D.T3.1.6 COMPARATIVE STUDY ANALYSING THE LOCAL SQ AND PP ASSESSMENTS RESULTS & DRAWING CONCLUSIONS ON OVERALL GAPS

Version 1

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A. Introduction

The present report is a comparative study of the main results of the preliminary self-assessments and public perception surveys carried out in the five CWC FUAs.

Each paragraph synthesizes and compares the specific results of the different involved FUAs, while conclusions point out the overall gaps, challenges, good practices and potentials related to circular water use.

B. FUA's self assessments syntesis

Each assessment is based on 44 indicators revealing the status quo at the FUA level regarding six main topics:

- Population and territorial configuration
- Natural water resources
- Infrastructures enabling the anthropic water cycle
- Water consumption
- Potential issues arising due to climate change
- Local laws and rules regulating the anthropic and natural water cycle and good practices.

The assessment required both quantitative and qualitative baseline information that help in understanding local critical issues and opportunities.

Indicators always refer to the FUA level. However, FUAs are usually not the territorial units for monitoring activities and data collection, since most of the existing data collected and published by various sources (e.g. environmental agencies and public administrations) refer to different territorial units, such as administrative areas, or areas served by a single service provider (e.g. sewage and water treatment companies). When calculating a quantitative indicator at the FUA level was too difficult or too costly given the available time and budget, i.e. the data could not be retrieved or easily reconstructed, each FUA was using an alternative procedure (described in the FUA level self assessment Manual D.T3.1.1) to get an estimate of the FUA level indicator.

In this synthesis, a sub set of 18 indicators was selected to present a general overview of the results. The selection process was based mainly on data availability and their significance for benchmarking.

B.1.Population growth trend

CWC FUAs are much heterogeneous in term of population: three clusters can be identified:

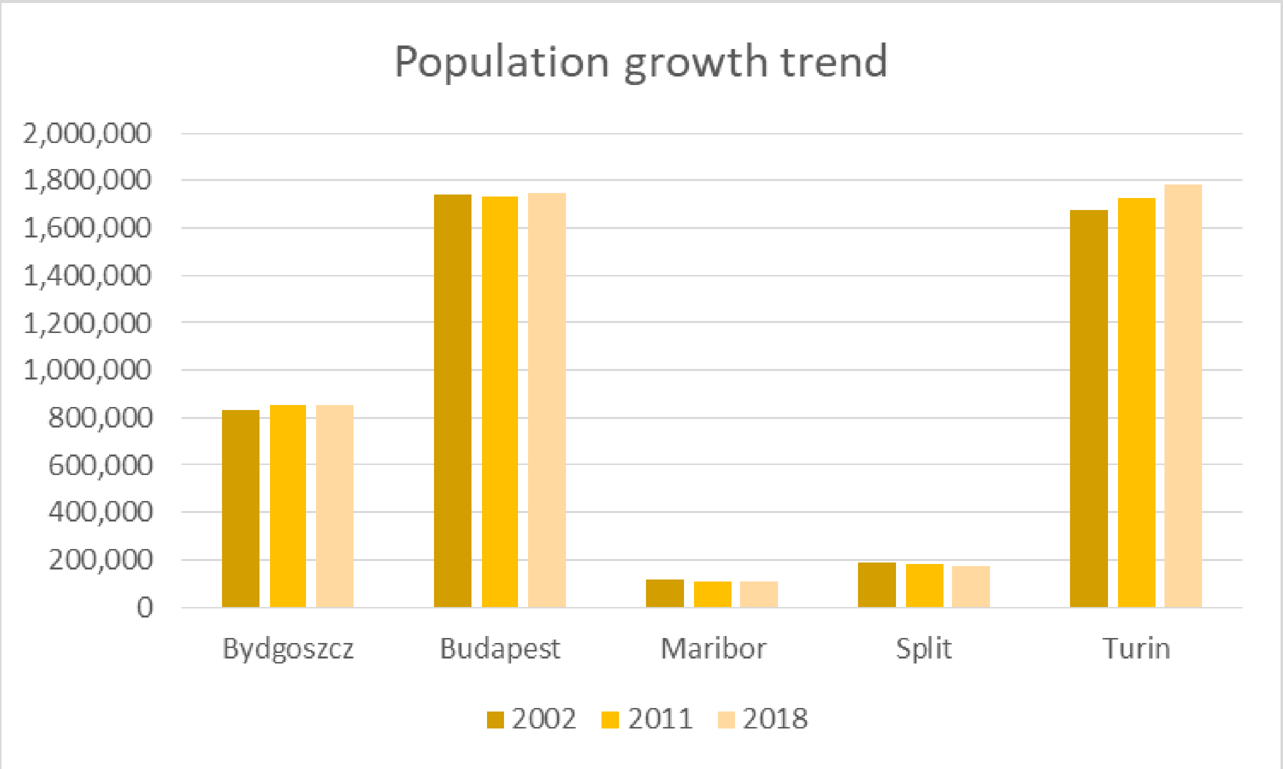
- Budapest and Turin FUAs have more than 1.5 million inhabitant
- Bydgoszcz FUA has nearly 1 million inhabitants
- Maribor and split FUAs have less than 200 thousand inhabitants

