Water use efficiency and economic approach

National study Croatia

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Introduction

The Mediterranean Strategy for Sustainable Development (MSSD) has set the water efficiency index as an indicator for monitoring progress in integrated water resources and demand management, considered to be one of the priority fields of action in the region.

The overall work on producing national water use efficiency indexes in the Mediterranean riparian countries, conducted by Plan Bleu, is intended to update the water savings potential at regional level and to propose/validate the regional water savings target for the future Strategy for Water in the Mediterranean. Actual water use efficiencies as well as plans for future water savings vary substantially among the Mediterranean countries due to their very different natural and socio-economic conditions.

Croatia is a relatively rich water country, mostly due to a large amount of external water resources coming from the neighboring countries, but with exceptional space and time variability in their distribution (Figure 1). The territory of Croatia is divided into two river basin districts, the Danube River Basin District and the Adriatic Basin District, which are the main territorial units for water management. The two districts differ in many characteristics, including their water availability and water use pattern.

Figure 1 - Spatial distribution of water resources in Croatia (average 1960-1990)

Source: Ministry of Regional Development, Forestry and Water Management (MRDFWM), 2008

According to a general water balance sheet, total renewable water resources in Croatia amount close to 112 billions m^3 or 25,000 m^3 per inhabitant annually[1]. Water resources generated from precipitation within the national territory amount 26 billions m^3 or almost 6,000 m^3 per inhabitant annually. Compared to the

[1] 50% of bordering waters are included (Danube River, Sava's tributaries coming from Bosnia-Herzegovina)

Adriatic Basin, the Danube River Basin is richer when considering its total natural water resources, and poorer when considering what its internal natural water resources are.

The natural water supply may not be regarded in total as an available resource. There are many technical, economic, environmental and political constraints limiting the amount of renewable water that can be effectively exploited for anthropogenic purposes. However, all analyses suggest that Croatia possesses sufficient quantities of water, and that water resources, in terms of their quantity and quality, are not a restricting factor for its socio-economic development. Due to marked temporal and spatial variability of the water regime, permanent investments in water works aimed for water production and distribution are required, as well as their regular operation and maintenance to be able to serve all different users. This is why economic and environmental reasons, more than a lack of water resources, are main drivers for taking measures for improving the water use efficiency.

The Ministry of Regional Development, Forestry and Water Management (MRDFWM) is the main authority responsible for water policy and management. Through its two directorates, it deals with water legislation and regulation, enforcement and water policy issues. Hrvatske vode (Croatian Waters, CW) is a legal entity for performing public services and other tasks through which the defined water policy is achieved. Under administrative supervision of the MRDFWM, CW is responsible for drafting plans, including those on managing with water quantity and water quality, and executing them after adoption in line with disposable funds.

The field of water is regulated by the Water Act and Water Management Financing Act (OG 153/2009) and about 40 by-lows. The new water legislation is fully harmonized with the EU water legislation.

The main policy document in the field of water is the Water Management Strategy adopted in the year 2008 by the Croatian Parliament (OG 91/2008).

I. Production of the water efficiency index by 2008

The main source of the data for the production of the water efficiency index achieved in Croatia is the Central Bureau of Statistics (CBS) that regularly collects data on water withdrawals and water use in different sectors (drinking water, industry, irrigation). Data are publicly available, aggregated on the national level, only exceptionally (drinking water) on the level of the river basins. Reporting started in 1990. Data are of diverse quality and reliability, those on drinking water production and distribution are better than those on water use in industry and water for irrigation. Water management authorities also collect some data on water use for their own needs. Analysis of water uses and calculation of water efficiency indexes (total, per sector), presented below are mostly based on the official statistics reported by the CBS. Shortcomings and gaps in the recorded data for some components for production the efficiency indexes in the industry and irrigation are compensated by using estimates or theoretical values.

All relevant data and information on the production of the water efficiency index achieved by 2008 are presented in the Annex 1.

1. Drinking water efficiency

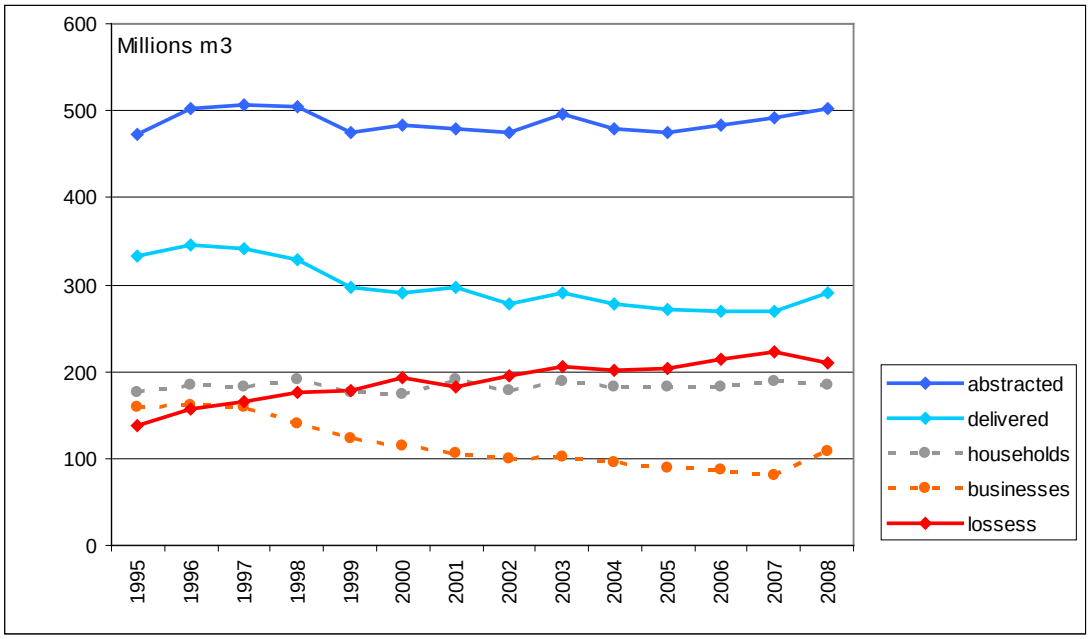
There are around 140 providers for carrying out the public water supply service on the territory of one or more local self-government units in Croatia. The national coverage rate (share of the population that is or can be connected to the public water supply system) is 82%. The national connection rate (share of the population actually connected to the public water supply system) is estimated to be of 74%[2]. There are significant differences in the level of coverage between Croatian regions: it is greater in the Adriatic Basin (84%)

Available data on public water supply shows a rather stable volume of abstracted raw water during the period 1995 – 2008, raising an annual average of 488 million cubic meters (m^3) (Figure 2). The source of water abstracted is mostly groundwater from spring-water intakes in karstic and mountainous areas or on well fields of alluvial aquifers in the plains. There are few surface water intakes and their share in the production of water for public water supply is small. In general, the quality of drinking water from public water supply systems is satisfactory at the level of the Republic of Croatia, but there are great regional differences. There is no data on numerous small "local" pipelines functioning without any permits and any control. At the moment, wide range of activities has been started collecting the data related to the water quality as well as on coverage and status of "local" water supply pipelines.

