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WATER REUSE IN EUROPE

INTRODUCTION

Renewable water resources in Europe change widely from northern Atlantic to the Mediterranean Sea as a direct consequence of climate (rainfall and temperature). In the space of every European country inflows from boundary watersheds can add significant percentage up to the freshwater resources, either as surface flow or as groundwater flow. In most cases, the availability of these external resources is regulated on treaties between the water-sharing countries. For instance, some countries of the Danube basin, which is governed by 18 countries, present high dependency on external resources (above 70%). The Netherlands and the Slovak Republic receive 80% of their freshwater resources from neighbouring countries. In Germany, Greece, Luxembourg and Portugal this rate is over 40% [Krinner et al, 1999].

The demand for water resources in Europe increased 600% during the second half of the 20th century and is about 660 km^3/year [Estrela et al, 2001]. About 75% of abstracted[2] freshwater in the EU for all uses comes from surface water, about 25% from groundwater and only minor contributions from reuse of treated wastewater and desalination of seawater [Krinner et al,1999].

Abstraction rates must be sustainable in order to ensure the management and protection of water resources and related ecosystems. The sustainable use of national water resources implies that the annually abstracted water should not exceed a certain ratio of the annual renewable water resources.

This ratio, known as Water Exploitation Index (WEI) or withdrawal ratio describes how the total water abstraction puts pressure on water resources. The warning threshold can be 20%, which distinguishes a non-stressed region from a stressed one. Thus it identifies those countries having high abstraction in relation to their resources and therefore are prone to suffer problems of water stress.

Severe water stress can occur for WEI>40%, which indicates strong competition for water. Some experts believe that 40% is too low a threshold, and that water resources can be used much more intensely, up to a 60%. Others believe that freshwater ecosystems cannot remain healthy if the waters in a river basin are abstracted as intensely as indicated by WEI>40% [Alcamo et al., 2000].

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[2] Abstracted water is the amount of water physically removed from its natural source.

In most of the European continent the amount of water available largely exceeds water demand. In the EU15 countries the average WEI was around 21% [EEA, 1999], which is quite a sustainable index. However severe imbalances between regions are observed as shown in Fig. 1: 4 countries, in southern Europe representing 18% of the population, are water stressed (Cyprus, Italy, Malta and Spain); 9 countries, lying mainly in southern Europe, which represent 32% of EU population, are moderately water stressed (Germany, Bulgaria, Denmark, Portugal, Romania, Turkey). Belgium abstracts more than 40% of its total renewable freshwater resources[3].

[3] *The long-term average freshwater resource is derived from the long-term average precipitation minus the long-term average evapotranspiration plus the long-term average inflow from neighbouring countries.*