The most significant rate of increase in a recent 16 years time span was in Turin FUA (+ 6.5%) and in Bydgoszcz FUA (+ 2.9%).

Split FUA had the highest population reduction, nearly 10% in 16 years.

	2002	(2011)	2018	% growth (2002-2018)
Bydgoszcz	830,537	852,265	854,766	+ 2.9 %
Budapest	1,739,569	1,733,685	1,749,731	+ 0.6 %
Maribor	(*)	111,730	110,871	- 1.9 %
Split	189,000	178,000	170,419	- 9.8 %
Turin	1,675,419	(*)	1,784,754	+ 6.5 %

(*) NA, in the chart missing data are estimated with linear trends.

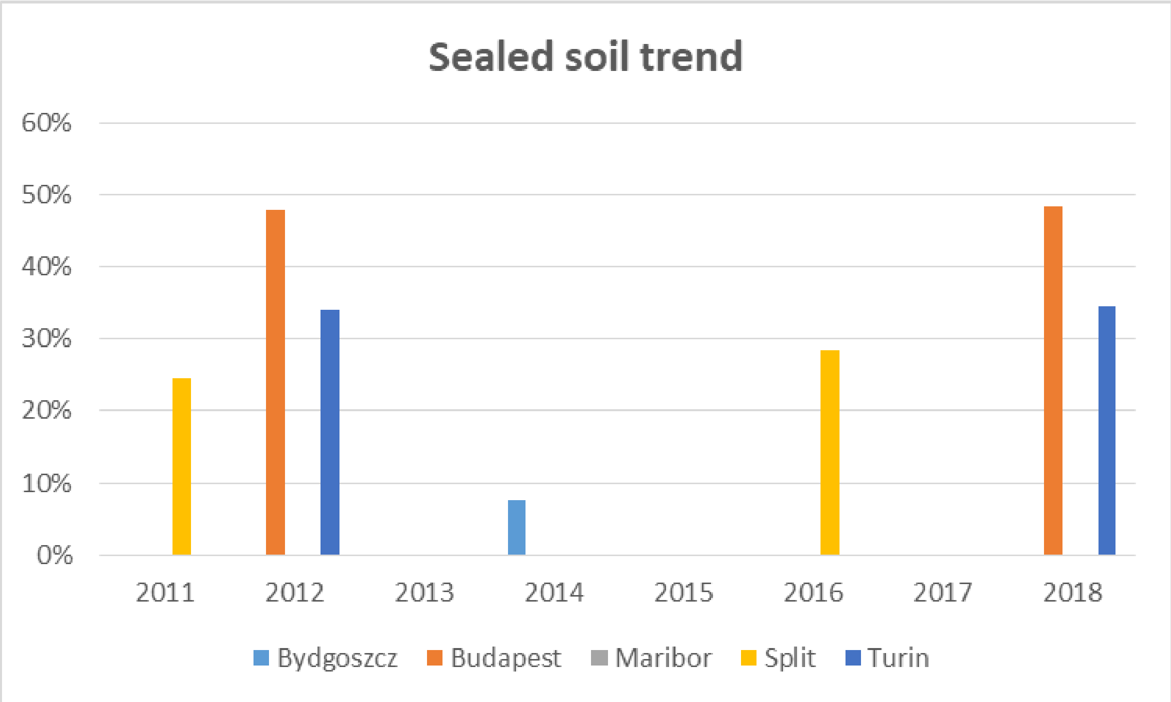


B.2.Sealed soil trend

Data on sealed soil are not available for Maribor FUA while for other FUAs they are available for different years. An homogenous trend comparison is then not possible but some information can be retrieved anyway:

