering Germany also missed this goal. In order to achieve a desirable reduction of nitrogen loads by half, a further reduction of the nitrogen excess to approx. 50 kg N/ha/yr and a considerable improvement of the denitrification capacity of the land (e.g. by backing-up or closing ditches, re-saturating wetlands, and improving the morphological structure of water bodies) would be necessary. The Fertilizer Ordinance (EU directive adopted into German law) requires farms to perform fertilizer balances. Nevertheless, the maximum permissible amounts of organic fertilizers - 210 kg/ha/yr nitrogen since 1996, 170 kg/ha/yr since 2000 - are still too high from the viewpoint of water protection. There are also no limits for the total amount of fertilizer used. Furthermore, this can be increased by 30% to compensate for	(Richert 2005) (Trittin 2003?)

nitrogen losses through organic fertilization. ***Trends*** • With such high application of nitrogen, further noticeable nitrogen pollution can be expected, especially from areas with water permeable surfaces, locations vulnerable to erosion, and fertilized shorelines. • Emissions of phosphorus from agriculture continue to increase due to the excess of phosphorus that still exists.	

Industry in general: increase / decrease	
E.g. heavy industry moving out of W-Europe	
Status *Industrial production rose by 3.3% in real terms in Germany in 2005, considerably outstripping GDP growth of 0.9%. Adjusted for the number of working days, the increase in output was even higher at 3.8%, though the December reading fell short of the high level of the two previous months. This elicited many negative comments. However, many people failed to note that the final quarter topped the third quarter by close to 1.5%.* *The chemicals sector led the growth standings last year with output rising by nearly 7%. The main driving force was the pharmaceuticals industry with an increase of over 11%. The key underlying factors were booming demand abroad and robust demand for influenza drugs at home. Makers of capital goods contributed to the above-average growth of German industry though, too. Industrial performance was better in Germany than in many other large European countries. The mechanical engineering sector in Germany increased its output by 4.1% in 2005. Besides strong export growth ("recycling of petrodollars" in large-scale plant engineering), domestic activity has also picked up. The automotive industry continued to chalk up gains (+4.2%) after already posting dynamic growth in 2004. Traditionally good export business (record sales of cars and trucks) and also a higher number of new car registrations in Germany (despite soaring fuel prices) was the key. Another one of last year's winners was the electrical engineering industry. However, a question mark hangs over the strong growth in sector output (roughly 5%) reported by Germany's Federal Statistical Office because it is partly attributable to a one-off occurrence. The new method of hedonic price measurement now used by the Office attaches greater weight to quality improvements, which resulted in significant price declines. Under the hedonic method, this leads to a decline in the price and thus inflates the growth rates of electrical engineering output in real terms. However, companies in the sector and the industry association cannot understand the high rates cited for 2005.* *In addition to the persistent weakness in the construction sector, there is no sign either of brighter prospects for the textiles and clothing industry (-4.3% and -7.7% respectively), even though in-house production in Germany has been cut back substantially. Structural factors are the main issue here. Food industry output increased more strongly than usual (+2.9%), thanks mainly to meat exports.* *Industrial production looks set to expand further in Germany again in 2006. The growth performance is likely to slightly surpass the 2005 level, coming in at close to 4%.* *The VAT effect should also fuel buying activity in the area of consumer durables (e.g. furniture, consumer electronics and electrical appliances) in the second half of 2006. Moreover, sales of state-of-the-art televisions will be enhanced by the upcoming football World Cup, since experience tells us that major sporting events trigger a run on TVs.*	(Frank 2005)

Output is expected to remain dynamic in the mechanical engineering sector (+4%). Demand has stayed very brisk - especially from the oil-exporting countries. It will also be buoyed in Germany by the temporary relaxation of depreciation rules for capital goods. The chemicals industry is likely to see the growth rate ease to 4% as the impact of special items peters out. All in all, industrial production is poised to expand noticeably faster than real GDP in Germany again in 2006.	

Wastewater treatment in general: influence on surface water quality	
Status Inputs from wastewater treatment plants are a significant point source. Household and industrial wastewater is treated at over 10,000 municipal wastewater treatment plants in Germany. In the former East Germany, the wastewater generated by 76% of the population is treated in wastewater treatment plants, while in western Germany the figure is approximately 96%. Additional point sources include industrial wastewater treatment plants whose effluent is introduced directly into the sewer system. Discharges from rainwater drainage systems are a source of pressure on water bodies, particularly during heavy rains. A substantial amount of the inputs from heavy metal, phosphorus compounds and oxygen depleting chemicals originate in polluted rainwater, particularly from densely populated areas with a high density of sealed surfaces. Inputs from residential areas are regarded as significant when a total of more than 10 km2 of sealed surfaces is connected to the sewer system. Certain inorganic salts can also pose problems for water bodies. For example, approximately 100 kilograms of chloride per second are dumped into the Weser river basin district owing to potash mining at the Werra mines there. ***Phosphorous and Nitrogen*** The Washing and Cleaning Agents Law which took effect in 1987 effected a significant reduction of phosphorus pollution from soaps and detergents. Due to the use of phosphatefree washing agents and to phosphate removal in waste water treatment plans (WWTP), only 20% of the emission loads observed from 1983 to 1987 enter into water bodies today. The phosphate emission at municipal WWTP's was reduced by 80% through the upgrade of *WWTP's* (third treatment stage), combined with the introduction of phosphate-free washing agents. This source of phosphorus pollution has thereby had the greatest proportion of reduction; currently, it accounts for only 31% of total phosphorus pollution. The comprehensive ongoing development of wastewater treatment in Germany has led to an improvement in water quality. However, the emission of nutrients from nonpoint sources in *agriculture* is still a problem. This kind of emission is described in the factor "How does agriculture use of water influence resources?" As was the case with phosphorus, the greatest reduction of nitrogen emissions was from point sources (reduced by about 45%). Point sources currently account for only 28% of all emissions of nitrogen. By contrast, only about a 10% reduction of nonpoint source nitrogen emissions was able to be recorded. ***Trends*** Wastewater pressures from municipal wastewater plants are likely to remain at current levels. The characterization showed that there is unlikely to be any significant increase in environmental pressures from municipal	(Richert 2005) (Trittin 2003?)