During the analyzed period a slight downward trend in the quantity of delivered/paid water has been recorded brought about by increasingly smaller quantities of drinking water delivered to business entities, first of all to industries. Larger industrial plants have been restoring their own water intakes as economically more favorable solutions. Recently, one third of the total sold quantity of drinking water has been delivered to businesses (2006 – 2008 average), compared to almost one half at the beginning of the analyzed period. In the whole period the delivery to households has remained stable, varying around an average of 183 million m^3 annually, without any indication of trend. Water losses in water supply systems are large, reaching around 44% (2006 – 2008 average) at the national level corresponding to a significant increase in comparison to the 30% recorded in 1995. Here the loss implies the difference between the abstracted and delivered quantity of water, which includes every non-registered and non-paid consumption, including some water uses which are not charged (e.g. water for the flushing of pipelines, municipal needs, fire fighting services, etc.), and not only water lost due to technical faults in the water supply network. Due to the data gaps, the loss cannot be broken down to its components. Although, the leakage is at any rate the main component.

[2] Estimate for the year 2005

Figure 2 - Public water supply in the period 1995 – 2008

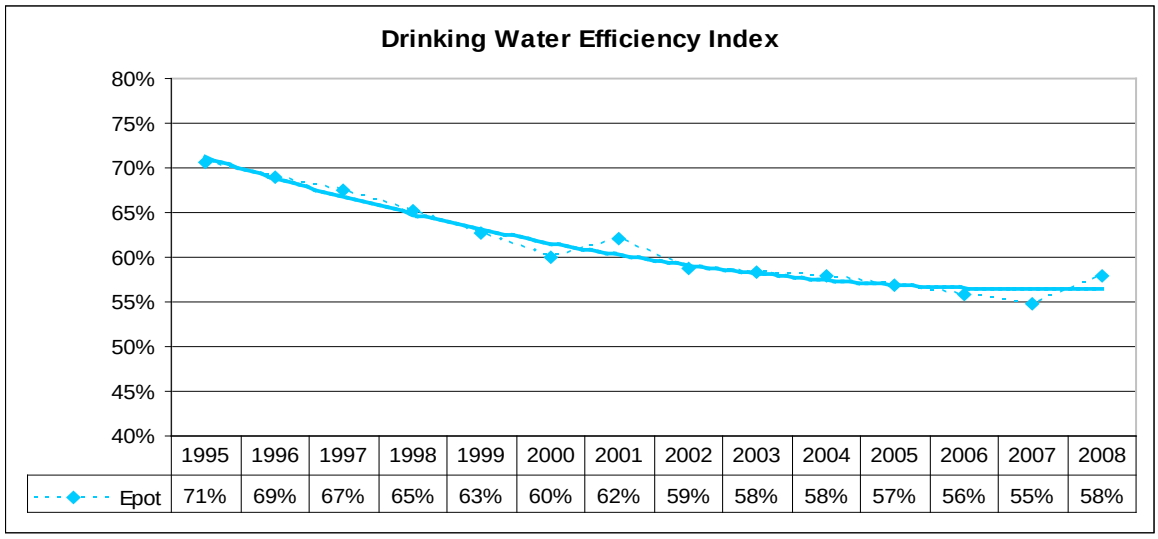


Source: Devic, 2010

Inefficient and rather wasteful drinking water use is the result of age and inadequate maintenance of the public water supply systems, as well as under-pricing of water for end users (consumers), first of all for households. Higher tariffs for industrial users (approximately two times higher than for households) have been incentive for reduction in their demands for drinking water.

Drinking water efficiency index, calculated as the ratio of drinking water delivered and paid by consumers over row water abstracted at the source[3], declined significantly during the past period, from about 70% at the beginning to the recorded minimum of 55% in the year 2007 (Figure 3). Declining trend seems to be stopped recently. Necessary measures for further rationalization of water consumption and reduction of losses are proposed by the Water Management Strategy.

Figure 3 - Drinking water efficiency index achieved in the period 1995 – 2008



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Epot	71%	69%	67%	65%	63%	60%	62%	59%	58%	58%	57%	56%	55%	58%

Source: Devic, 2010

[3] It is assumed that there are no losses in the drinking water production process: produced drinking water equal abstracted row water.

2. Irrigation water efficiency

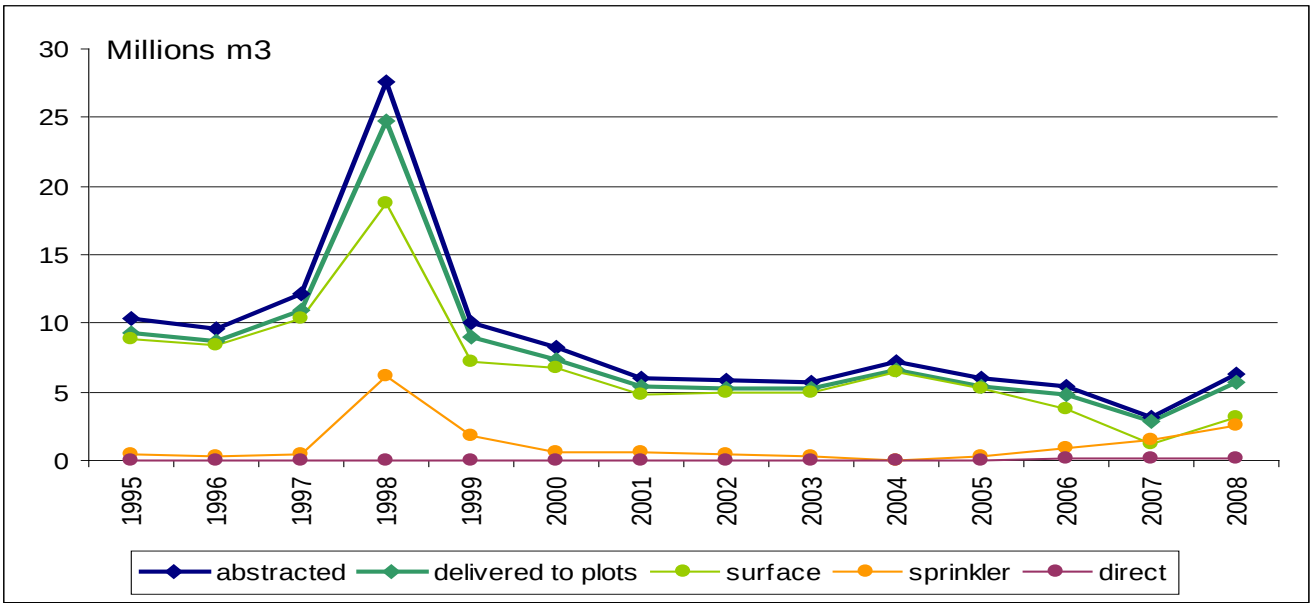
The official records show that only a small, almost negligible part of the agricultural land was irrigated in the previous period. It was below one percent of the total cultivated area. The agricultural production has mainly been oriented to rainfed (first of all cereal and corn). However, this leads to substantial losses in production during drought years.

