EUREAU
European Union of National Associations of Water Suppliers and Waste Water Services
127 rue Colonel Bourg, B-1140 Brussels
Tél+32/2/706.70.80 Fax+32/2/706.40.81

WHY IS WATER REUSE SO IMPORTANT THE EU?

Drivers, Benefits and Trends

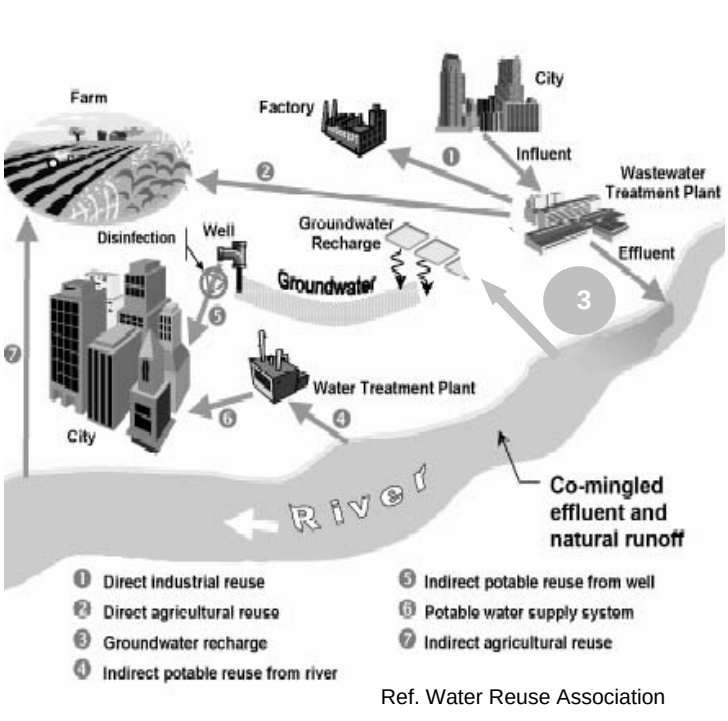
1. EXECUTIVE SUMMARY

The European Union (EU) depends on the appropriate treatment of wastewater to enhance surface and groundwater resources so that the water can be reused through abstraction for agriculture, industry and treatment for potable use. This is a well established practice in the highly developed regions of EU where many cities rely on indirect potable reuse for 70% of their potable resource during dry summer conditions due to high population density and low rainfall. The benefits of water reuse are not well understood and there are no quality guidelines, best practice framework or definition of the appropriateness of water reuse in EU legislation other than those for wastewater treatment and drinking water.

The need for reuse is increasing and there is an urgent need to clarify the meaning of the statement in the Urban Wastewater Directive (UWWD) that **"treated wastewater should be reused whenever appropriate**"

The Water Framework Directive (WFD) is predicted to reduce the availability of water as abstraction licenses are cancelled to maintain higher volumes in the surface and groundwater bodies to protect their quality. This will increase the need for water reuse where it is appropriate as well as encouraging a reduction in water consumption. Similar legislation in NSW, Australia has reduced the availability of water by 20%.

The use of recycled water is one of the least understood applications in the water cycle and the benefits of water reuse are often undervalued due to most organizations separating their activities into potable and wastewater as if they were unrelated subjects.



Ref. Water Reuse Association

Recycled water is a valuable water source that is used as a substitute for potable water (potable substitution) and reduces the impact of water shortage due to population density or drought. Water reuse practice for agriculture and industry is one of the fastest growing applications internationally (approximately three time the growth of desalination). EU needs to lead this innovation, reduced the institutional barriers for appropriate projects, agree water quality guidelines, good practice examples, clarify water ownership issues and promote innovative and whole life sustainable solutions. The growth in the volume of water reuse is 25 to 60%/yr in the areas that recognize the benefit. EU needs to take advantage of this growth opportunity to sustain its environment, economy and exploit the export opportunities in the water technology sector by:

(a). Recognising water recycling and reuse is common practice and an essential process for the protection of our environment throughout Europe [1]. The application ranges from river and lakes and groundwater recharge for indirect potable use in the North to agricultural and landscape irrigation in the South.