wastewater treatment plants, thanks to clearer legal regulations, continuous optimization and modernization of wastewater treatment plants, the use of new technologies and the expansion of rainwater treatment capacities.	

Demographical factors

Distribution of population (Rural areas / cities)	Source
Trends in rural-urban migration of population: rich people are moving out of the cities, young people - in?	
With regard to internal migration the eastern federal states of Germany have already experienced this after 1991. Also in the future the regional distribution of population reduction will vary considerably: The population density in the macro-regions the mid-west and east will be reduced to a greater extent than in the north and south (Sommer, 2004).	(Kuckshinrichs 2005)

Absolute growth of population	
Demographic developments at the beginning of the 21st century constitute a historical challenge for the social and economic situation and for political response in Germany. It is the coincidence and the dynamics of population reduction, ageing and new regional distribution that pose a new challenge for which there is no historical precedent. Decisive parameters for projection are life expectancy, birth rate, and net immigration. Based on different assumptions for these parameters the main results of present projections are (Federal Statistical Office, 2003c): • By 2050 Germany will lose up to 35% of its population; • The ageing of the remaining population will continue due to further increasing life expectancy. The share of the economically productive population will decrease disproportionately to 45% • With regard to internal migration the eastern federal states of Germany have already experienced this after 1991. Also in the future the regional distribution of population reduction will vary considerably: The population density in the macro-regions the mid-west and east will be reduced to a greater extent than in the north and south. The increased life expectancy is accompanied with by the trend towards decreasing birth rates. The age structure of Germany's population will more closely resemble an inverted pyramid, where the majority of the population is concentrated among the older age ranges. In 2050 half of the population of the German Federal Republic will be older than 50 years. What effects will such a transformation have on economic growth, infrastructure, welfare, public debts and the way people live? There is no historical experience of such a development and no data for guidelines for political measures. The systems which must be expected to feel the impact of these demographic developments are the following: • economic and social systems such as the job market, the	(Kuckshinrichs 2005)

health care • and pension system; • end-use products, such as household appliances. For these systems a number of studies have been presented or are in preparation, which identify the problems and solutions or options for action. ***Water supply and sewage infrastructure*** With regard to grid-bound infrastructures, particularly for water and sewage systems, research is still just beginning. Based on studies for water infrastructures as an example the following qualitative statements may be summarized: • The population decline can lead to underuse of infrastructures. This is, for example, particularly problematic in the case of the water supply due to the high proportion of fixed costs and possible deterioration in quality because of a lack of flow; • Ageing is not regarded as so serious, although it is undoubtedly important. • Age-related changes in user behaviour have an impact on the demand for infrastructure services; • The changing regional distribution of the population results in an outflow of population from whole areas and in population growth in other areas. This leads one to expect considerable changes in the regional demand for infrastructures services and the utilization of infrastructure capacity. To this extent, infrastructures are subjected to considerable pressure to adapt. ***Influence of demographic trends on water sector*** Demographic developments in Germany and also in Europe pose new challenges for the water sector. It was shown, that the future will bring a decline in the domestic population and a change of the demographic composition of German society. Along with the demographic change, there will be a decline and a change in the demand for water infrastructure services. A demographically conditioned decrease in water demand does not lead to a proportional reduction of production costs but to an increase in specific costs for the remaining consumers. Due to the high fixed costs of technical systems for water supply and sewage systems the long-term demographic trends have to be considered today.	(Kuckshinrichs 2005)

Age distribution / life expectancy	
E.g. older persons are more sensitive to water contaminants	
see previous factor: absolute growth of population	