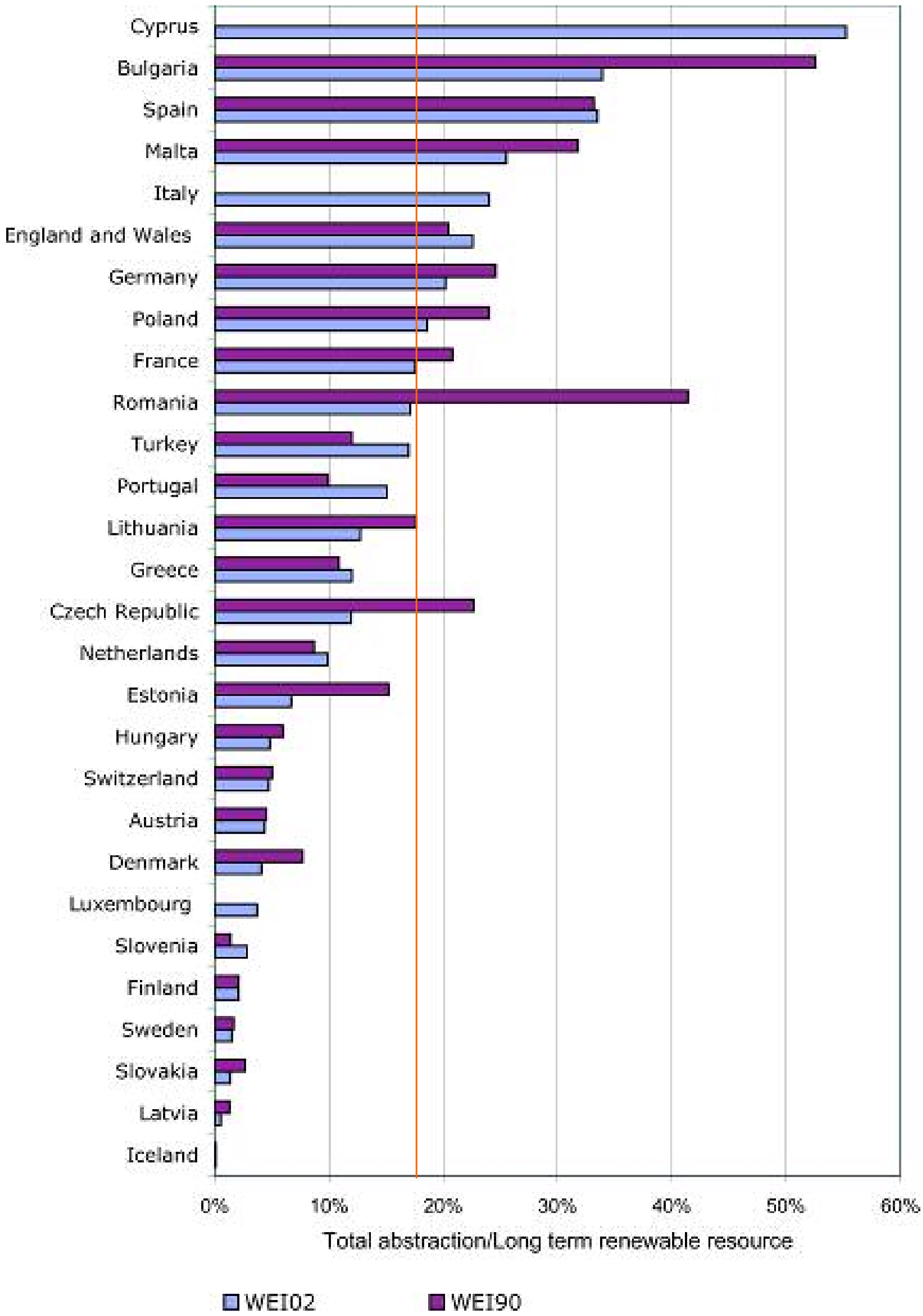

Fig. 1 - Water Exploitation Index in European countries (copyright EEA, Copenhagen, 2005)

The picture also compares WEI in 1990 and in 2002 and shows that the WEI has decreased in 17 countries during the period 1990-2002, mostly in the new member states due to the decline of abstractions (institutional and economic changes), but also in older members, such as Denmark and Sweden due to the implementation of sustainable water use programmes. Six countries have increased their WEI – Greece, Luxembourg, Malta, Portugal, Turkey and the UK.

The future situation of sustainable water resources will depend basically on the trends of renovation of water resources and pressure for water abstraction. Renewable water resources will be affected by climate change, which seems to be a recognised reality at present and by water pollution caused by human activity. Pressures on water abstraction will be affected mainly by the evolution of sectoral water uses (mainly agriculture), population and urbanisation growth, tourism, industry.

CLIMATE CHANGE IN EUROPE

Climate change in Europe seems to be revealed by a succession of floods and droughts in recent years. Studies on future trends of climate change in Europe suggest that in northern Europe annual rainfall will stabilise or increase by 2050, but will decrease elsewhere. Temperature will increase all over Europe ranging between 1ºC to 3.5ºC by 2100. As a consequence glaciers will retreat affecting river flow and annual flooding patterns, but potential evaporation will increase and can lead to decrease of run-off. About 30% reduction in run-off is forecasted in drier regions of southern and eastern Europe [Estrela et al, 2001].

Droughts are phenomena that affect not only southern European countries, but it is anticipated that southern European countries will be more severely affected by droughts due to climate change. Actually, the drier regions of southern Europe are the most sensitive to climate change impacts.

Long and replicated droughts induce the deterioration of the natural vegetation cover of soil reducing the infiltration capacity and causing soil erosion, the process intensifying the desertification process. The risk of desertification is already visible in semi-arid Mediterranean countries.

Droughts have important impacts on regional economy, on environment and on the population quality of living. As a matter of fact, drought originates losses in agriculture (crops and cattle), impacts negatively freshwater ecosystems and induces the extinction of vegetal and animal species, the last but not the least, drought cause problems on water supply.

TRENDS OF SECTORAL WATER USES IN EUROPE

Fig. 2 shows the average percentage of water abstraction per sector [EEA, 1999]. In average in the EU water consumption is around 32% of water abstraction, since most of abstracted water is not consumed but returned to the water cycle and made available to further uses, after proper treatment or natural purification.

Fig. 3 compares water abstraction and water consumption as a percentage of total renewable freshwater resources in the EU 25.

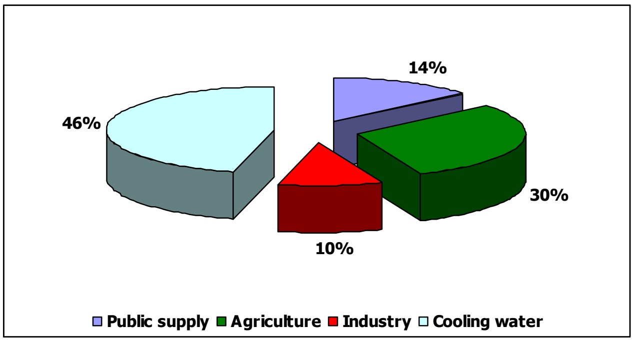

Fig. 2 – Sectoral water abstraction in Europe

Agriculture

In spite of the declining importance of agriculture in the economy of European countries agriculture still is a very important economic sector in many European countries. Agriculture represents the highest consumptive water use – 55%. Irrigation is the most significant use of water in agriculture, being almost 100 %, since livestock consumption is around 0.6%.