- Highest soil sealing: Budapest FUA, close to 50%
- Lowest soil sealing: Bydgoszcz FUA, below 10%
- Highest soil sealing increase is in recent years:Split FUA, 15% in 5 years
- Budapest and Turin FUAs had a low (below 1%) soil sealing increase in a recent 7 years time span

	2011	2012	2013	2014	2015	2016	2017	2018	% change
Bydgoszcz	-	-	-	8%	-	-	-	-	-
Budapest	-	48.04	-	-	-	-	-	48.39	+ 0.7% (2012-2018)
Maribor	-	-	-	-	-	-	-	-	-
Split	24.63	-	-	-	-	28.46	-	-	+15 % (2011-2016)
Turin	-	34.15			34.31	34.37	34.50	34.50	+ 1.0 % (2012-2018)



B.3.Monthly precipitation

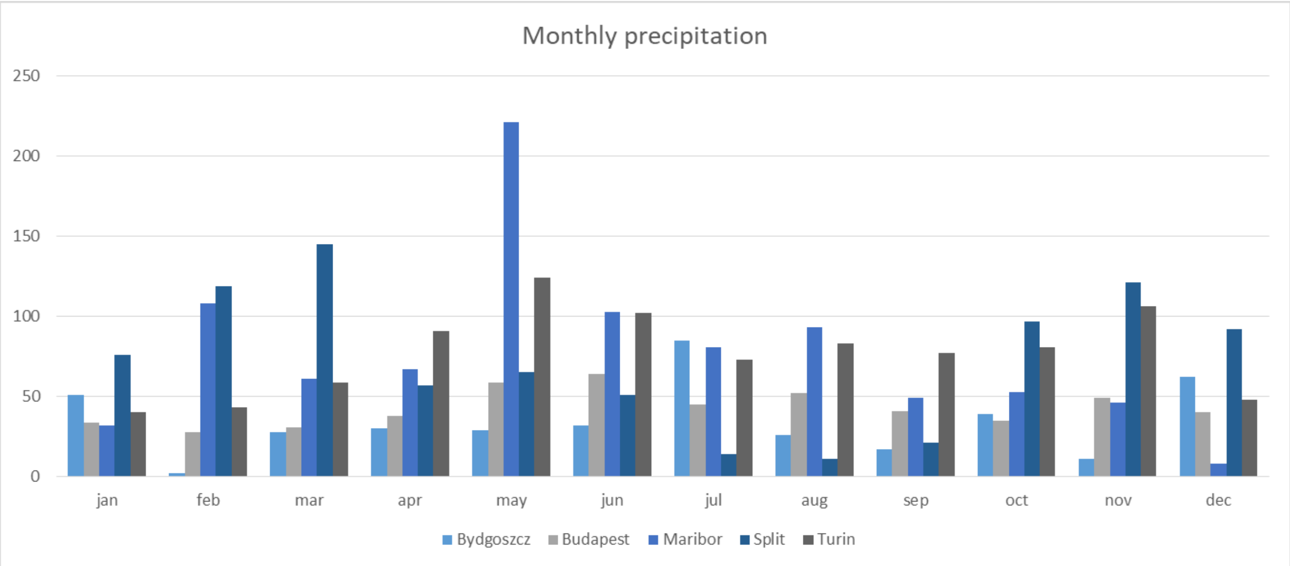
Each FUA provided data about average monthly precipitation.