Organizational factors

Privatization (different models)	Source
German water resources policy is currently undergoing major upheaval. First, more and more cities and communities are selling shares in the water supply utilities that they own to private investors. This trend toward privatization in water resources policy has already begun and is proceeding in tandem with a gradually increasing consolidation of the industry. Second, the Federal Ministry of the Economy (BMWi) plans to open up water supply in Germany to competition and to liberalize it, in line with the previously liberalized telecommunications and energy sectors, as one of the last areas of public services. The likelihood that the liberalization of water resources policy will be enacted before this legislative period ends, is highly unlikely as the BMWi has commissioned a study intended to explore the ramifications of a possible liberalization of Germany's water supply. According to Deutsche Bank Research, one of the most important goals pursued by the BMWi in their plans for liberalizing water resources policy is a „correction" of the German utilities' structure in order to bolster the international competitiveness of German companies. The extremely fragmented German system, with its approximately 6,650 water supply companies - and an additional 8,000 wastewater treatment companies - is in fact antiquated in comparison with other countries. The almost total absence of competition and rivalry is considerably slowing the pace of the consolidation process within the industry and choking the tempo of needed structural adjustments. **German System: holding back growth within the World Market** The small size of German companies is the crucial impediment holding back Germany's stronger participation in the growth of the world water market. In addition, the various sectors of water resources policy (water supply, wastewater treatment, construction of plants and machinery, consulting, engineering, research, etc.) are only seldom concentrated in one company. Nevertheless, German water resources companies' participation in international privatization projects has been almost exclusively limited to roles as suppliers. Complete offers from one source fail for lack of capital and industry-spanning experience. Another negative factor is that very few German companies can present reference projects credential, which as a rule are absolutely necessary in order to obtain relatively large contracts. In general, the majority of water supply companies are publicly owned companies run by local governments or owner-operated municipal enterprises or special-purpose associations. Mixed forms, in which the water supply enterprise is an entity under civil law but is owned by the municipality, are gaining in importance. Purely private-sector enterprises, which assume the responsibility of water supply under license of cities and communities, continue to be the exception, but are generally the larger providers. The terms liberalization and privatization are frequently mentioned in one breath in the discussion of the future of water supply. In actuality, many arguments speak for liberalization and for privatization of water management - and vice versa. In the opinion of Deutsch Bank Research, the critical advantage of liberalization of water supply is that competition increases the efficiency	(Heymann 2000)

of the market and pressure on prices. Monopolies and monopolistic prices must be viewed negatively from the standpoint public policy and for distribution reasons. The existence of competition, in contrast, protects the freedom of action of the market participants, facilitates entry to the market and makes it more difficult to create and/or abuse a dominating position in the market

Opportunities of privatization

In the opinion of the Deutsche bank research, the most important advantage of privatization of water resource management is the greater involvement of private capital. The federal government estimates the funding requirements for restructuring and maintaining the German water and wastewater system at EUR 150 to EUR 250 billion over the next 15 to 20 years; the investments will flow primarily into pipeline or sewage networks, of which some are up to 100 years old. Capital investment requirements need to be viewed along with the municipalities' chronic financial limitations. Due to the conservative expenditure policy of public budgets, this is not likely to change in the coming years. This means that the required investment amounts shown above can hardly be provided by the public sector; support from the private sector is required.

Along with easing the burden on public budgets, other factors argue for a stronger private sector organization of water resource management. These include are fewer bureaucratic barriers, faster decision paths and therefore faster implementation of investment projects and their optimization as business measures, a more pronounced cost awareness, higher cost transparency, realization of synergy effects and cost reduction potentials (for example, in the case of innovative practices or in purchasing) and better employee motivation. Finally, it is easier for private companies to raise capital on the financial markets.

Risks of privatization

Opponents of privatization of water resources management fear that profit-oriented enterprises would accept a neglect of quality and environmental standards, exploitation of water resource, and lower maintenance levels in plant and equipment in order to improve their financial results. They also are skeptical about the "control" of water shifting to private hands.

In a system without competition, the danger that the privatization of a municipal monopoly will merely lead to a private monopoly cannot be dismissed. Against this background, public private partnerships (PPP) must also be evaluated critically. While they basically represent a step in the right direction, there is nevertheless a danger that in some cases only municipalities and private companies benefit from this arrangement (from private capital and know-how on the one hand and from the monopoly position in the supply territory on the other).

Trends

The trends of liberalization, privatization, and consolidation in water resource management can no longer be halted. This will change the structure of the German water market on a lasting basis. The broad outline of trends - consequences of privatization and liberalization - in water supply in Germany is described below.

Number of Companies: The number of water supply companies in Germany will significantly decline in the intermediate and long term. This does not mean that companies will totally disappear from the market, but rather that they will be merged into larger units.

Employment: In water supply, a reduction of employment is unavoidable over the long term. With increasing consolidation and greater private sector participation, jobs are also disposable. Thus the retention of jobs was made a condition of the partial privatization of the BWB.

Competitive situation: It is already apparent that foreign competitors and competitors in other industries are forging ahead in the German water market - especially the large French water companies and German energy conglomerates; one reason for this is the high price level in Germany. This trend is likely to further intensify. Competition for shares in municipal utilities will become more intense in the future.

Multi-Utility Growth Market: The multi-utility concept is a key reason why energy conglomerates are pushing into the water market.

Water Prices: The introduction of competition will lead to lower prices for drinking water in Germany over the long-term. However, due to the specific peculiarities of water, requirements for drinking water quality, and necessary investments, the potential for price cuts is not as high as in the case of electricity, where prices fell by around 30% following liberalization. It's realistic to expect to see the price of drinking water in Germany drop by approximately 10% to 15% in the next ten years - and even more if special charges are eliminated.

Water Quality and Environmental Standards: Germany continues to be top-ranked internationally when it comes to drinking water quality, supply reliability, and environmental and resource protection. The currently achieved standards will continue to be met. In the future, environmental and quality guidelines will become increasingly stringent. However, along with ecological aspects, economic aspects will be given greater consideration. There will be an orientation to the price/benefit relationship, while the concept of „what is technically achievable at any price" will fade into the background. The minimization requirement of the TVO may be replaced by a prohibition of any changes for the worse.

Liberalization and Privatization of German Water Supply Desirable
The introduction of competition through liberalization will lead to increases in efficiency and will increase pressure on prices; this will benefit the consumer. In addition, competition will accelerate the necessary structural adaptations in water resources management.