Although there is a significant water potential and areas suitable for irrigation, only a small number of irrigation concessions was issued until today. Instead of that, an uncontrolled collecting of irrigation water from rivers and lakes, and also from groundwater aquifers is the wide-spread practice. The dominant irrigation mode used to be surface irrigation. Certain improvement in the irrigation practice in terms of irrigation modes, as well as slight increase in the irrigable area began with the launching of the National Project of Irrigation and Land and Water Management (NAPNAV) in the year 2005.

Recorded data on irrigation water are of rather low reliability, due to the small-scale and uncontrolled irrigation practice. According to records, total annual volume of water abstracted for irrigation purposes is small, and has been decreasing (Figure 4). Year 1998, as one of the driest years in the analyzed period, was an exception.

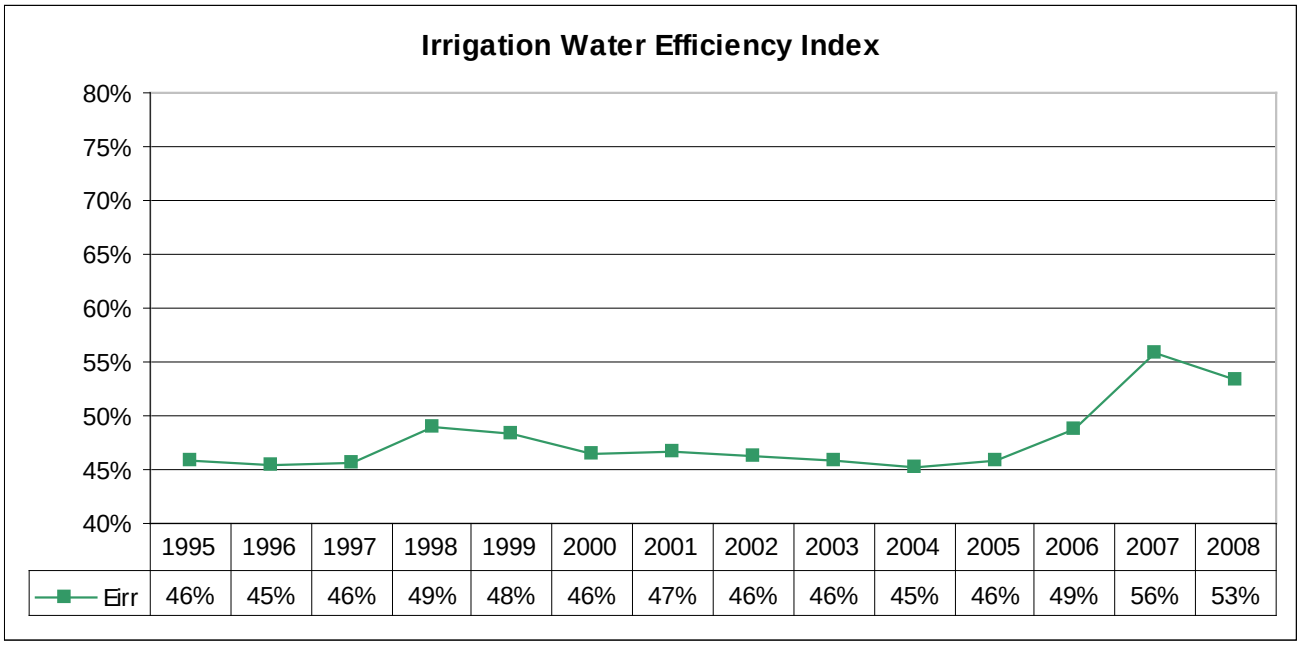
The irrigation water efficiency index can be just roughly estimated, as the product of assessed efficiency of irrigation water transport and distribution and theoretical plot irrigation efficiency. It is supposed that transport losses for small-scale irrigation systems are not too high, and that the efficiency of the water transport and distribution might be around 90%. The theoretical plot irrigation efficiencies of 50, 75 and 85% are assessed for the surface, sprinkler and localized irrigation respectively. In line with such assumptions, estimates for the irrigation water efficiency index in the analyzed period vary between 45 and 50% (Figure 5). Some kind of breakthrough in the irrigation water efficiency seems to be occurring after 2005, due to the increasing share of advanced modes of irrigation resulting from the first steps in the implementation of the NAPNAV. Significant increase of the sprinkler irrigation has been detected while the direct irrigation still remains low.

Figure 4 - Irrigation water in the period 1995 – 2008



Source: Devic, 2010

Figure 5 - Irrigation water efficiency index achieved in the period 1995 – 2008



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Eirr	46%	45%	46%	49%	48%	46%	47%	46%	46%	45%	46%	49%	56%	53%

Source: Devic, 2010

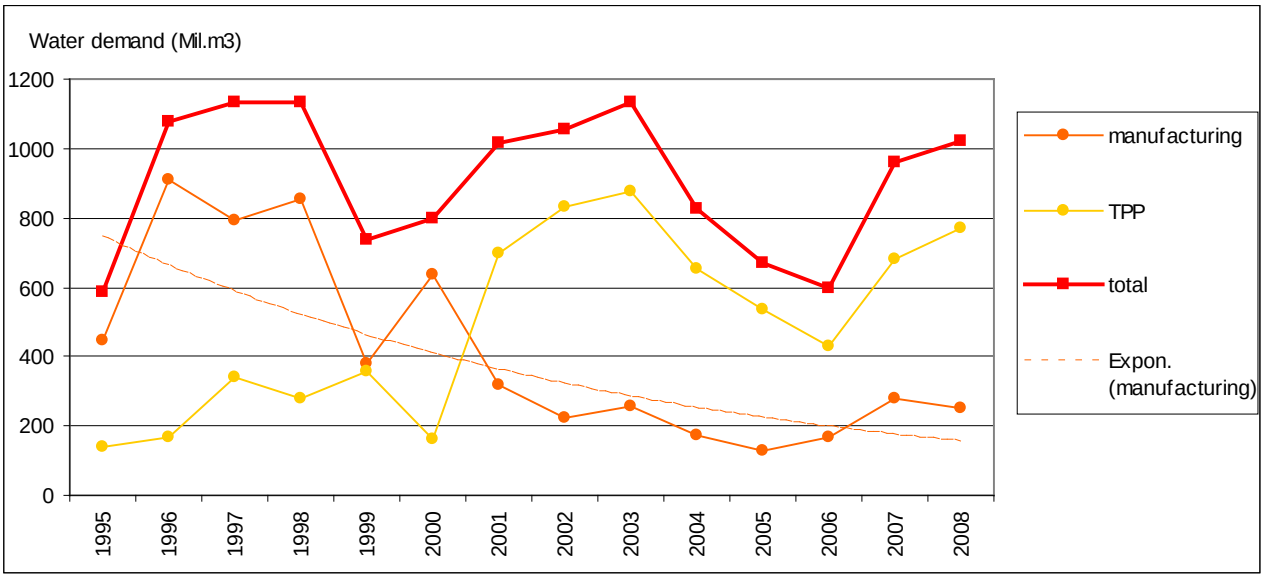
3. Industrial water efficiency

There was no straight regularity in the industrial water use in Croatia in early years of the analyzed period, due to huge changes in the volume and structure of the industrial production that were occurring as a consequence of the war and transition of the economy. The year 2000 marked the beginning of a period of certain economic stability.