Bydgoszcz and Budapest FUAs have in general the lowest rainfall that is nearly half of the annual rainfall in Turin and Maribor. In Maribor FUA a peak of more than 200 mm is highlighted in May,

The months with lowest precipitations are February in Bydgoszcz and Budapest FUAs, December in Maribor FUA, August in Split FUA and January in Turin FUA.

Summer in Split FUA has an overall low precipitation, while in the rest of the year precipitation are quite abundant.

	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
Bydgoszcz	51	2	28	30	29	32	85	26	17	39	11	62
Budapest	34	28	31	38	59	64	45	52	41	35	49	40
Maribor	32	108	61	67	221	103	81	93	49	53	46	8
Split	76	119	145	57	65	51	14	11	21	97	121	92
Turin	40	43	59	91	124	102	73	83	77	81	106	48

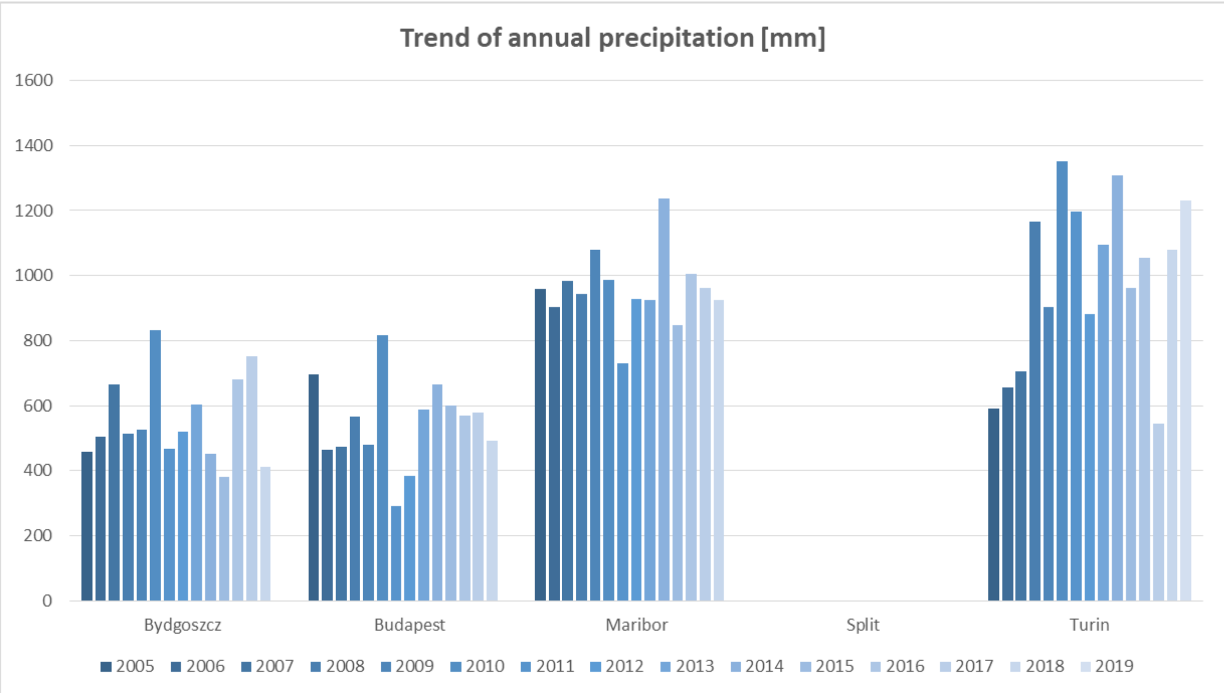


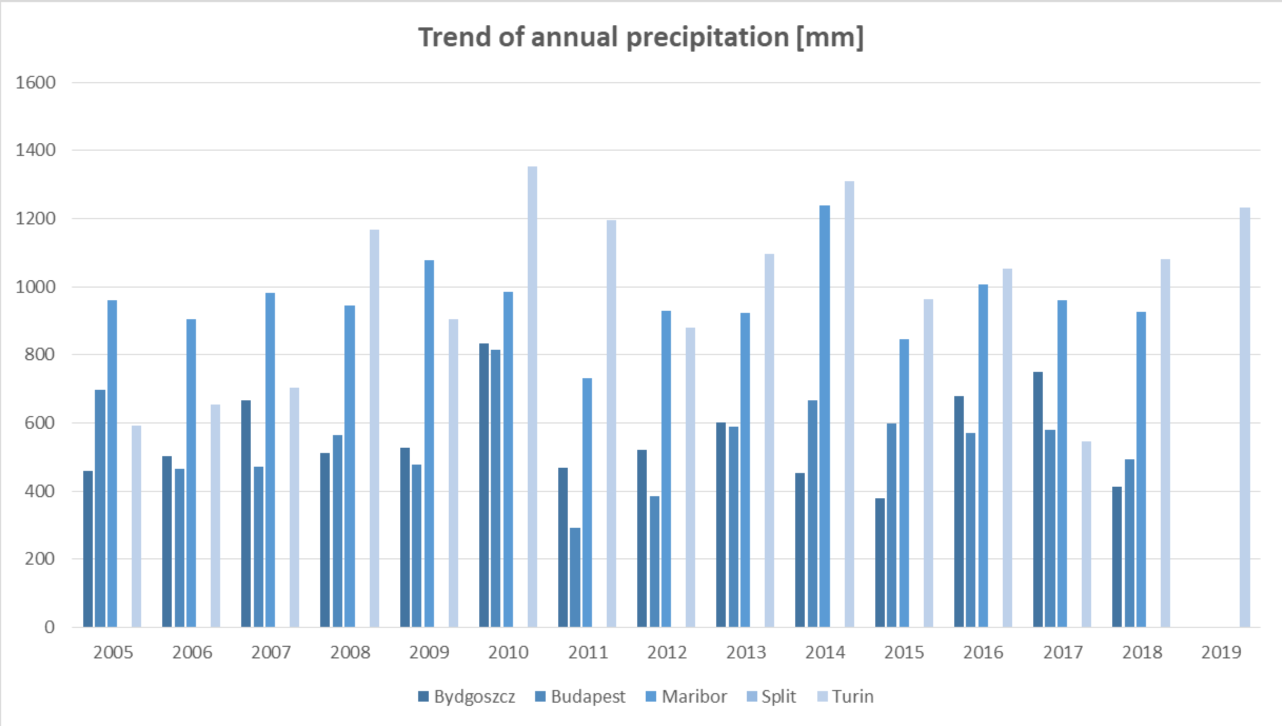
B.4. Trend of annual precipitation

The trends shows that Bydgoszcz and Budapest FUAs have an average low yearly rainfall. In some years the total rainfall is below 400 mm per year, and in 2011 the precipitation in Budapest was below 300 mm. Turin FU has the highest peaks of yearly rainfall, with 1352 mm in 2010 and 1309 mm in 2014. The precipitation in general have a 400 mm maximum variability form year to year, while in Turin this variability can be also above 600 mm.