While it is not ideal for Germany to go it alone in liberalizing water supply, it is better than waiting for harmonization to take place on the EU level; experience has shown that this will take many years. As a result of the study commissioned by the BMWi, liberalization in Germany is not likely in this legislative period. It is to be hoped that the topic will be taken up again as quickly as possible in with 2002 and that unnecessary delays will be avoided.

Privatization will mobilize urgently needed private capital and thus narrow funding gaps in public budgets. In addition, economic efficiency reasons argue for the privatization of water resources management.

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5.2 Switzerland

Matrix of Factors

General information

Region	**Central Europe**
Covering countries	**Switzerland**
Population	**7.5 million**

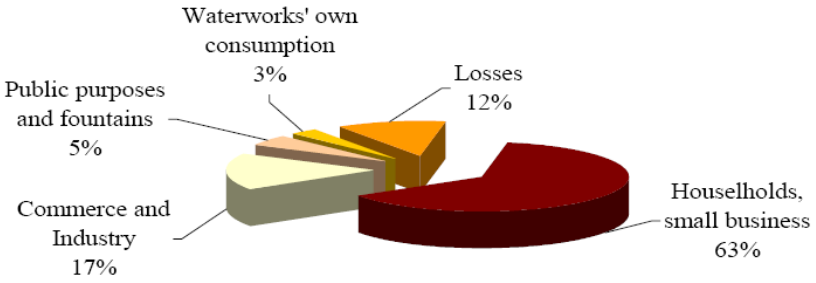
Socio-cultural factors

Willingness to pay for drinking water	Source
Is drinking water an important part of the budget in general? How will this change and will this be accepted?	
The drinking water consumption in Switzerland is about 162 lt/p/d, which is 59 m^3 per person and year. The price per m^3 is approximately 1.60 CHF, which is around 95 CHF per person and year. The household income in Switzerland is about 100'000 CHF per year; the household expenses about 92'000 CHF per year. With an average of 2.3 people per household the annual household water consumption is around 135 m^3 per year or 220 CHF per year. That means the drinking water is around 0.24 % of the household expenses. The price for waste water disposal is around 120 CHF/p/a, which is about 280 CHF per household an year. So the price for drinking water supply and waste water disposal is about 500 CHF per household and year, which means 0.55 % per total household expenses or 0.5 % per total household income.	BA für Statistik BAFU

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	
Since 2004 all water suppliers have to provide detailed information regarding the drinking water quality to the customer at least once a year.	

The appreciation of drinking water	
For example, water can be a life style product; especially this seems to be the case for bottled water (?)	
The bottled water consumption in Switzerland is about 104 lt/p/y.	

Other Socio-Cultural Aspects	
Public Opinion is considered by the specialists as the most important driving force of the water sector in Switzerland. Public opinion clearly influences the orientation and the possible evolution of the sector. There are already several cases where the role of public opinion in blocking moves towards more autonomy in the water supply sector is evident. Public opinion and local politics could also prevent regionalisation, since again water is conceived as something very local, which must be municipally driven (direct contact). In terms of sanitation, public opinion seems much less interventionist than in water supply, and one could therefore imagine more changes and developments in the sanitation sector. Overall, public opinion is very happy with the current status quo, as it obtains good quality water for a perceived good price. Public opinion is therefore pushing for the maintenance of the status quo.	Manso

Consumption	
The main consumers of drinking water in Switzerland are households and small businesses, accounting for about 60% of the total[4], with commerce and industry following next with 17% of the total consumption (fig. 2). Losses are estimated to be about 12%.  Estimated relative water consumption per type of users For the past 30 years, water consumption in Switzerland has been constantly diminishing. Mean water consumption per household dropped from 180 to 162 litres per day between the early eighties and the late nineties largely because of water-saving taps and sanitary installations, as well as greater public awareness for the need to conserve water. In general, domestic consumption, including small business and industry, felt from about 500 litres per inhabitant per day in the early seventies to about 400 litres in the late nineties[6]. However, it was the industrial sector, which has contributed most to the general decrease, due to the introduction of new production processes and the reorganisation of the sector.	