For the whole period there are regular statistical reports on water supplied to industry by source (public supply systems, own intakes on rivers, lakes, reservoirs, groundwater bodies, and coastal water bodies) and water use in industry by purpose (processing, cooling, sanitary and other purposes). Data on recycled water are not separately recorded. For the calculation of the water efficiency index recycled water is estimated by a difference between gross volume used and volume supplied.

Figure 6 presents data on past water demand for two water dependent industrial sectors: manufacturing and thermo-power production (TPP). Mining and quarrying sector has not been recorded as the significant water user. According to these data, the industrial water demand has been varying in the range 600 to 1100 million m^3 annually. The water demand for the manufacturing has had decreasing trend, while the water demand for the thermo-power production used to grow in the first half of the period and got higher amounts of 400 to 900 million m^3 in the period 2001 – 2008. Since 2001 the industrial water demand has been predominantly generated by the thermo-power plants, mostly as water for cooling purposes. In the same time marine water has high share in the industrial water supply, first of all in the cooling water supply. Mostly it goes for cooling water for the thermo-power plants located at the Adriatic coast. Due to shortcomings in the current water statistics, there is no possibility for separation fresh (inland) water and marine water in terms of their gross volumes used for industrial activities.

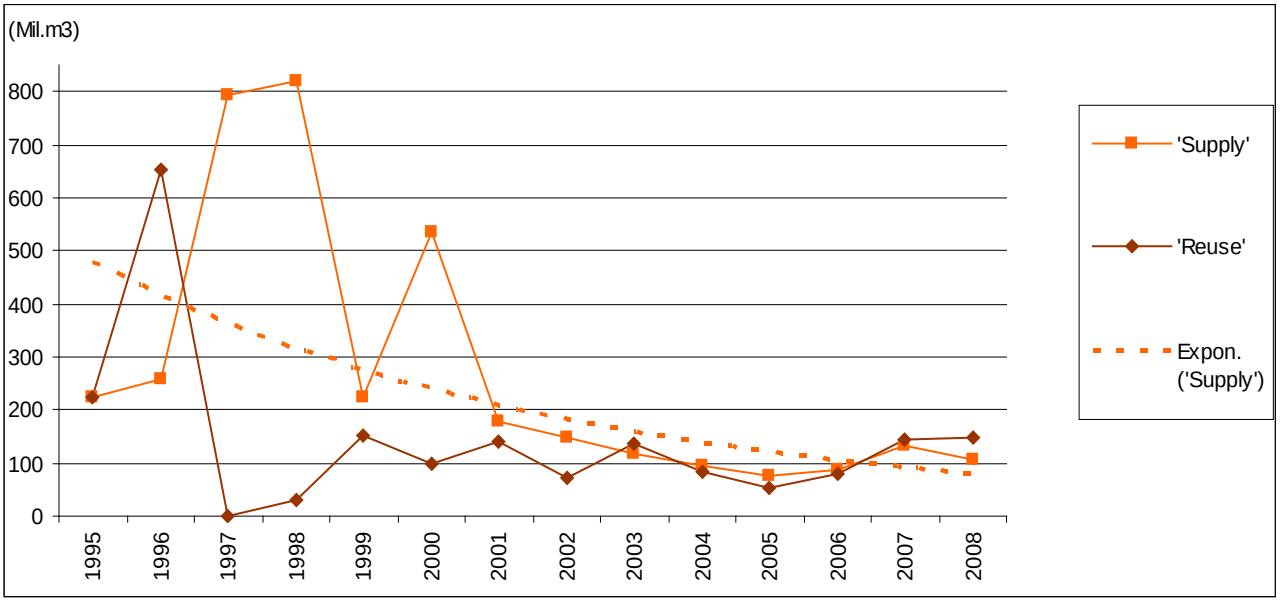
Figure 6 - Industrial water demand in the period 1995 – 2008



Source: Devic, 2010

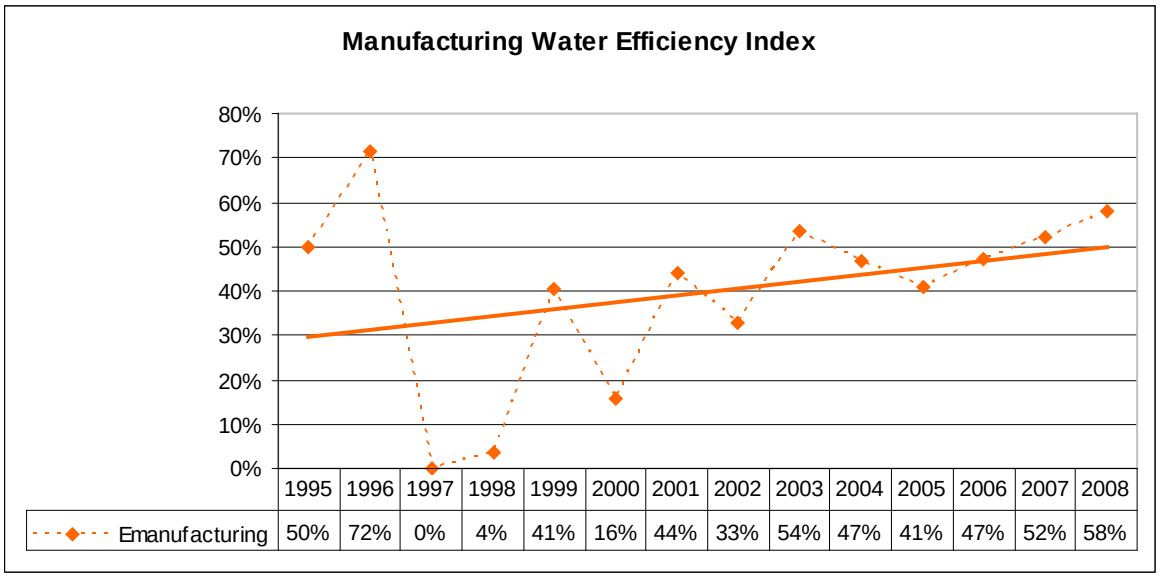
Water supply to manufacturers was reduced bellow 200 million m³ in the year 2001, and has remained under that level until now, with a minimum of about 80 million m³ in the year 2005 (Figure 7). In the same period, the volumes of water reused were almost the same. The manufacturing water efficiency index seems to have a straight increasing trend, reaching around 50% at the end of the analyzed period (Figure 8).