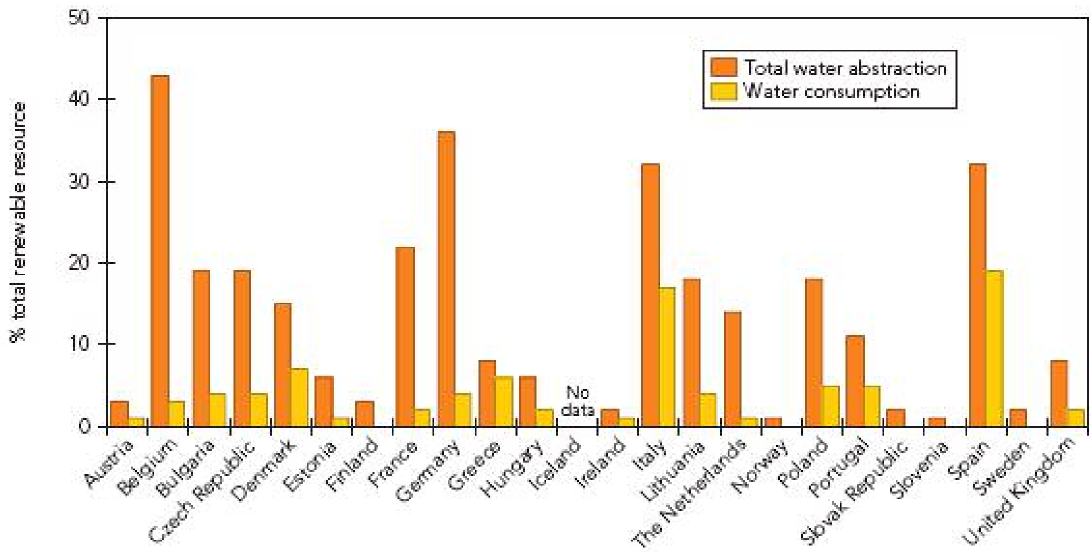

Fig. 3 - Water abstraction and water consumption as a percentage of total renewable freshwater resources in the EU 25 (copyright EEA, Copenhagen, 1999)

The volume of irrigation water depends on climate, the crop being cultivated, the area being irrigated and the irrigation method. Therefore, sharp differences on the portion of irrigated land out of the total agricultural land are observed in Europe: virtually nil in some northern and central countries like Lithuania and Switzerland to 60% in the Netherlands. In the southern countries the parcel of irrigated land is a smaller percentage of the total agricultural land (38% in Greece, 18% in Spain). Nevertheless, in Southern European countries water for agriculture rises to 73% of consumptive uses and 62% of total uses [Krinner, 1999]. Greece, Spain, Italy, Portugal, Denmark and Romania are the countries that consume higher percentage of water for irrigation.

It is difficult to foresee the pattern of water use in agriculture in Europe in the future. The Common Agriculture Policy (CAP) and its reforms present a major influence on agriculture water use. The CAP reform in 1992 reduced production and led to the use of more efficient irrigation methods. As a consequence, water for agriculture decreased during the 1990s in the southern western countries. However, since 2002 an increase of water for agriculture is observed in the new member states of Southeastern Europe (Romania, Bulgaria, Hungary).

The implementation of the Water Framework Directive (WFD) together with climate change impacts (water shortage in southern regions) will probably push farmers to adopt more efficient irrigation methods. In addition, CAP will no longer subsidise agriculture after 2013. The answer to the consequent cost increase of crop production may be the reduction of irrigated area and/or the production of new crops preferably of high value in the market and requiring less water for irrigation.

Urban water supply - population growth

Urban water supply includes mainly households, public services, commerce and small industries. In average the household consumption is around 45% of public water supply use in several countries (Hungary, The Netherlands, the UK). The demand of urban water depends mainly on population served (population growth, population density) and socio-economic level of society. Large variations on public water use can be observed in Europe, caused not only by differences in lifestyle, but also by the water price and the leakage in the supply systems.

From 2003 to 2004 the population of EU 25 increased 2.1 million which meant 0.5% increase in 2003. Such increase of EU population was mainly due to net inward migration, only 200 thousand resulting from natural increase, i.e., excess in the number of births over the number of deaths.

Over the last 44 years the population of the world has more than doubled from 3 to 6.4 billion people. Over 90% of this increase has occurred in less developed countries that constituted 70% of the world population in 1960 and 80.8% in 2004. Over this period the population of China has doubled to 1.3 billion and the population of India reached 1 billion in the year 2000. In contrast the population of the EU contributed 2.4% towards world population growth. The EU share of world population has been declining for many years: 12.4% in 1960, only 7.2% in 2004.