(b). Establishing at National or EU level water recycling and reuse quality and good practice guidelines to enable projects to be implemented for all environmental, social, public health and economically beneficial applications. These need to include community and stakeholder participation from the beginning.
(c). Justifying projects on environmental, social and economic benefits using whole life, sustainability and cost effective analysis that provide a fair way of evaluating the benefits including environmental and economic externalities.
(d). Taking advantage of existing or new financial incentives for beneficial projects in each country.
(e). Encouraging innovative projects and research to promote international leadership and export opportunities for EU enterprise.
(f). Water reuse should be included in the Water for Life programme to enhance the opportunity of achieving the Millennium Development Goals (MDG)

EUREAU represents the water and wastewater operators in EU and EFTA countries. It is EUREAU's responsibility to provide leadership in this specialist subject and promote innovative solutions to help create sustainable economic growth and export opportunities. The Water Directors discussion on flooding and the impact of the scarcity of water resources [2] have increased the profile of water reuse as one of the solution to both these serious problems. Water reuse is also included in the European Commissions Environmental Technologies Action Plan (ETAP) [3]. EUREAU strongly believe that water reuse needs to be raised as priority for discussion so that an action plan on reuse can be developed and agreed. EUREAU shall be pleased to meet and discuss how best we can assist in the preparation of "Best practice in water recycling and reuse" as part of the solution for drought and flooding and environmental protection.

2. INTRODUCTION

Innovative alternative water resources such as treated wastewater and desalination are frequently being adopted as part of an integrated water cycle management strategy. The UN Agenda 21 [4] clearly states that the following could be implemented to improve integrated water resource management:

(a).Development of new and alternative sources of water supply such as desalination, artificial groundwater recharge, use of marginal quality water and recycled domestic wastewater.
(b). Introduction of the precautionary principle in water quality management, where appropriate, with a focus on pollution minimisation and prevention through use of new technologies, products and processes such as pollution reduction at source, effluent recycling, treatment and environmentally safe disposal
(c). Encourage and promote the use of adequately treated and purified wastewaters in agriculture, aquaculture, industry and other sectors.

Ancient European civilizations could be considered as the pioneers of the principles and practices for integrated management of municipal wastewater. Toilets flushing, separated sewers and disposal sites known as "sewage farms" were used by the Minoans 4,500 years ago, in order to support the hygienic and the functional requirements of palaces and cities. These advanced Minoan technologies were expanded to all over Greece in the later periods of Greek civilization and afterwards in other European countries {5}. Thus, the separation of potable drinking water from sewage has been practiced later on by Romans. The need was emphasised in 1854 when Dr John Snow's identified that cholera outbreaks in London were being spread through groundwater contaminated with sewage. The local outbreak of 500 deaths in 10 days was solved by removing the handle of the groundwater pump in Broad Street Soho [6]. In recent years the impact of cryptosporidium has reminded everyone of the hydraulic link between wastewater and potable water sometimes caused by sewers leaking into the aquifer and the need for a proactive approach.

WHO using epidemiological evidences and studies measuring real exposures that occur over time and based on experimental data have developed recommendations for revising WHO (1989) guidelines. Besides, reuse of treated wastewater in agriculture, in the revising WHO guidelines, urban settings, aquaculture and artificial recharge of groundwater shall be included. A first a draft of the review of the WHO (1989) guidelines will be published before the end of 2004. Recently, WHO (2003) has published a State of the Art Report: on Health Risks in Aquifer Recharge Using Reclaimed Water [7]. This Report contributes to the improvement of intentional groundwater management as well as introduces a precautionary approach to relevant practices. The first step is developing simple, flexible and practical health related guidelines that contribute to improving both direct and indirect groundwater recharge.

In EU the WFD introductory brochure “Tap into it!” confirms the importance of water reuse and the EU Environment Agency [1] states that indirect water reuse for potable supplies is a common practice in Europe for many centuries. Article 12 of the UWWD indicates that treated wastewater should be reused whenever appropriate. The appropriateness of an application is not legally defined in EU legislation and this creates confusion and reduces the opportunity for beneficial projects. Water reuse is also encouraged in the Integrated Pollution Prevention Control (IPPC) legislation as part of the WFD.