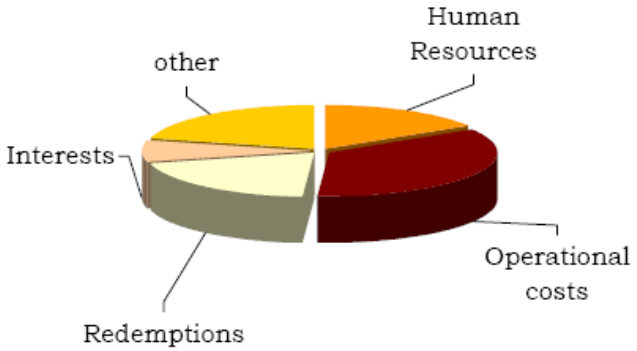
Economical factors

Financing models Privately owned, fully state-owned and different participation models exist. What trends can be observed?	Source
The Swiss market is highly segmented, with each area being characterised by a local monopoly normally controlled by the municipality or the municipally owned operator (direct public management). It can be said that there is hardly any type of competition in the Swiss water market, or to be more precise, in the multitude of water markets within the federal territory. There is no competition in the market, and both competition for the market and yardstick competition are practically inexistent. At present there are some 3 000 independent water suppliers[12] operating in the market, none of them owned by the federal level, due to the historical cantonal and local organization of the sector. There are slightly less water entities than the total number of municipalities as a result of multi-municipal services. In fact, and as it was outlined before, municipalities are the main actors in the sector, directly managing the provision of the water services or, in less frequent cases, delegating part or the totality of these management tasks to a public corporation or a private company. One can find the following management structures in the Swiss water sector: autonomous and non-autonomous entities under public law, cooperative societies, and public and private corporations under private law. *Non-autonomous entities under public law* are technical and administrative units, which assume a well defined public mandate. Normally, these units have their own accounts, separated from the local administration, but have no competences in terms of human resources and financing. It is the most widespread form of operation and management in the water supply sector. *Autonomous entities under public law* are independent corporate bodies under public law. The interference of the municipal executive and the population in operational and managerial matters is limited, in theory, to the selection of the board, to the approval of the accounts, and to the modification of the founding charter. *Cooperative societies,* which are normally under private law, can be public, mix or privately owned. They have as a final goal the economic cooperation between the members, normally drinking water users. It accomplishes all the tasks reserved for a "Water Service" and charges taxes that cover their costs. Their activities are ruled by a contract for the provision of the service signed with the municipality (or a group of municipalities). The use of this form of management in the water sector is limited due to some legal constraints, namely the compulsory application of public law if its members are corporations under public law (e.g., municipalities), and the right each member has to participate in every decision independently of his/her share in the capital. Finally there are the cases of *companies under private law* whose ownership may be public, private or mixed. Although they are few in number, they	

provide water supply services to about 10% of the Swiss population. Even when municipalities are the majority owners, this type of organisation has the advantage of being flexible and politically independent, enabling the participation in capital markets and the making off alliances. These corporations are particularly appealing for multi-utilities[13], as they permit the creation of holdings with affiliates for each sector. Given the fact that private law companies (e.g., cooperatives and corporations) are subject to different fiscal rules, in practice there is an obstacle to their further expansion in the water sector. In fact, municipalities and their services are exempt from direct federal tax and, in the majority of the cases, from cantonal taxes. Cooperative and limited corporations may only be exempt from these taxes if they prove to provide services of public interest, which happens to be very difficult to prove, especially in the particular case of multi-utilities. The number of privately owned companies under private law in the Swiss water market is very limited. The existing ones are normally local companies operating in limited areas for several decades, and which enjoy a long-term relationship with the municipality. The majority of the water supply services are provided by entities under public law. In fact, the most common type of operator is the "water services" (non-autonomous public law entities). In the majority of the cases, the water service has no independent legal personality and all the strategic decisions are taken by the municipal council. Therefore, the competences of the water services are normally limited to administrative ones. In some cases, especially in the biggest municipalities, several sectors are regrouped in larger industrial services providing water, electricity, gas, urban heating, and others more. In Basel and Geneva, these industrial services are organised at the cantonal and not at the communal level. Multi-municipal services (non-autonomous public law entities) are the second most common way to organise water supply services. The infrastructures and service management of each municipality is shared among the group of municipalities, which have only administrative competences. All decisions are taken by the inter-municipal council, which is controlled by the individual municipal councils. The ownership of the infrastructure and the responsibility of service provision remain with the municipalities	

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	
Nowadays the goal to meet in the renovation rate in Switzerland is set at 1,5 %, in some regions even higher (up to 2 %).	

Other Economical Aspects	
The main guiding principle behind water sector financing is the equitable allocation of financial charges between the Confederation, the cantons, and municipalities, with a compensation benefiting municipalities with weaker financial capacity. According to Saladin (2002), a total of 250 CHF per inhabitant per year was invested in water supply infrastructures, operations, and maintenance by the three governing levels. This amounts to about 0.5% of the gross domestic product. The majority of these investments (65 to 80% according to the WWF, 2003) are linked to the construction, maintenance, and renewal of network infrastructures. There are mostly three sources of financing in the water supply and sanitation sector: tariffs, fees, and contributions from users; the municipal budget; and subsidies. ***Tariffs, fees and contributions*** The tariffs charged for water supply and the connection and user fee for sanitation are the most important source of financing of the sector. Given the division of competences between cantons and the Confederation, the responsibility to fix water prices rests with the cantons, which they normally delegate to municipalities. The structure of the tariffs is therefore highly heterogeneous (e.g., some municipalities have fees for connection, for the meter, or for consumption), as is the way of calculating the fixed fee (e.g., some municipalities use tax estimations and others the number of connections). In practice, water prices vary from municipality to municipality, depending on issues such as the availability of the resources, the topography, and the length of the pipe. The price[21] of tap water can vary between CHF 0.50 and CHF 3.50 for every 1000 litres, with the average being CHF 1.60. At present, water tariffs have a rising tendency due to a relatively old network, which consequently requires investments. Some specialists consider that this may be a problem especially in very small communes managed by non-professionals, given that the renewal of the infrastructure may have been omitted in the pricing costs. Even if the total consumption of water has been declining, the price of the service has not decreased. The reason for this is that the burden of the fixed costs is much higher than that of the variable costs. According to the Swiss Gas and Water Industry Association , the fixed costs associated with the infrastructure network (construction, maintenance, and renewal) are independent of the level of water consumption. Therefore, even if the consumption decreases, there will be the need in the long run to increase the price of water in order to guarantee the financing of water supply. **Box 4:** Structure of the total costs of water supply operators. The major cost categories for the median water supplier operator in Switzerland are operational costs (accounting for more than one third of the total), depreciation costs (adding up to about 20% of the total), human resources costs (about 15% of the total costs), and, finally, the payment of interests (about 8% of total costs).	