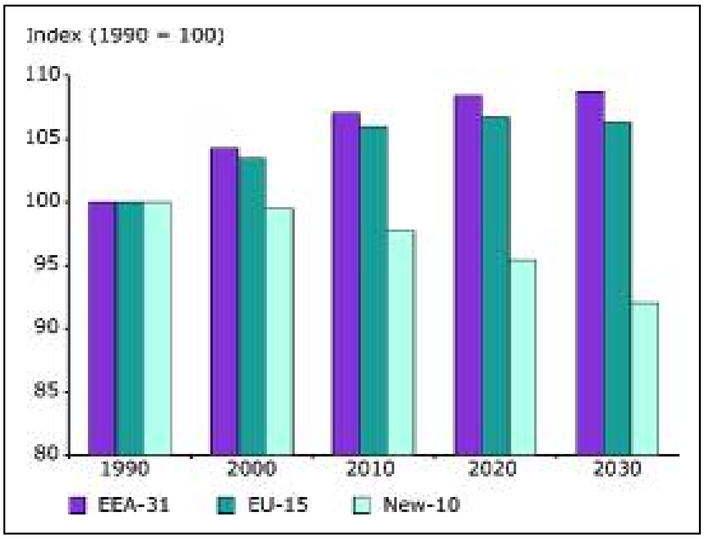

Fig. 4 – Population growth in the EU (copyright EEA, Copenhagen, 2006)

The mild population growth rate partially explains the steady increase in urban water demand in most European countries in the 1980s and 1990s. As mentioned before, the socio-economic growth (e.g. the increasing use of domestic appliances) and leakage explain the increase in public water supply.

It is interesting to note that more than 2/3 of the EU population is living in urban areas and the proportion of population living in small communities is decreasing.

It is estimated that in many EU countries the population will continue increasing at a moderate rate reaching 390 million in 2010.

In addition to the wide variation in public water supply demand different trends can be distinguished: in some countries consumption has been decreasing (e. g. Denmark, Sweden, Germany) whereas other countries have shown an increasing pattern (e.g. Austria, Belgium, Italy, Switzerland). Use is highest in western southern countries largely reflecting the warmer climate in this part of Europe.

In the future it is anticipated that in spite of population and socio-economic growth, urban water demand will stabilise or decline slightly, as a result of water pricing policies and improvement in efficient water usage.

Tourism

Tourism has become more prevalent in the last 4 decades all over developed countries and represents an important parcel of GDP in many countries. In terms of water resources, the problem is that tourist resorts are generally installed in sunny places often associated with limited availability of water resources like Southern European countries. Consequently the peak season periods are usually in summertime. For example, in Spain the major tourist areas are located in southeast areas suffering of water stress. In Southern European coastal areas groundwater in particular has been abstracted unsustainably with the subsequent risk of seawater intrusion into aquifers.

Tourist water consumption is about the double of local inhabitants. In addition, large volumes of recreation water - golf courses, swimming pools, water parks – are required exception for the snow tourism.

Tourism will continue to be a high water consumer in Europe and the demand will grow in the future. The pressure of tourism on water resources will be particularly severe in Southern Portugal, Spain, France, Italy, Malta, Cyprus and Greece.

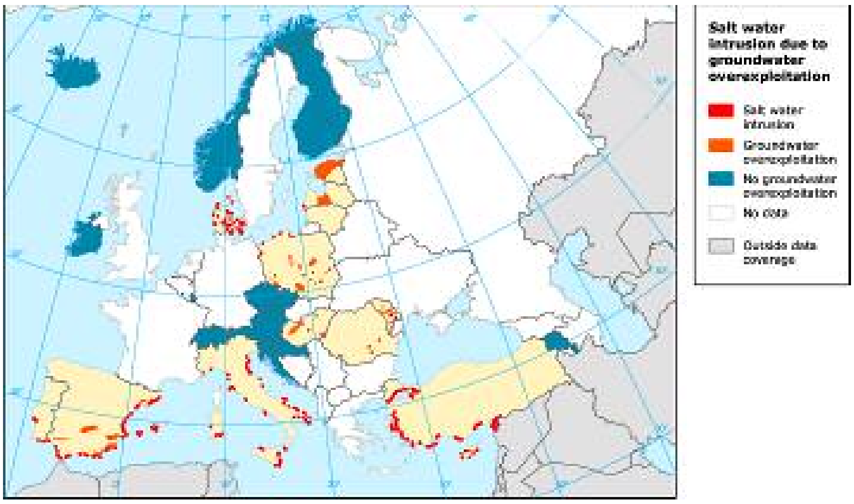

Fig. 5 - Salt water intrusion due to groundwater intensive exploitation (copyright EEA, Copenhagen, 2005)

Industry

Excluding cooling water, the main industrial water users are the chemical industry, the steel and metallurgy industries, the pulp and paper industry. Industrial use of water accounts for about 32% of total water abstractions in the EU. Cooling water represents about 10%, because most of cooling water is used and not consumed, generally returned to the water cycle.

Industrial use of water decreased in all the European regions during the 90's as a result of a combination of factors: technological improvements to reduce water consumption, increased recycling and reuse in the plants, recession with plant closures in heavy water consuming industries such as textiles, iron and steel industry and due to economic restructuring in the new member states.