Figure 7 - Water for manufacturing in the period 1995 – 2008



Source: Devic, 2010

Figure 8 - Manufacturing water efficiency index achieved in the period 1995 – 2008



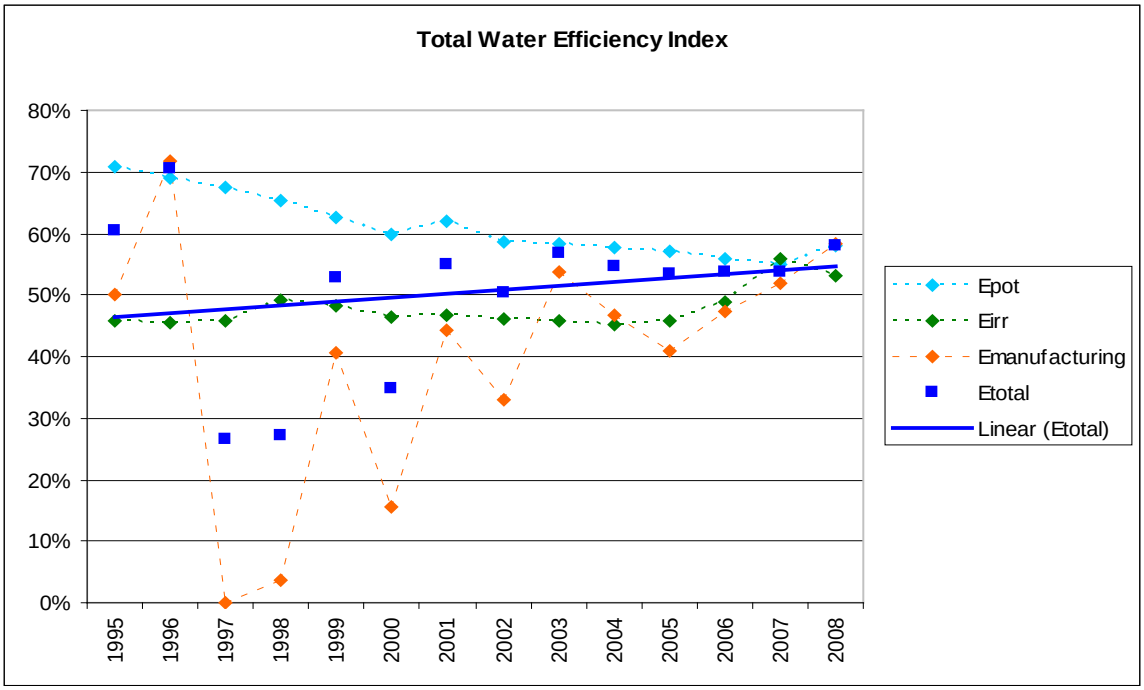
Source: Devic, 2010

4. Total water efficiency

Total water efficiency index presented below is an aggregation of weighted efficiencies achieved in the drinking water supply, irrigation and manufacturing water use. In spite of the identified data gaps and uncertainties, there is an indication of gently raising trend in the overall water efficiency in the period 1995-2008 (Figure 9). A linear trend line directs to the increase in the total water efficiency of about 10%, approximately to 55% in the year 2008. The main reason for such a narrow efficiency improvement was the drinking water supply sector, having had the opposite tendency for a long period of time.

Water use efficiency in the thermo-power production has not been taken into account when calculating the total efficiency index.

Figure 9 - Water efficiency index (total and by sector) achieved in the period 1995 – 2008



Source: Devic, 2010

5. Gaps and uncertainties

As said before, the availability and the quality of the data needed for the calculation of the water efficiency indexes are rather diverse. The following dominant gaps are noticed:

- Lack or low reliability of the data related to irrigation,
- No information about recycled industrial water nor separated records on industrial water use by water category (fresh water, marine water),
- Accessibility of official data only on the national level (usually),
- Data collected by the water management authorities not properly kept, nor reported.

Proposed measures for improvement accuracy of the water efficiency index in the future could be:

- Expand/modify National Statistical Research Program in the field of water,
- Improve data quality management,
- Increase communication and close cooperation between the CBS and the water management authorities,
- Include water management authorities, first of all Croatian Waters, in preparing some elements of the water statistics on regular and official basis,
- Intensify activities on the Water Information System,
- Initiate research projects related to the water efficiency (e.g. on plot irrigation efficiency by mode of irrigation),
- Establish a comprehensive water accounting system.

II. Improving water efficiency in different using sectors

The Strategy of Sustainable Development of the Republic of Croatia adopted in 2009 by the Croatian Parliament (OG 30/2009) has recognized the issue on sustainable use of natural resources as one of its overall objectives. It asks for drawing strategies on usage of natural resources and for establishing bases for planning human activities dependent on natural resources.

More detailed framework for acting in the field of water has been defined by the Water Management Strategy. It is based on the principles of sustainable development and integrated water resources management, which should ensure a permanent balance between usage of water resources for the improvement of human wellbeing, and protection of water and preservation of its ecological functions. Strategic directions towards the sustainable use of water resources are pointed out, especially maintenance and improvement in the efficiency of present water use systems, construction of the new systems where necessary, and reaching the consent among various water using sectors. Following general actions are foreseen:

- Preparing integrated river basin management plans, comprising assessment of water availability, as well as water supply/demand in different sectors,
- Improving research and monitoring of water resources and water uses to be able to ensure sustainable water supply for all users,
- Encouraging reduction in losses for all uses, especially in public water supply systems,
- Encouraging re-use of treated waste water for irrigation,
- Gradual introduction of economic water pricing,
- Introducing obligation of public water suppliers for paying water use charge on abstracted water quantities,
- Encouraging inter-sectoral communication when preparing plans for allocation of water resources,
- Inclusion of all interested parties and the general public in the planning process from the very initial phases.

1. Goals in drinking water supply

- Increasing the coverage of population by the public water supply by expanding the existing and construction of the new water supply systems

  Population using "local" water pipelines and individual water supply facilities (e.g. wells, tanks) will be gradually integrated into the public systems, whereby the quality of supplied water will be monitored, as well as payment of the water use charge supervised.

  Obligatory connection into the public water supply system will be regulated by special regulations.

  The water supply for islands will be ensured from the land by means of submarine pipelines (for island communities closer to the land), and by using local resources (including desalinization) or transport of water by boats (for remote island communities). Special attention will be given to the efficient use of water on the islands.

  Total cost of construction/extension of water supply facilities up to 95% supply level, with all quality standards in treatment, equipment and materials, is adjusted to 12, 6 billion kunas (1, 7 billion euros). Major improvements will be achieved in 12 years from the date of accession of the Republic of Croatia to the European Union[4], approximately until 2023.

[4] According to the National Implementation Plan of the Water Utility Directives (draft document)

- Improving management of public water supply systems by implementing institutional and technical measures

  Reorganization and consolidation of existing water companies will be carried out which will result in a significantly smaller number of companies in comparison to the current state. Distribution areas will be determined as sustainable technological and economic units for performing water services. At each distribution area, a single utility company will be established.

  Small single systems on the distribution area will be linked into regional system which will result in improving the efficiency and the certainty of the drinking water supply.

- Introducing an economic price for water in line with the user-pays principle will be gradual up until 2015

  As a consequence of the institutional and technical integrations, a single water price will be stipulated at the distribution area level. Corrections to the water price will give rise to the revenue of the utility company and, therefore, to speeding up the construction of the water supply facilities, as well as to improving the operation and maintenance of the water supply system. At the very end this will contribute to the quality and security of the public water supply on the service area.

  Finally, the gradual introduction of the economic water prices will be incentive to the rationalization of the water consumption.