Source: Surveillance des Prix, 2001

Structure of the total costs of water supply operators, 2001.

In the past couple of years, total costs have increased. Considering the different categories of prices, operational and human resources costs have increased the most, while capital depreciation and interest costs have decreased. This reduction may be explained by the decline in the national interest rates and, consequently, by better credit conditions.

According to DFE (1998), factors such as the amount of water services provided, the number of interruptions in the network, and eventually the water losses have a considerable influence on total costs per m^3 of sold water.

Municipal budget

The municipal budget is especially important for financing sanitation services. In fact, according to their competencies, municipalities have to gather the financial resources necessary for the sanitation sector. Depending on the volume of investments, municipalities may take loans at market conditions (for bigger amounts of capital) or include the expenses in their operational budget (for smaller amounts). The fact that municipalities must present balanced budgets to the cantons acts as a tool to avoid uncontrolled indebtedness.

Subsidies

Subsidies in general, and in particular those at the federal level, have been decreasing constantly since the seventies. Furthermore, a distinction needs to be made between water supply and sanitation. Water supply, at least in theory, is financed through full cost recovery pricing. This information is very difficult to check (since the accounts of the communes are generally not really transparent) and it may be possible that there are some cross-subsidies between the different sectors or services within the communes. However, water supply services do not get any subsidies from the federal or cantonal levels for the maintenance of the infrastructure. For the extension of the infrastructure, some subsidies are however available. As for sanitation, this sector benefits from more subsidies at the federal and cantonal level. Federal and cantonal subsidies are essentially meant to motivate and empower measures such as environmental protection.

Political factors

Decision making process for innovations / investments Are trends visible in this process?	Source
The main characteristics of water management in Switzerland are its big diversity, strong decentralisation, and different modes of management between drinking water supply and sanitation. Both, the distribution of water and sanitation, fall within the competences of the cantons, which normally delegate this mandate down to the municipalities. In what concerns drinking water supply, municipalities are very autonomous, namely when it comes to the choice of the structure and organisation of the service. Indeed, they may choose to provide the service directly or to delegate it to a third party. Regarding the provision of water sanitation services, they must, by law, be directly managed by the municipality. The water sector in Switzerland is organised as a local monopoly, with the most common organisational structure being the municipal water service for drinking water supply, and the (non-autonomous) municipal management for sanitation services. Switzerland's direct democracy system slows down any significant changes to the way the water sector is organised, and, in addition, also favour heterogeneity. In fact, there is no large regional network, and both public authorities and water suppliers give preference to local management solutions. Although in general both consumers and authorities are satisfied with the overall performance of the Swiss water sector, there is increasing conflict between three following principles: (1) according to the federal law, water must be available in sufficient quality and quantity at all times (which cannot be done without high costs); (2) for environmental reasons, water saving is good, yet it reduces the income of utilities, threatening their ability to maintain the costs of high levels of supply security; and (3) water utilities should be financially sound and self-sufficient, thus covering their costs by the income from the provision of water services. Moreover, several inefficiencies are pointed out. On the one hand, the very small size of several suppliers limits the benefits that can be derived from economies of scale. On the other, the growing financial demands for maintenance and rehabilitation of the networks, coupled with the growing financial pressure in several municipalities, as well as the political unease with price increases, may lead to insufficient investments, thus affecting the quality and reliability of the services. The liberalisation of WSS markets is not directly envisaged by the main actors in the sector (including the public authorities). Indeed, there is a general consensus that the degree of water liberalisation is unlikely to increase in the future, and that by giving enough autonomy to the utilities, the business principles and practices can be adhered to without suffering the disadvantages of liberalisation.	

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	Source
Water supply data According to the statistics, 98% of the total population is linked to piped water supply networks, which are spread over 53 000 km. The tolerances and threshold values for drinking water are regulated by the Ordinance on Extraneous Substances and Ingredients in Foodstuffs of June, 26th 1995 (revised in 2002).	

Ecological factors

Subfactor: Resources

Trends in resource water

Due to Political factors

E.g. NL: less groundwater use due to regulation on wetlands

With an estimated 262 billion cubic meters of water, Switzerland can be classified as a high water availability country, holding about 6% of the Europe's freshwater resources. The majority of this amount of freshwater lays in lakes (51%), 25% rests in the country's glaciers and snow, about 21% are stored in the underground, and, finally, about 1% in man-made lakes (see table 1). Due to climate changes, overuse, and reduced ability of surface waters to infiltrate, groundwater levels have dropped in recent years.