The increase of water demand for industry is not expected in Europe in the future because of increased efficiency in industrial processes, greater water recycle and re-use as well as the decline of water intensive consuming industries in Europe.

The overall demand of water in Europe

The assessment of the sectoral water abstraction and consumption in Europe suggests that the total water abstraction in the EU will stabilise in the near future (2010), although it may increase in some regions. It is expected to decrease by more than 10 % until 2030 with pronounced decreases in Western Europe.

Climate change is expected to reduce water availability and increase abstraction for irrigation in Mediterranean regions. Under mid-range assumptions on temperature and precipitation changes, water availability is expected to decline in Southern and South-eastern Europe (by 10 % or more in some river basins by 2030).

The sectoral profile of water abstraction is expected to change in the long term: abstraction for the electricity sector are projected to decrease dramatically over the next 30 years as a result of continuing substitution of once-through cooling by less water-intensive cooling tower systems; industrial water use is likely to stabilise or even decrease; in Eastern Europe, urban water supply may grow significantly; agriculture is expected to remain the largest water user in the Mediterranean countries, with more irrigation and warmer and drier growing seasons resulting from climate change.

These are mean general conclusions that neither take into account the irregular availability of water resources in time nor the vulnerability of the regions of low rainfall, mainly the southern part of Europe. Water shortage in such European regions affects important economic activities such agriculture and tourism inducing intensive exploitation of water resources, namely the aquifers. Severe environmental impacts are drawn by over exploitation of water resources such as pollution of surface water, depleting the groundwater level, intrusion of seawater into the aquifers, acceleration of the desertification process, damaging wetlands and habitats.

In one sentence: presently there are regions in several EU member states where water abstraction is impairing the sustainability of water resources and the environment and the situation tends to aggravate in the future.

WATER REUSE – IMPORTANT STRATEGY OF WATER CONSERVATION

Water conservation is the hydrological answer to the problem and certainly water reuse is an important component of water conservation strategies. Other solutions can be implemented such as water savings (e.g. suppressing the leakage of supply networks, using more efficient irrigation techniques such as drip irrigation and small flush systems), tapping other resources (e.g. desalinating seawater or brackish water) [Angelakis et al, 1999]. Reducing demand through pricing is also a possible option but it raises many political difficulties.

Water can be reused for one or more beneficial purposes: irrigation for agriculture or landscape purposes, industrial supply, non-potable urban applications (such as street washing, fire protection), groundwater recharge, recreational purposes and direct or undirected water supply.

Water reuse can have two important benefits. The most obvious is the provision of an alternative water resource. The second is the reduction of environmental impacts by reducing or eliminating wastewater disposal, which results in the preservation of water quality downstream. Therefore, when considered in the framework of an integrated water management strategy at catchments scale, the benefits of wastewater reuse should always be assessed taking into account that it contributes to both enhancing a region's water resource and minimizing its wastewater outflow.

Agricultural irrigation is the major application for water reuse in both developed and developing countries because it is not so difficult to match the quality of treated wastewater with the required quality of water for irrigation. Agriculture is the economic sector of human activity which, by far, consumes the largest volume of water.

In developed countries landscape irrigation is the second application of water reuse [EPA, 2004]. The water used or reused for landscape irrigation includes residential, commercial, and municipal applications.

Therefore, the use of treated wastewater for irrigation means a positive contribution for appropriate water resources management, particularly in arid and semi-arid regions. In addition to augmenting water resources, the use of reclaimed wastewater for irrigation can reduce the need for fertilizers thanks to the nutrients it contains.

OVERVIEW OF WATER REUSE IN EUROPE

In Europe treated wastewater is reused for agricultural irrigation, landscape irrigation, industrial recycling and reuse, groundwater recharge, non-potable urban uses and indirect potable use. There are about 700 reuse projects in Europe [CIWEM, 2006]. Reuse projects are more numerous in Southern European countries (Cyprus, France, Greece, Malta, Portugal, Spain,) but reuse projects are implemented in central and northern countries (Belgium, Sweden, UK). A brief description of the situation on water reuse in the European countries where reuse is implemented at a larger extension is presented herein.

Belgium

Belgium is one of the member states presenting a high water exploitation index. The reduction of effluent discharge in sensitive waters is an additional reason for reuse in Belgium. The Belgium government wishes to reduce groundwater abstraction and stimulate water reuse.

Presently almost all the urban wastewater is treated. There is a growing interest about recycle and reuse namely for industrial water supply (cooling water in power plants, food processing plants, textile industry) although the parcel of treated effluent that is reused is limited.

The most important reuse project is located in Wulpen where treated wastewater is reused for indirect potable water supply [EPA, 2004]. The Wulpen WWTP treats 2.5 million m^3/yr by microfiltration and reverse osmosis and then the effluent is stored for 1-2 months in the aquifer prior abstraction to produce potable water. In addition to water resources augmentation this project brings another environmental benefit: it provides a hydraulic barrier to salt water intrusion.