Recycled water is of fundamental importance to our environment and economy. The benefits include:

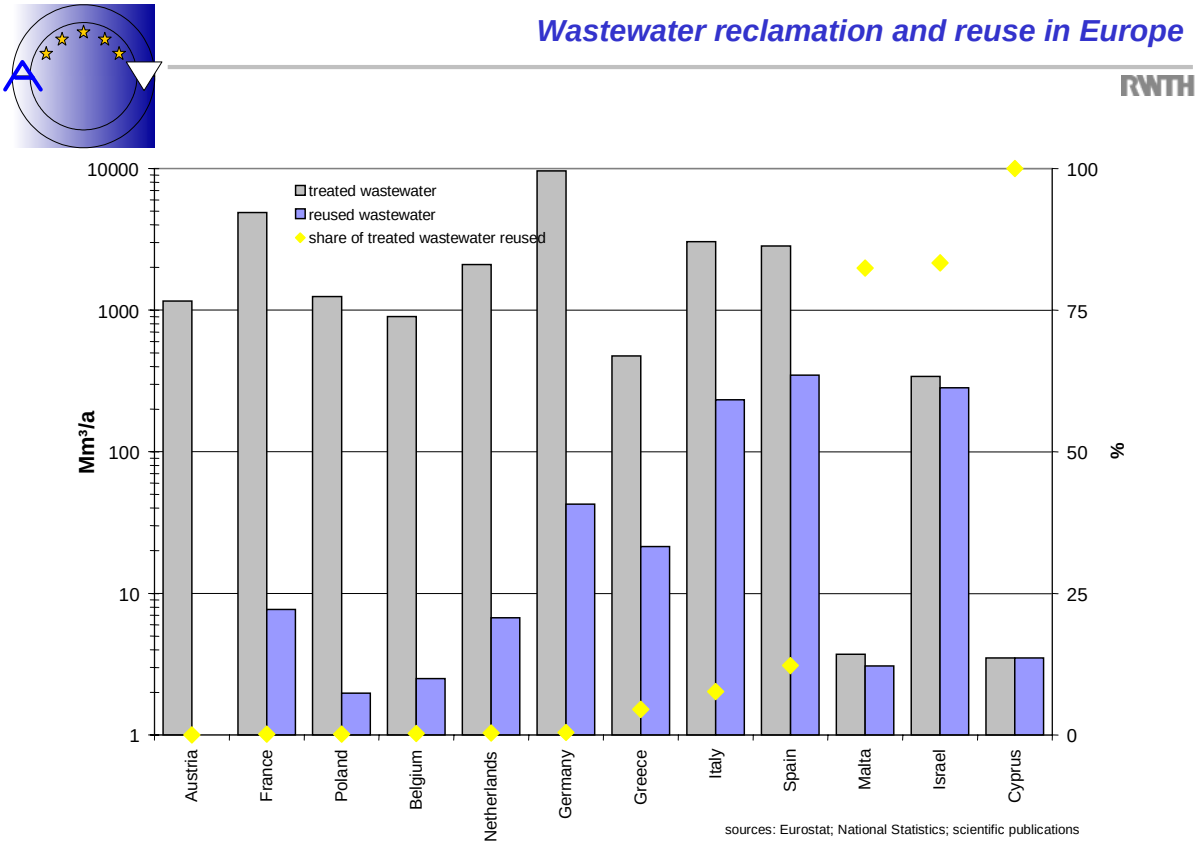
(a). The stimulation of economic growth by providing an additional supply of water due to overcome water shortage due to population density from urbanisation, tourism or drought. There are good examples of the benefits in Belgium, Spain, Italy, Cyprus, Malta and other coastal areas of the Mediterranean. There are several cities in northern Europe that rely on indirect potable reuse for 70% of their potable resource during dry summer conditions. London’s population density and 690mm/yr of rainfall results in a water availability of only 265m^3/inh.yr demonstrating the need for water recycling and reuse using desalination technology [8].

(b). Providing a reliable source for cooling and boiler feed for industry.

(c). Providing an appropriate and nutrient rich source for agricultural and landscape irrigation.

(d). Reducing the demand on the limited fresh water resources, reducing the discharge of pollutants, energy consumption and pollutants to the environment.