- Reducing of water losses from public water supply systems to acceptable levels (15-20%)

- Improved technical and managing conditions in the public water supply sector should result in the significant reduction of water losses. This means reduction of quantities of abstracted water resources from the nature, and therefore, more efficient water use in the future, not just in terms of saving water resources, but financial resources as well. Reduction in the volumes of water produced and water delivered will likely give rise to reduction in the costs of water supply.

- Preserving quality of raw water intended for public water supply

- Meeting water demands

  The future increase in the drinking water demands will be affected by:

  – Increasing the rate of connection for the population,

  – Developmental needs in certain business sectors (first of all tourism),

  While their reduction will be affected by:

  – Declining trends in the population numbers,

  – Reducing water losses, and

  – Introducing economic water prices incentive to rationalization of water consumption (water savings).

  An increase in the rate of connection of population to the public water supply generally causes an increase in the drinking water demand. Such increase will be limited in the case of Croatia, due to unfavourable demographic trends, pointing to the reduction in the total number of population in the following decades. Decreases by 4,4% (196,000 persons) and 7,9% (352,000 persons) are expected in the periods 2005-2020 and 2005-2030 respectively[5].

  Drinking water demands in business entities might increase to some extent. Slight increases are expected in smaller industrial facilities, trading centers and craft shops, which are connected to the public water supply systems. Large industrial plants will keep on in meeting their water demands using their own water intakes.

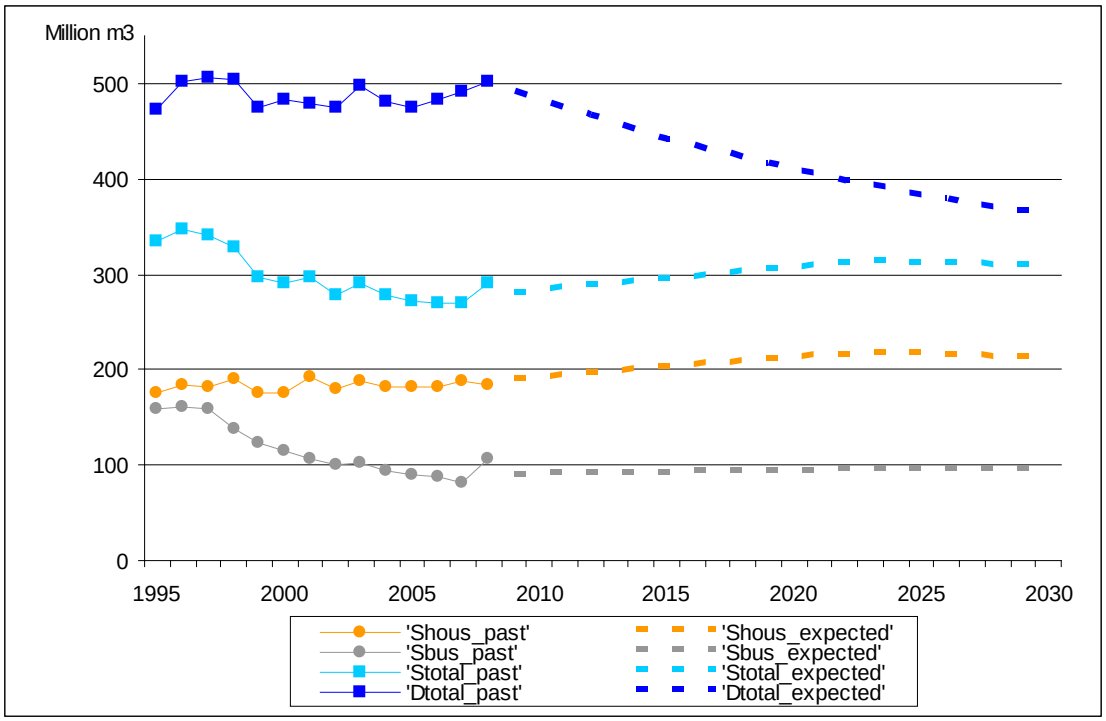
[5] Demographic projections of the Central Bureau of Statistics

A larger increase of water demands can be expected in tourism, not so much for an increase in the number of tourists but more due to achieving a higher level of tourist services. The expressive seasonality of the Croatian tourism hinders a solution of the drinking water supply on the Adriatic coast due to the large differences in seasonal and non-seasonal water demands.

Figure 10 presents rough projections of the dynamic of the future drinking water supply and demand. In spite of certain increases in drinking water supply to both, households and business entities, significant saving of water resources is expected in consequence of implementing strategic measures in the public water supply sector, first of all reducing of water losses.

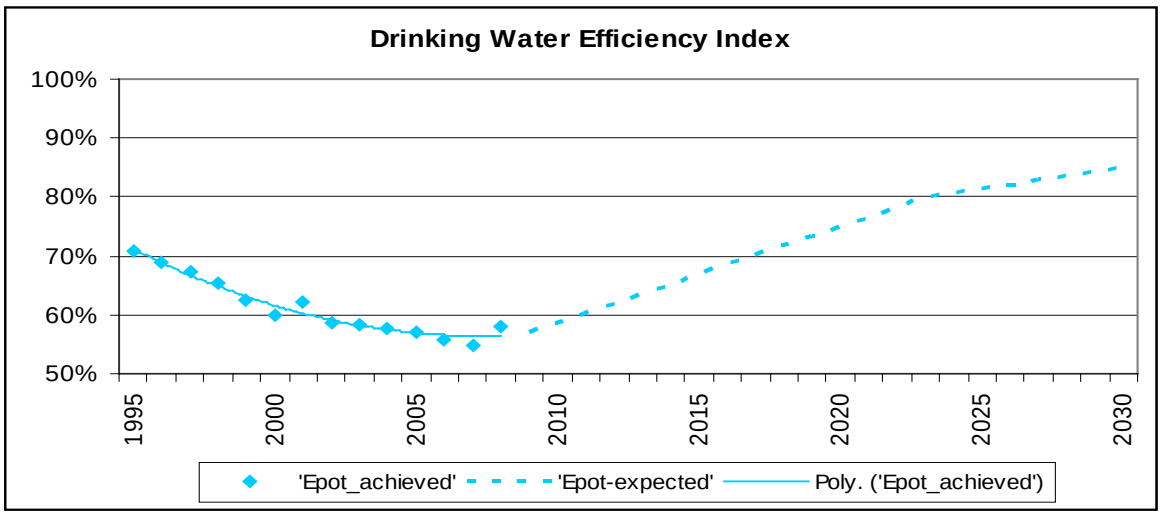
Concerning the drinking water efficiency, a gradual increase up to 85% is expected in twenty years, more intensive in the period until 2023 (Figure 11).