Belgium guidelines for water reuse are in preparation.

Cyprus

Cyprus is a Mediterranean island where tourism is a very important economic activity. Water scarcity and deterioration of bathing water on the beaches are growing as constriction factors to tourism development. The reuse of treated wastewater is an important contribution to the solution of both problems. Irrigation for several purposes (agriculture, landscape, green areas in hotel, golf courses) is the main application in Cyprus [Zachariou-Dodou, 2006].

Cyprus has adopted guidelines for wastewater reuse for irrigation and published a code of practice.

France

The Mediterranean French region has lower water resources available that the mean of the country and water demand has been growing in this area mainly due to tourism pressure. Consequently the majority of reuse projects are located in the islands and Mediterranean coastal area of France, although there are important reuse projects in other parts of the country. As a matter of fact France has a long tradition in irrigation with treated wastewater (as a land treatment process) that was initiated in the 19th century. In Achères, close to Paris, the capital’s wastewater were applied on soil up to the 1940’s.Unplanned indirect water reuse is common in France through the abstraction of surface water diluted with wastewater to treat for the production of drinking water.

The interest for water reuse grew significantly in the 1990’s. The main justification is water deficit in some regions, environmental protection by reducing effluent discharge in receiving waters, namely in recreational and shellfish waters. Reuse for agricultural irrigation is the major application. There are over 3000 ha in France where treated wastewater is used to irrigate gardening crops, orchard fruit, cereals, trees, grassland, golf courses. A large project worth to mention is located in Clermont Ferrand, where 700 ha of maize are irrigated with the effluent of an activated sludge plant followed by maturation ponds. The reuse of industrial wastewater after purification to supply cooling water, wash water or even process water after sophisticated complementary treatment is widely developed in France [[EPA, 2004]].

In 1991 France published official guidelines concerning reuse for irrigation. In 1996 technical recommendations about wastewater treatment to comply with reuse Guidelines were published.

Greece

As a typical Mediterranean country Greece suffers of heavy water imbalance along the year, consequently high demand for water is observed particularly in summer. The existing wastewater treatment plants serve more than 60 % of the population. Therefore the reuse of these effluents would contribute to satisfy an existing water demand. Several research and pilot projects dealing with wastewater recycling and reuse have been carried out in Greece [Angelakis et al., 2003]. In addition, a few small projects on wastewater reclamation and reuse are in practice.

Agricultural irrigation is the main interest for reuse in Greece. There are projects to reuse 20,130 m3/d of treated wastewater to irrigate olive trees, cotton, forest and landscape irrigation [Tsagarakis et al, 2000].

Guidelines for water reuse are under consideration.

Italy

Some regions in Italy (Sicily, Sardinia and Puglia) are affected by recurrent droughts and suffer of water imbalance and low water quality. The reuse of treated wastewater is an important contribution to the solution of both problems. The demand for irrigation water has been increasing along the years. The practice of wastewater use for irrigation is known since the early years of the century XX, although such practice decreased due to the low quality of water.

Agriculture is the major interest for reuse in Italy. At present there are over 4000 ha irrigated with treated wastewater in Italy [EPA, 2004]. There are favourable conditions to implement reuse projects in Italy because 60% of the urban wastewater is treated in medium and large plants (treating more than 100 thousand people) that produce adequate quality effluents at a reasonable cost (EPA, 2004). One of the largest projects was implemented in Emilia Romagna where 400 ha are irrigated with treated wastewater. 16 new reuse projects are being implemented in Sicily and Sardinia (Grammichele, Palermo, Gela).

Existing Italian legislation (General Technical Standards - G.U. 21.2.77) sets very strict parametric values and has been a constriction to the development of water reuse projects in the country. New legislation is being prepared that gives better attention to the management of water resources and in particular to the reuse of treated wastewater.

Water reuse for industry is practiced in the metropolitan area of Turin. Municipal WWT operator companies have already planned to build a separate supply network for wastewater reuse for industry (Azienda Po Sangone and CIDIU) in the Turin metropolitan area.

Portugal

In spite of the fact that Portugal is not bathed by the Mediterranean Sea the Portuguese climate presents some features of Mediterranean climate particularly in the half of the country south of river Tagus. Under a natural regime 57.5% of the country mainland suffers a water deficit. Recurrent droughts severely affect the southern Portugal.