The graph above have been produced as part of the current EU funded Aquarec research project [9]. The project includes the estimated growth potential in EU by 2025. The 15 countries with the highest estimated growth include regions North Western, Central and Southern Europe. The conservative interim estimates of growth from 2000 to 2025 range from 1.3 to 14 fold increase with an average of 2 fold increase. This conservative estimate for 2025 represents approximately 5 billion € of potable water at 2.5 €/m^3 or 1 billion € of irrigation water at 0.5 €/m^3 without considering the economic or environmental impact. The current level and conservative estimated growth in water reuse emphasises the need for clarification of the appropriateness of water reuse through water quality and best practice guidelines.



3. INTEGRATED WATER CYCLE MANAGEMENT

EUREAU's first priority is to safely maximise water management efficiency by reducing wastage, leakage and evaporation losses. The second priority is to reclaim used water for the environment and users downstream. Reclamation technologies vary from biological treatment to advanced water purification processes that often include membrane technologies to remove dissolved impurities such as salts and organics. The appropriately treated recycled water can then be used for indirect potable applications or directly for manufacturing industry and power generation. The industrial use of recycled water for process and boiler feed water often demand water qualities that are higher than potable water. Where demand is in excess of supply then the more expensive process of seawater desalination is applied to make up the deficit.

Do we understand the real water cycle? Our cities and river basins today rely on efficiently treated wastewater to help recharge the surface and groundwater systems. Multi barrier treatment processes achieve reliable water quality control and protect public health [7]. The multi barrier and indirect reuse approach takes advantage of the benefit of natural processes (bank filtration, reservoir and aquifer storage) and the latest water treatment technologies.

The applications of water reuse are not well understood as they do not fit easily into the traditional separate municipal disciplines of potable water and wastewater management even thought indirect potable use of treated and diluted wastewater is common practice. The lack of understanding discourages discussion about the source of the freshwater and levels of dilution under dry weather flow. This poor communication reinforces the separation between those concerned with potable and wastewater management as if they were not part of the same water cycle.

An Integrated Water Cycle Management (IWCM) approach that has been adopted in China and Australia is needed to avoid the risk of focusing only on drinking water quality and wastewater treatment for environmental protection as unrelated subjects. The IWCM approach must:
(a).Satisfy the appropriate quality standards and strives towards greater water security during drought and natural disasters.
(b).Meets today's needs without jeopardising the ability to meet the needs of future generations.
(c).Enables the development of the local economy.
(d). Satisfies local requirements.

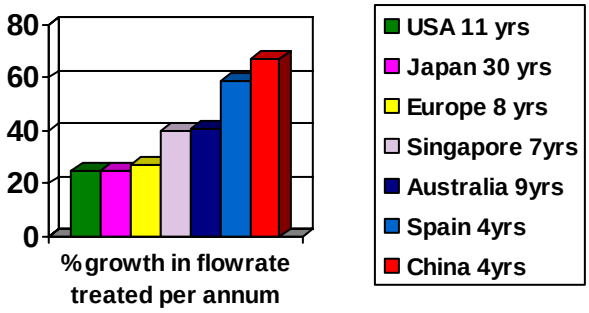
4. WHAT ARE THE BENEFITS?

EUREAU International benefits questionnaire. To gain evidence of the actual benefits and issues EUREAU distributed a questionnaire in September 2003 to specialists and scientists organisations around the world to understand their reuse experience. (Appendix). The key benefits and issues identified from over 90 questions asked are as follows:
(a).Saving high quality water for potable supply and reduced polluted discharge into receiving bodies.
(b). Indirect wastewater reuse is practiced as part of the existing water cycle but often by default. There's a need for a more proactive attitude and a positive policy towards reuse generally
(c). Demonstrate the value of water and the real water cycles. Reuse links all the parts of the large natural water cycle and the smaller urban water cycle together and can be used as a catalyst to help everyone understand the real water cycle in an integrated way.

5. WHAT CAN WE LEARN FROM INTERNATIONAL EXPERIENCE?

The availability of water is affected by changes in population density due to tourism or urbanisation, the mean rainfall patterns, increased evaporation rates, pollution risk and reliability of imported water. Many EU countries in the South and the North have experience water shortage due to population density and drought as demonstrated in 2003.