Figure 10 - Projection of drinking water supply and demand until 2030



Source: Devic, 2010

Figure 11 - Expected improvement in the drinking water efficiency index until 2030

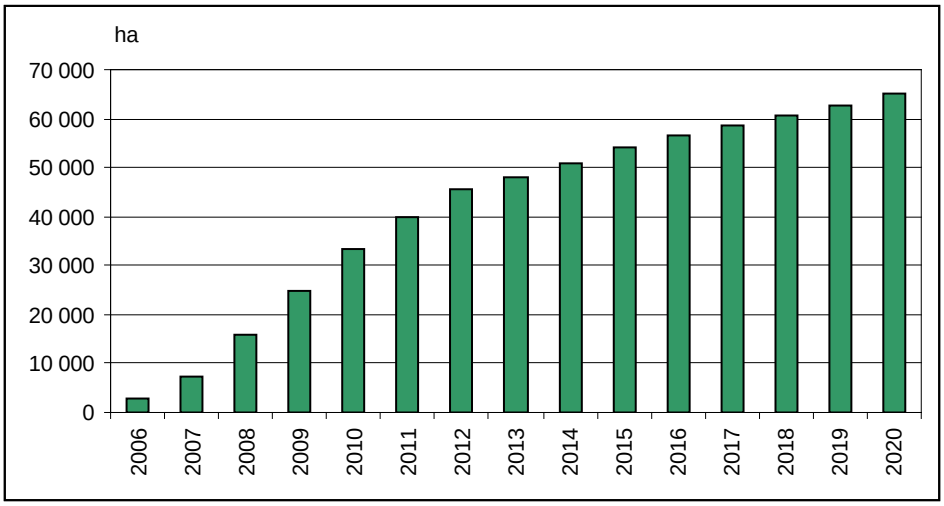


Source: Devic, 2010

Goals in irrigation sector

Extensive hydro-melioration works for both, draining of water surplus as well as irrigation, are predicted by the Strategy of Agriculture and Fishery, adopted in 2002 by the Croatian Parliament (OG, 89/2002). Renewal of existing and construction of new irrigation systems is stated as one of the strategic preconditions for improving productivity of the agricultural production. As mentioned before, a comprehensive elaboration on the issue on irrigation in Croatia is presented by the NAPNAV. According to the NAPNAV, the goal is to irrigate 65,000 ha, or about 6% of the agricultural land, by the end of 2020 (Figure 12). Agricultural areas are classified in view of their appropriateness for irrigation taking into consideration soil suitability and water availability. Two river basin districts in Croatia differ in the size of priority areas for irrigation and in technical and financial conditions for resolving water supply for irrigation. More detailed analyses are carried out on the regional (county) level.

Figure 12 - Projected dynamics of enlargement of irrigable areas until 2020



Source: Devic, 2010

Considering the small areas that are currently irrigated, ensuring ample quantities of water for irrigation becomes a priority. According to the Water Management Strategy:

- Within the Danube River Basin, increasing irrigation is based on the presumption that the structure of the agricultural production will change, and that growing of vegetables and fruit cultures will be introduced in larger extend. As supplementary measures, irrigation will also increase in some agricultural areas intended for traditional crops. A more significant incentive for irrigation will be offered by the construction of the multipurpose Danube-Sava canal, bringing water from two large rivers (first of all the Sava River) close to the fertile agricultural areas spreading in the eastern part of the basin. There is enough water in the area to meet irrigational requirements, mostly from the major rivers, but also from water storages constructed where necessary.
- On the Adriatic Basin irrigation is an ordinary measure for any successful agricultural production, as there is regular shortage of water in the soil during growing period. Demands for irrigation water are greatest during droughts and most unfavorable hydrologic periods, meaning that required quantities can be ensured only by water accumulations. There are plans for local accumulation of water during the wet season, especially on islands, by using the existing winter surplus of water at the sources and within the public water supply systems. The introduction of other non-conventional sources of water for irrigation is also foreseen, for example the use of treated waste water.

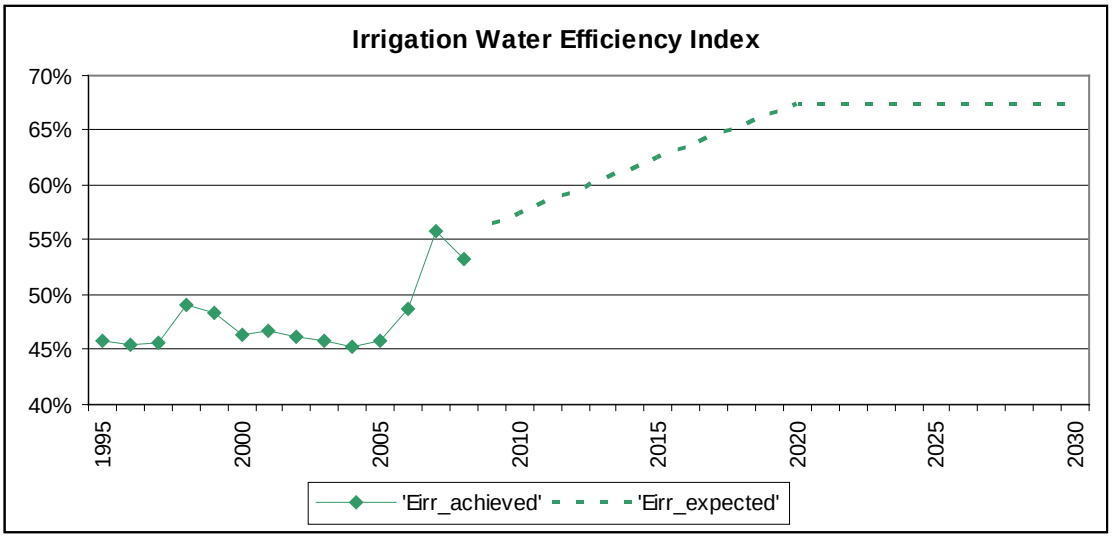
  Advanced technology and equipment has to be applied, to reduce the irrigation water demands at a minimum.

It is difficult to predict the future irrigation water efficiency as irrigation projects are not designed yet. According to the NAPNAV, Croatian Waters is in charge on issuing water permits, and monitoring water use after putting irrigation systems into operation. Also, Croatian Waters is responsible for organizing/supervising construction of water works for irrigation water supply to plots, including allocation of state subsidies for such purposes, which would cover up to 80% of investment costs of irrigation water. So, Croatian Waters has mechanisms to direct the development of irrigation in the right direction with regard to the water efficiency and water savings.

The efficiency of transport and distribution networks should be pretty high as there will predominantly be a new water infrastructure. 90% is a quite realistic assumption.

Plot irrigation efficiency will depend on the share of advanced modes of irrigation. On coastal areas, especially on islands, modern technology and equipment will be required, due to high costs of water accumulation and transport to the right place in the right time. Inland areas are not so cost sensitive as there are water sources quite near to the irrigated areas. Under some very uncertain assumptions, following irrigation water efficiency might be foreseen.

Figure 13 - Expected improvement in the irrigation water efficiency index until 2030



Source: Devic, 2010

Goals in industrial sectors

Although not quite clear, the past data indicate that water users in the industry (manufacturing) were steadily improving their water use efficiency. Such tendency could be expected in the future too, as business entities are definitely interested in reducing their production costs. Processing water and cooling water, which might be measured in large quantities, also have their cost which can be reduced by reducing volumes of water incoming to the plant. As cost of water comprises the water use charge too, proper adjustment of this charge might be an incentive for water savings in the industry. Water permits are also a practical tool towards achieving rational and efficient water use.