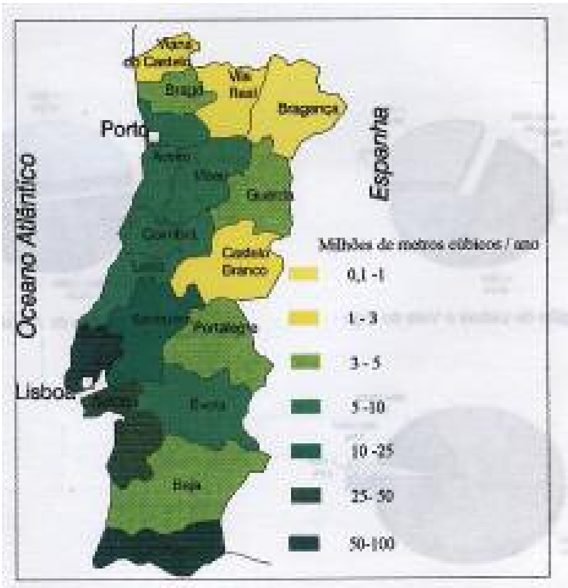

Fig. 6 – Annual volume of treated wastewater available for reuse

The major water reuse interest in Portugal is for agriculture and landscape irrigation [Marecos do Monte, 1998]. Presently there are just a few small cases of reuse for agriculture irrigation, road construction and car washing. However, the interest for the irrigation of golf courses has increased significantly in the last couple of years. The most important reuse projects are for the irrigation of golf courses are under implementation in the region of Algarve a tourist region in the south of Portugal (Fig 7). According to the studies the effluent flow of 14 WWTP is sufficient to cover the water demand for irrigation of the existing 28.5 golf courses of 18 holes and the planned 19 golf courses (Martins et al, 2006).

Guidelines for water reuse for irrigation were recently published in Portugal (NP 4434:2005) [IPQ, 2005]. This Portuguese standard provides guidance on the use of treated urban wastewater for agricultural irrigation (crops, forest, plant nurseries) and landscape irrigation (parks, gardens, sport lawns such as golf courses). It is the first regulation in the country that presents not only quality criteria for treated urban wastewater for irrigation but also provides guidance on other important aspects to ensure safe practice, e.g. for selection of irrigation equipment and methods, guidelines for environmental protection and includes environmental impact monitoring procedures in areas irrigated with treated urban wastewater.

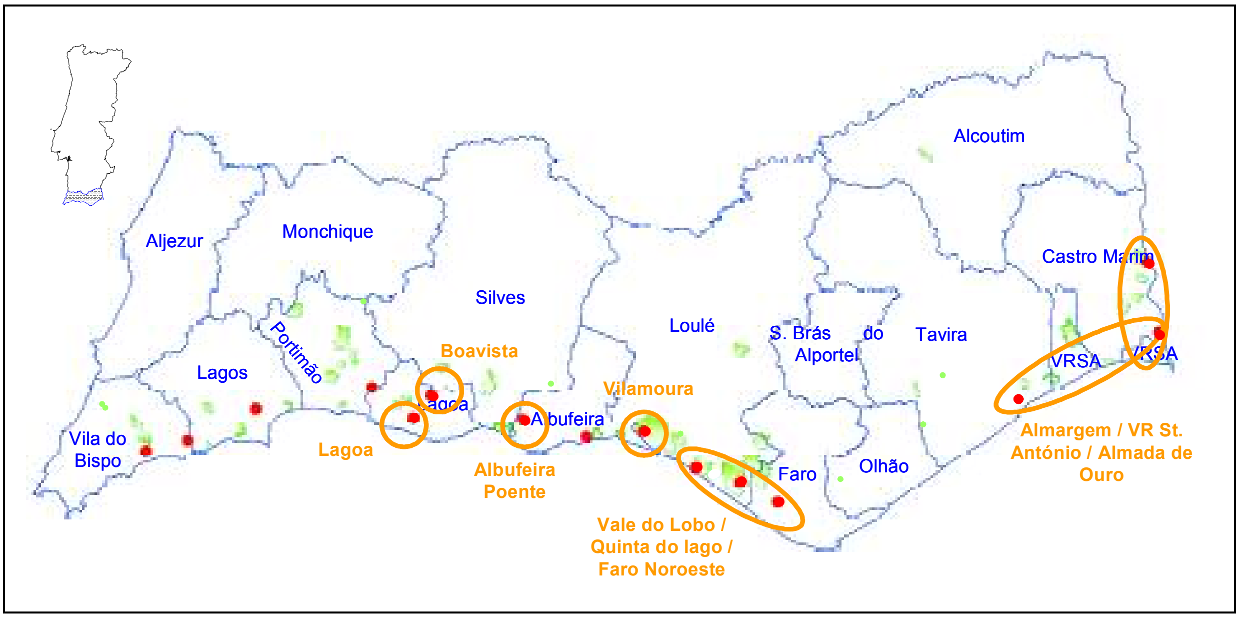

Fig. 7 – Location of WWTP (in red) and golf courses (in green) in Algarve, and priority systems for water reuse (in orange) (picture by courtesy of Águas do Algarve)

A Technical Guide on Reuse of Reclaimed Water is expected to be published by the end of 2007 in Portugal. This guide focus on several reuse applications such as irrigation, urban uses (street washing, fire fighting), recreation and environmental uses, that show a potential interest in Portugal.