Growth in recycled water capacity. Many countries with "Mediterranean" climates and economies have embraced water reuse for industrial applications, saline ingress control, groundwater recharge and irrigation. This has resulted in an increase in the water volume used for recycle projects of 25 to 65%/yr over the last 5 years in the countries that recognise the benefits (% values exclude surface recharge). This compares with growth in desalination of approximately 17%/yr in the most active country of Saudi Arabia. These water reuse projects have helped the local economies develop more robust and flexible water resource management strategies. Their experience and technological developments are building their export business as well as providing the solutions needed at home to respond to the ever-changing rainfall patterns and increase in water demand.



Average annual growth rate over rapid growth period

The EU average growth of approximately 25%/yr is mostly being achieved in Spain. North American and Australian consultants and technologies are dominating the more advanced high-tech reuse applications and it is forecast that the current water management strategy and technological developments in China are likely to directly impact on European reuse business in the near future.

Australian experience. Summary: 31 major projects; growth started in 1994; 42%/yr average growth in flowrate reused in 9 years, most projects in New South Wales, Queensland, Southern, Western Australia and Victoria.

The "Mediterranean climate" regions of Australia have set targets of 20% recycle of wastewater by 2012 and arid region's targets are set at 50 to 100% wastewater recycle (as Israel and Cyprus). Rainwater catchments is common practice to substitute potable water and reduce runoff.

Australia has a similar legislation, economy and climate to the south European coastal regions. They have recently implemented a River Basin Water Management strategy (RBWM) and are actively promoting water reuse due to the environmental, economic and social benefits. Their RBWM strategy has reduced abstraction and the availability of water in New South Wales by 20%. In Queensland the drought has added to the loss in available water to a total reduction of 50% and the States Government provides subsidies of 50% of capital cost for the beneficial reuse of treated municipal wastewater.

North American experience. Summary: 1500 projects treating 800,000 m^3/day, 4.9% municipal wastewater reused, accelerated growth started in 1995, 25% per annum average growth in flowrate reused in 11 years, 90% of projects are in California, Florida, Arizona and Texas.

Californian legislation in 1960 started to encourage wastewater reclamation, recycling and reuse. The majority of membrane projects using Canadian or Australian technology based on ultrafiltration, microfiltration and membrane bioreactor technology. The projects tend to be heavily subsidised by state or federal funds due to the benefits to the economy.

Japanese experience. Summary: 1,718 projects treating 512,000 m^3/d, 25% average annual growth in reuse flow rate over 30 years driven by legislation. Rainwater reuse for potable substitution and flood control has been implemented in 141 cities with 3500 installations

The population density in urban areas in Japan have stressed the reliability of water supply and promoted the development of alternative water resources. The schemes for water reuse range from individual building water recycling system to watershed scale system and have been promoted through legislation and financial incentives. The individual building water recycling systems are operated for toilet flushing in the same site with an on-site wastewater treatment plant with membrane bio-reactor. In some case, several buildings are connected together to a block-wide wastewater treatment facility and their treated wastewater is distributed to the buildings mainly for toilet flushing.

In the large area water reuse systems, the effluent from tertiary or advanced wastewater treatment process in municipal wastewater treatment plants is employed for further treatment before water reuse. In 2001, 218 municipal wastewater treatment plants among total 1,718 plants in Japan provided water reclamation and reuse. It should be noted that the water reuse practices in Japan has been non-potable urban use. The main uses of reclaimed water are for toilet flushing and environmental water. Environmental water for restoring "aquatic amenities" in the urban environment characterizes recent trends in large-volume reclaimed water use in Japan and this environmental application occupies about 45% of total treated wastewater reuse [10].

Chinese experience. Summary: 12 projects treating a total of 400,000m^3/d, accelerated growth started in 2001, 67% average growth in flow rate per annum over 4 years. There are about 30 projects in operation or under construction in 2004 [11].