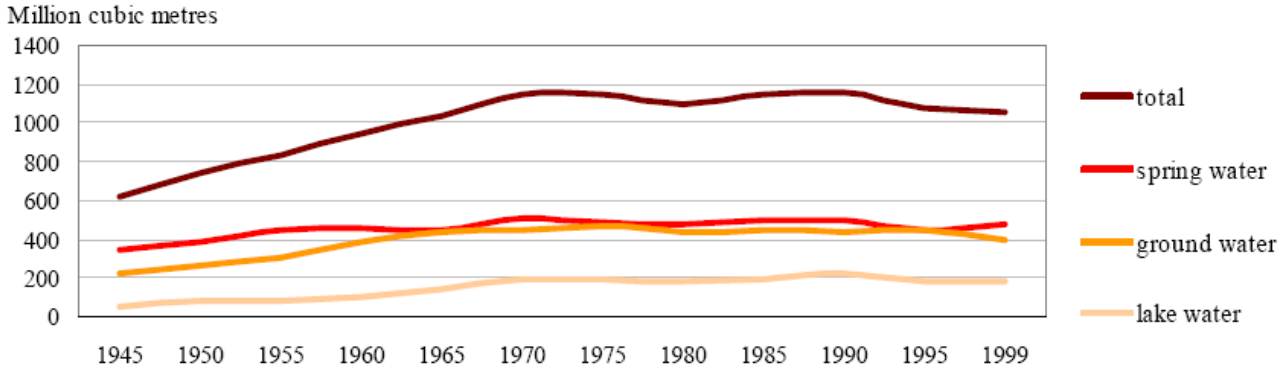
Table 1: Water resources in Switzerland.

Resource	vol. in million m3	%
Natural lakes	134'000	51.1
Glaciers	67'500	25.8
Groundwater	56'000	21.4
Reservoirs	4'000	1.5
Streams and rivers	500	0.2
Total	262'000	100

Source: Swiss Federal Statistical Office (SFSO), 2002

Switzerland shares several river basins with its neighbours, the most important being the Rhine, the Rhone, the Po, the Adige, and the Inn.

A total of 2 560 million m^3 of water is annually abstracted in Switzerland (EEA, 2003). In the past, it was possible to extract water from water bodies without restriction. However, today a concession is needed for every use of a water body, be it for irrigation, electricity generation or cooling purposes. Regarding drinking water, the main sources of abstraction are spring water (about 40%), ground water (around 40%) and, to a lesser extent, lake water (approx. 20%). Therefore, spring and ground waters are the major water supply sources in Switzerland (see fig. 1).



Evolution of drinking water abstraction per source, 1945-1999

Almost half of the ground and spring water withdrawn require no further treatment and can therefore be used directly as drinking water. Nevertheless, this situation in changing due to a deterioration of the quality of many aquifers with an increase in pollution of all kinds, especially from agricultural and industrial activities, urbanisation, transports, as well as from air pollution

Due to other factors

E.g. climate change, river restoration projects

Wastewater treatment in general: influence on surface water quality	
Switzerland's sewerage network is virtually completed, comprising about 40 000 km of underground pipes and sewers carrying wastewater from households and industries to sewage treatment plants. The majority of the approx. 1 000 wastewater treatment plants meet the current statutory requirements. However some older plants, dating back to the 1960s, still need to be upgraded. Today about 95% of the population is connected to wastewater treatment plants, which represents a huge progress compared to 14% coverage levels in 1965 (fig. 3). A further 2% of the population could still be connected, but for the remaining 3% there is no point in connecting them since they live in remote and less densely populated areas[7]. In international terms, Switzerland records one of the highest levels of connection in the world, with the Organisation for Economic Co-operation and Development, (OECD) average being about 62%. In addition, it generally uses the most advanced technologies in its treatment plants.	

Demographical factors

Distribution of population (Rural areas / cities)	Source
Trends in rural-urban migration of population: rich people are moving out of the cities, young people - in?	
The country has a total population of 7.2 million inhabitants, of which about 70% live in urban areas. The average population density is very low in the mountains – which represent about half of the territory – but it is very high in plain and metropolitan areas. In the past two decades, the concentration of the population and economic activities has increased, especially in two areas: (1) the "Golden Triangle" between Basle, Olten, Zurich, Zoug and St. Gallen, and (2) the "Lake Geneva Basin" between Geneva and Lausanne. Switzerland has one of the highest development indexes in the world. The nominal Gross Domestic Product (GDP) was CHF 416.84 billion in 2002, with the services sector accounting for about 60% of that value. According to the data from SFSO, in 2002 about 70% of the active population was employed in this sector, 25% in industry and business, and the remaining 5% in agriculture and forests. Two important trends can be identified since the early seventies, namely the decline in persons employed in the industrial sector and the continuous reduction of active farmers. These structural changes necessarily affect the water supply and sanitation needs.	

Organizational factors

Privatization (different models)	Source
In principle, the ownership of the network (i.e., the infrastructure) lies with the municipality or a group of municipalities. Only in one exceptional historical case, the case of Zoug (see Box 3), a private company owns the water infrastructure. In Zurich, Luzern, Schwyz, Nidwald, Zoug, Fribourg, Bâle, Tessin, Vaud, St-Gallen, and Neuchâtel communal laws enable the participation of the private sector in the provision of water services (see table 5 for an illustration of the potential tasks that can be delegated under the current legal framework from public to other entities in the canton of Zurich). In practice, the participation of the private sector in the Swiss water sector is still limited to a few cases. This participation of the private sector may take the form of a concession agreement for the provision of water supply, as well as the construction or the maintenance of infrastructures. The award of these concessions is not normally subject to international competitive tendering. These concessions are regulated by contracts establishing the conditions for service provision, which must be approved by the municipal and state councils before coming into force. For the particular case of infrastructural developments, there is an obligation to make a public tendering for bigger adjudications (normally exceeding 50'000 CHF). The main criteria for selecting the service provider are the guarantee of quality, the respect for delays, and the price. In most of the cases, the selected company belongs to the territory of the canton (both for bigger and smaller projects). The only privately owned water supply operator in the Swiss water market is the *Wasserwerke Zug AG,* a multi-utility company operating in Zug (see Box 3). The historical background and the type of strategy of this private multi-utility is closer to the "traditional" multi-utility entities active in the Swiss market (i.e., the industrial services) than to the new private multi-utility corporations, which have recently been created in other countries worldwide. In fact, *Wasserwerke Zug AG* is limited to its local area of competence and is capable of supplying the same customer with water, electricity and gas. The evidence shows that the relationship with the local authorities is based on long time collaborations and relies on high levels of mutual trust developed during decades of cooperation. Although significant changes are not expected in the Swiss water sector in the next couple of years, there are important dynamics that may help understanding how the sector will most likely evolve. **Liberalization** There is a general understanding that liberalization is unlikely to take place in the Swiss water market in the near future, even if it has come under increasing pressure to open up its water services to the private sector (for example from water multinationals – for example, Veolia Environment and Suez – and in the context of the GATS negotiations). Water distribution and sanitation have been traditionally in public hands and there is a very strong and politically active lobby opposing the liberalization of the sector, arguing that the national water system works very well and opening the market would only increase the prices and deteriorate the quality of the service provided.	manso