Spain

Wastewater reuse has been practiced in some places in Spain since many decades ago, perhaps centuries. Planned reuse of treated wastewater is a recent trend in Spain that is growing at a fast rate together with the increasing number of WWTP in operation to fulfil the treatment requirements set in the EU directive 91/271/EEC. This pattern is similar to what can be observed in Greece, Portugal and Italy. As shown in Table 1 irrigation is the most widespread use of treated wastewater, followed by urban uses, golf courses and recreational uses, industrial uses and environmental uses:

Table 1 – Use of treated wastewater in Spain in 2004 [Iglesias, R., 2005]

USE	Volume (hm^3/yr)	%
Irrigation	323.0	79.2
Urban uses	33.0	8.1
Golf courses and recreational uses	25.0	6.0
Industrial uses	3.0	0.7
Ecological uses	24.0	6.0
Total	**408.0**	100.0

Reuse has developed more actively in the coastal Mediterranean regions (Valencia, Murcia, Cataluña), the islands of Canarias and Baleares, but the interest in the Autonomous Region of Madrid has grown very strong in the last couple of years. Studies carried out by the CEDEX estimated that volumes of wastewater reused in the more important reuse projects present the geographical distribution shown on Table 2:

Table 2 – Geographic distribution of water reuse in Spain (in Iglesias, 2006)

Region	Volume of wastewater for reuse (hm3/yr)
Comunidad Valenciana	128.0
Comunidad de Murcia	106.0
Islas Canarias	47.5
Islas Baleares	40.0
Cataluña	33.0
Coast of Andaluzia	11.5
Vitoria-Gatzei	12.5
Madrid	8.0

Sweden

In spite of its high availability of water resources and a low rate of abstraction of renewable water resources (just 2%), in the southeastern region of Sweden there is an interest for reusing the tertiary treated effluents of WWTP for irrigation [EPA, 2004]. The reason for this practice in Sweden is due to the fact that precipitation is low in this part of the country and the effluent reuse contributes to preserve coastal receiving waters and to conserve groundwater for nobler uses. There are over 40 reuse projects consisting of effluent storage up to 9 months in large reservoirs before being used for irrigation. In some cases the effluent is blended with surface water.

United Kingdom

The UK is another example of an European member-state apparently rich in renewable water resources where a strong interest for water reuse had led to some interesting projects including indirect potable reuse [EPA, 2004] as well as direct reuse for golf courses and road verges irrigation, cooling, fish farming, car washing. The Millennium Dome in London is an example of a demonstration project of water reuse as it accommodates the so-called "Watercycle" project where run-off water, grey water and polluted groundwater are treated in three treatment lines to a high quality level and subsequently reused in more than 600 toilets and 200 urinols.

CONCLUSIONS

The demand for water resources in Europe increased 600% during the second half of the XX century. The sustainable use of national water resources implies that the annually abstracted water should not exceed a certain ratio of the annual renewable water resources.

The future situation of sustainable water resources will depend basically on the trends of renovation of water resources (that will be affected by climate change and by pollution) and pressure for water abstraction (depending mainly on the evolution of sectoral water uses, population and urbanisation growth, tourism, industry).

Climate change is expected to reduce water availability and increase abstraction for irrigation in Mediterranean regions. Under mid-range assumptions on temperature and precipitation changes, water availability is expected to decline in Southern and South-eastern Europe (by 10 % or more in some river basins by 2030).

The sectoral profile of water abstraction is expected to change in the long term: abstraction for the electricity sector are projected to decrease dramatically over the next 30 years as a result of continuing substitution of once-through cooling by less water-intensive cooling tower systems; industrial water use is likely to stabilise or even decrease; in Eastern Europe, urban water supply may grow significantly; agriculture is expected to remain the largest water user in the Mediterranean countries, with more irrigation and warmer and drier growing seasons resulting from climate change.

The global consequence of the estimated changes in the sectoral profile of water abstraction and consumption in Europe seems to be that: in the near future (2010) the total water abstraction in the EU will stabilise, although it may increase in some regions; in the long term (until 2030) water abstraction is expected to decrease by more than 10% with pronounced decreases in Western Europe.

These mean general conclusions neither take into account the irregular availability of water resources in time nor the vulnerability of the regions of low rainfall, mainly the southern part of Europe. Presently there are regions in several EU member states where water abstraction is impairing the sustainability of water resources and the environment and the situation tends to aggravate in the future.

Water conservation is the hydrological answer to the problem and water reuse is an important component of water conservation strategies. Other solutions can be implemented such as water savings (e.g. suppressing the leakage of supply networks, using more efficient irrigation techniques such as drip irrigation and small flush systems), tapping other resources (e.g. desalinating seawater or brackish water). Reducing demand through pricing is also a possible option but it raises many political difficulties.

Water can be reused for one or more beneficial purposes: irrigation for agriculture or landscape purposes, industrial supply, non-potable urban applications (such as street washing, fire protection), groundwater recharge, recreational purposes and direct or undirected water supply.

Water reuse can have two important benefits. The most obvious is the provision of an alternative water resource. The second is the reduction of environmental impacts by reducing or eliminating wastewater disposal, which results in the preservation of water quality downstream.

The path of water reuse will certainly be followed by many regions in Europe. European guidelines to assist the sustainability of water reuse are necessary as have been pointed out by several experts [Marecos do Monte, et al, 1996].

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