Northern China is the most water stressed region with water availability of 990m^3/inh.yr. The Government has reviewed and adopted best practice on water reuse from international experience with the following results:

(a) Changed strategy and planning to an integrated water cycle management approach.
(b) Creating opportunity by reducing the problems of overlapping institutions and regulation.
(c) Implemented demonstration projects to prove benefits and build local experience.
(d) Advocating that all types of wastewater treatments shall take reuse into consideration.
(e) Water reuse is an integral part of a water cycle management approach for their developing country and the Chinese experience will be of value to the rest of the developing world as an MDG solution.
(f) 82 reuse projects are included in the 10th five year construction plan.
(g) The Green Olympic Act and the Beijing Olympic Game Plan includes water reuse of 50% wastewater.

6. THE WAY FORWARD

Countries with similar climates and economies to EU and developing countries have embraced water recycling and reuse mainly for industrial applications, agricultural and landscape irrigation. EUREAU is concerned that the EU is not going to achieve the WFD objectives without taking full advantage of appropriate water reuse. There has been extensive investment in water reuse research and development projects and the skills and technological solutions are available. These need to be developed into best practice and quality guidelines as part of the integrated WFD strategy to the benefit of EU citizens.

EU should be able to implement water recycling and reuse projects with EU technology and expertise to create export opportunities based on the credibility in our home markets. EU needs to have in place the regulatory and institutional framework tailored to suit local needs to take advantage of the water recycling and reuse opportunities and to help overcome the water shortage problems. Also, EU needs clarity over quality, ownership and real costs to enable viable water recycling and reuse projects to proceed.

Recommendations

(a) Water recycling and reuse should be recognised as common practice and an essential method of protecting our environment and economies throughout EU through the development of guidelines and best practice documents on quality criteria, public health and environmental protection.
(b) National or EU wide water quality and good practice guidelines need to be agreed to enable water reuse to be implemented for all environmental, social, public health or economically beneficial applications. Initiatives are already being developed in Spain, Belgium, Italy. France, Greece, Portugal, and the UK. These needs to include community and stakeholder participation from the start.

(c) Project viability should be based on environmental, social and economic benefits using whole life, sustainability and cost effectiveness tools that provide a fair way of evaluating the benefits.
(d) Projects should be able to take advantage of existing or new financial incentives to build skills and confidence in each country.
(e) Innovative projects should be encouraged to promote international leadership and export opportunities.

EUREAU strongly supports this initiative to build on the strength of experience and is keen to help EU to take advantage of this opportunity and shall be pleased to meet and discuss this document.

References

[1] Sustainable Water Use in Europe, Part 2 Demand management, section 6 page 47 EU, EPA, 2001

[2] Scarcity of water resources : Which policies are developed in European countries? Discussion Paper, Pierre de Montlivault 26 February 2004 WFD Strategic Coordination Group.

[3] Stimulating technologies for sustainable development: An ETAP for the EU, COM92004) 38 Final 28.1.04 http://europa.eu.int/comm/environment/etap/

[4] United Nations Division for sustainable development, Agenda 21,Ch. 18. www.un.org/esa/sustdev/documents/agenda21/english/agenda21chapter18.htm

[5] Angelakis, A.N., D. Koutsoyiannis, and G. Tchobanoglous. Urban Wastewater and Stormwater Technologies in the Ancient Greece. Wat. Res., 2004 (accepted).

[6] John Snow: The London Cholera Epidemic of 1854, Scott Crosier www.csiss.org/classics/content/8

[7] Aertgeerts R. and A. N. Angelakis (Eds.). State of the Art Report: Health Risks in Aquifer Recharge Using Reclaimed Water. WHO, Water, Sanitation and Health Protection and the Human Environment WHO, Genova and WHO Regional Office for Europe, Copenhagen, Denmark, pp. x, 212, 2003.

[8] Planet Water, RWE Thames, London, UK, 2003.

[9] Aquarec EU water reuse research project unofficial interim results www.aquarec.org

[10] Japan Sewage Works Association (2003), Sewage Works in Japan, Tokyo, Japan
National Land Agency (1998), Japan's Water resources. Prof. N. Funamizu, Dept.of Envn. Eng. Hokkaido Univ., Tokyo, Japan.

[11] Strategy study on the development of municipal wastewater reclamation and reuse in China, Xingcan Zheng *et al*. IWA Global Conference Marrakech, Morocco, September 2004

Appendix

Results from international questionnaire survey on the benefits of recycle