No specific national objectives are set for the improvement of the industrial water efficiency. At least current water efficiency level of about 55% might be expected in the future period.

III. Economic approach to water management

As said at the beginning (I.), Croatia is relatively rich with water. In spite of their unequal distribution in space and time, water resources are not found as the limiting factor of the socio-economic development of the country. Due to that fact, economic and environmental reasons, more than a lack of water resources, are main reasons for planning measures for improving water use efficiency in Croatia.

At present there are no economic analyses on the whole issue on water efficiency. Strategic decisions towards the better water resources management are already set. But individual water saving programs still have to be developed whereby potential financial savings coming from the more efficient water use should be thoroughly investigated on the case by case basis. Certain analyses have been carried out in the drinking water supply sector.

IV. Synthesis and conclusion

The latest data indicates an actual water efficiency index in Croatia of about 55% in total, with small differences among the main water using sectors. In respect to such findings, Croatia might be considered an averagely water efficient country.

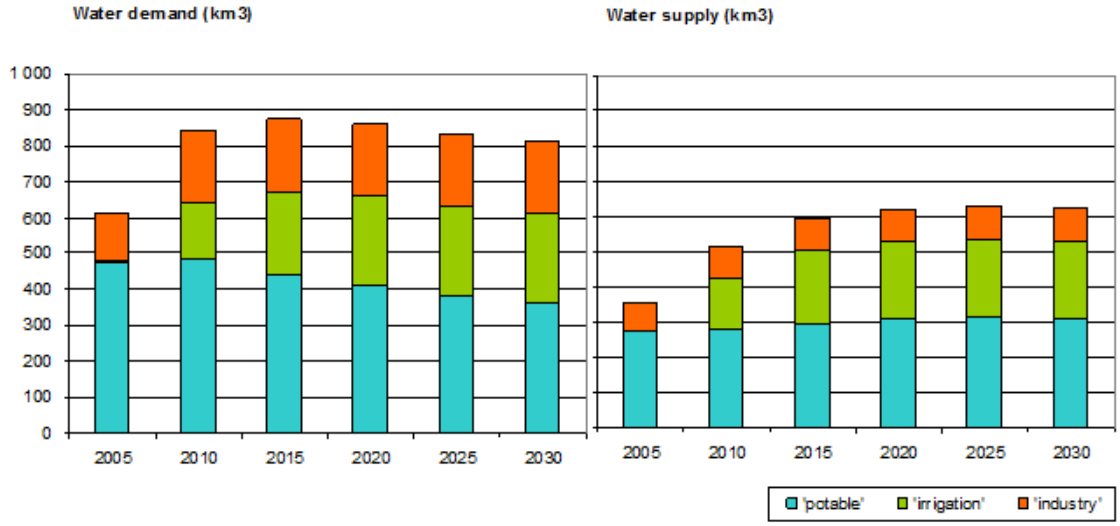
Significant deficit has been found in the drinking water supply sector that used to deteriorate its efficiency for years. The present drinking water losses, comprising leakage and every non-registered and non-charged water consumption, are amounting roughly 45%, and it seems they are reaching their top level. There are ambitious national objectives for improving sector's performances, among others for reducing water losses to an acceptable level in the range of 15 to 20%. Major improvements are expected till the year 2023, as foreseen by the Implementation Plan of Water Utility Directives of the European Union.

The past indicators on the industrial water efficiency might be considered satisfactory, first of all in manufacturing. The efficiency index has been significantly improved, and is slightly exceeding the level of 50% these years. A future industrial efficiency index cannot be positively projected. At least current level of about 55% might persist for a longer period of time.

The irrigation water use wasn't any substantial factor affecting the overall water efficiency in the past period because of minor volumes of water used for irrigation. It has been changing since the adoption of the NAPNAV in 2005 to reach a very optimistic objective of 65 000 ha of irrigated areas in the year 2020.

For economic and environmental reasons, more than a lack of water resources, Croatia is intending to implement various measures contributing to a more rational and efficient water use in the future. Their likely impact on the future water demand and water supply is presented in the two charts bellow (Figure 14). Significant changes are expected in two sectors, drinking water service and irrigation.

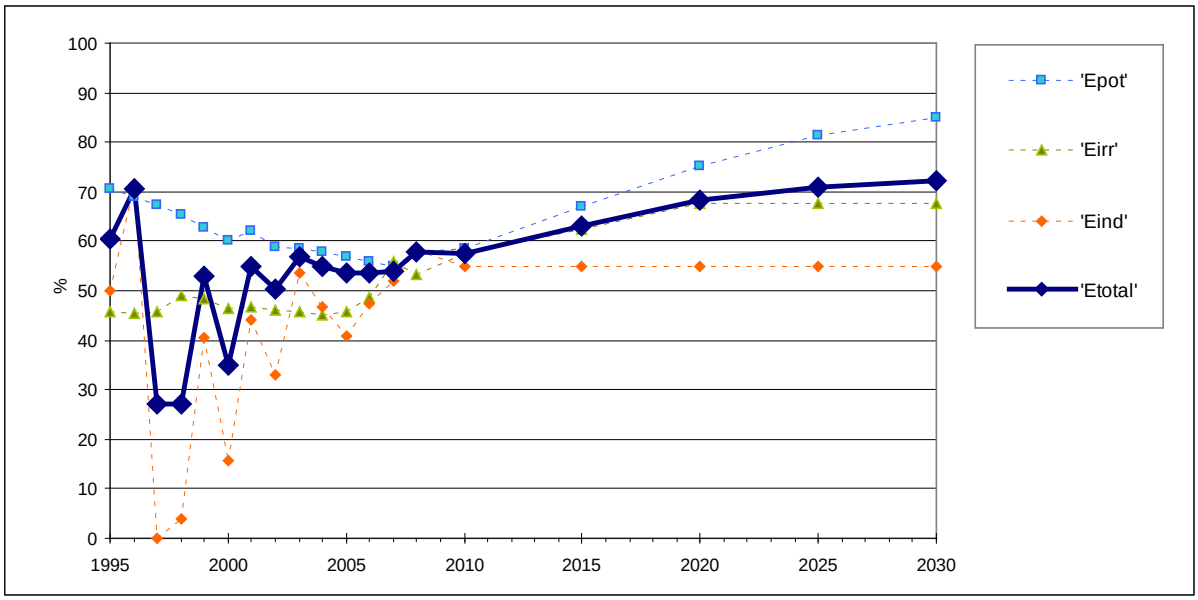
Figure 14 - Dynamic of water demand and water supply per sector



Source: Devic, 2010

Resulting water efficiencies (Figure 15) point to an acceptable long term situation. In general, water use is progressively becoming more and more efficient, especially drinking water use. According to the current national plans, a high-efficiency water use situation, characterized by an overall efficiency index exceeding 70% level, might be achieved in Croatia in some 15-years period of time.

Figure 15 - Water efficiency index, total and per sector until 2030



Source: Devic, 2010

ANNEXES

Excel spreadsheet - the questionnaire on the water efficiency index (total and by sector) providing all background details

Table of illustrations