There are three main areas of concern regarding liberalization, namely quality standards, security of supply, and prices. As mentioned above, quality standards are defined at the federal level, but an important part of the precautionary measures, which are not described in the law but have a significant impact in reaching the high quality levels of the sector in Switzerland, are carried out by local (often municipal) suppliers. The participation of the private sector in water services provision is then perceived as a dangerous evolution towards lower water quality levels. In fact, there is a common understanding that, in a federal regime, the necessary regulatory framework for guaranteeing the same levels of water quality and security of supply in the event of private sector participation is difficult and expensive to design and implement. As a result, water prices would have to increase in order to absorb these new regulatory costs.
About two years ago, it was expected that the liberalization of the electricity and gas market was going to affect water supply management. Indeed, electricity, gas, and water supply services were usually regrouped in the same entity under municipal control and the change in the status of electricity and gas towards legal private entities could well have triggered significant changes in the water supply sector. However, the liberalization of the other network industries has rather acted as a counter force to liberalization, reinforcing the main specificities of the water supply sector. For example in Beinwelden, local politicians were willing to transform the municipal company managing several utilities into a private law company so as to adapt to the changes in the energy sectors. This company would still be under public control but, following the reaction of local citizens, special rules were adopted for water when it comes to pricing and the decision-making process. This shows how special water is when perceived by the citizens of Switzerland.

Centralization / Regionalization

Manso

Autonomisation and professionalisation of operators

The main mode of management at present in the Swiss water sector is non-autonomous direct public management. Yet, in the past ten years, and especially in what concerns water supply operators, there has been a trend towards the autonomisation of the public entities. Even though autonomous public entities only represent about 10% of the total number of operators, it is interesting to note that most of these autonomous operators are situated in big cities like Baden, Arau, Bern, Lucerne, and Geneva. At the core of this evolution is the restructuring of the water and industrial services, which aim at more autonomy in their management.

The recent wave of legislation on consumable goods has an impact on the water sector. The Ordinance on Extraneous Substances and Ingredients in Foodstuffs of June, 26th 1995 (as revised in 2002) increases the responsibility of water operators by holding the operator legally responsible in case of the contamination and/or deterioration of the water quality. This new bill thus pushes for more transparency on water quality standards and procedures, and for more professionalisation. Indeed, in the case of small communes, professionals in water services could well be

hired by fear of the legal responsibility that one has to assume according to this new law. **Regionalization** According to some interviewees (Manso), municipalities (mainly smaller ones) have come under increasing pressure from (1) the multiplication, increasing complexity, and interdependency of communal tasks; (2) the worsening of their financial situation; and (3) the increasing citizens' demand. This has contributed to a mounting number of inter-municipal collaborations in the fields of water distribution, water treatment, and network development and rehabilitation (Steiner, 2000). Encouraged by some cantons (e.g., Neuchâtel, Soleure and Berne) for economic, technical, and security reasons, inter-municipal entities are already a common type of organisational structure in the Swiss water sector. In fact, the main reasons for regionalisation are the exploitation of complementary equipment, the collaboration between overdrawn networks to optimise the management of the resource (namely avoiding the overexploitation of groundwater reserves), the rehabilitation of infrastructure, and the budgetary constraints. However, one should expect to find regionalisation when municipalities have more or less the same size, rather than being federated around big systems, such as Zurich and Geneva (basically because the smaller communes feel they loose their autonomy). There is no single model concerning multi-municipal associations' competences and legal form, and they actually differ from region to region (e.g., they may take the form of municipal syndicates under public law or companies of limited responsibility under private law). Independently of the form of organisation, one of the most important advantages of these associations is the possibility to manage water distribution in a more global and sustainable way, due, for example, to the planning independence from the municipal political authorities	

Other Organisational Aspects	
Nevertheless, there are important restructurings going on in the Swiss water sector. Firstly, there is a trend towards an increasing autonomy of water management in relation to politics, even though municipalities remain in the majority of the cases the owners of the assets. The most common cases are the transformation of organic units within the municipality or cantonal structures into autonomous organisations possessing sole decision-making competency at all levels of managerial action. Finally, it is the regionalisation of the distribution of drinking water in the form of inter-municipal or regional associations, a beneficial solution especially for smaller municipal water and industrial services, which can profit from important synergies (e.g., benefits in terms of procurement and laboratorial services).	