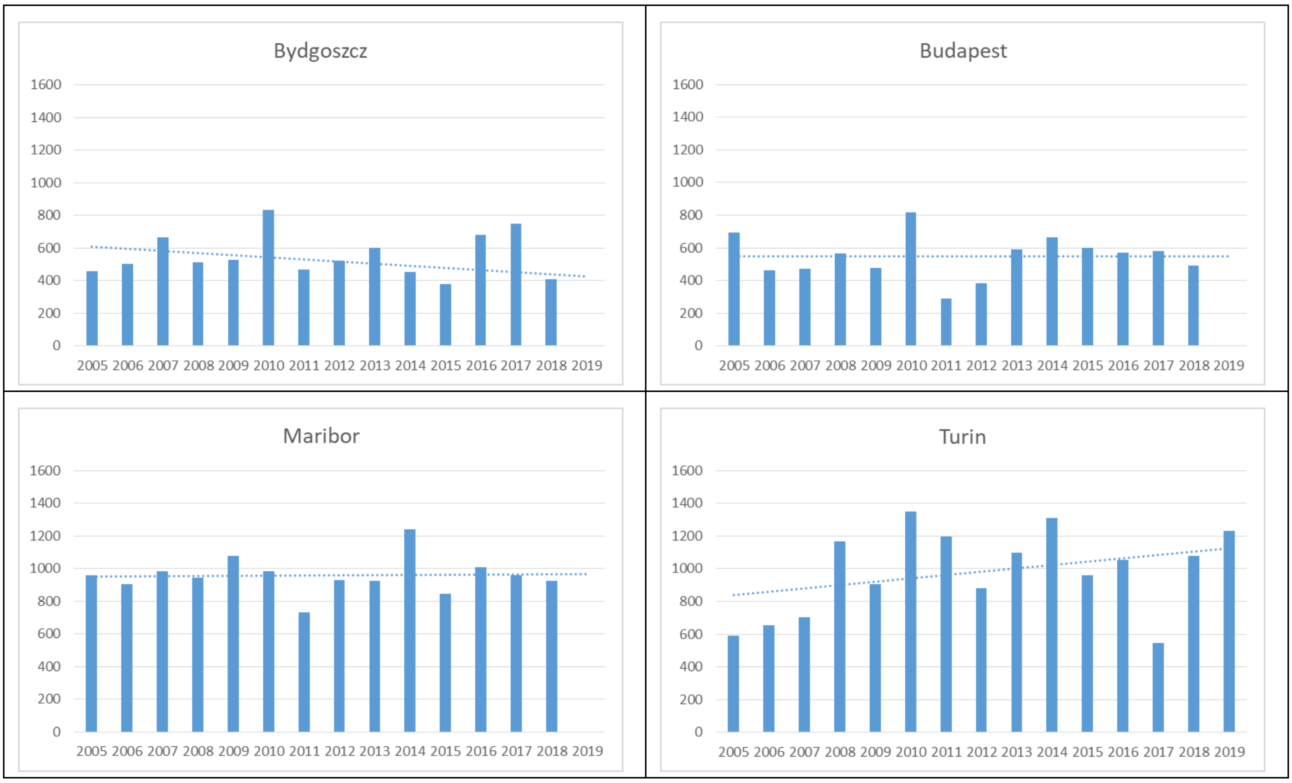
Historical trend of yearly rainfall is not available for the Split FUA.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Bydgoszcz	459	503	666	512	527	832	467	521	602	452	379	680	751	411	-
Budapest	696	464	472	565	479	815	291	384	588	665	599	569	579	493	
Maribor	959	903	982	944	1078	986	730	929	924	1238	846	1006	961	926	
Split															
Turin	591	655	704	1166	904	1352	1196	881	1096	1309	962	1054	544	1080	1231





The data shows a stable trend in Budapest and Maribor FUAs, while in Bydgoszcz FUA a decreasing trend is happening and in Turin a general increase of yearly rainfall in recorded.



B.5.List of main rivers and channels within the FUA, and their flow rate

Very important rivers run through the Bydgoszcz, Budapest and Maribor FUAs. Also Turin have many significant rivers, even though the Po river, the main Italian river, is in its initial stage in Turin. Split has much lower water flows in rivers: the most important river in Split is the Jadro, with an average 8 m^3/s flow rate.

Bydgoszcz	
Wisła	NA
Toruń	771 m^3/s
Bydgoszcz Fordon	830 m^3/s
Brda	49 m^3/s
Budapest	
Danube	1837 m^3/s
other	<1 m^3/s
Maribor	
Drava	670 m^3/s
Split	
River Jadro	8.18 m^3/s (peak in March 21.21 m3/s)
Turin	
Po (Torino)	94.39 m^3/s
Canale Cavour	87.60 m^3/s
Orco	26.28 m^3/s
Stura di Lanzo	25.59 m^3/s
Dora Riparia	24.83 m^3/s

B.6.Synthetic water quality evaluation of rivers

The quality of the water in the rivers is generally good in Bydgoszcz and Maribor FUAs.

In Turin, each river has different water quality status; in general, the quality is quite good.

The Danube in Budapest has a Poor chemical and ecological water quality.

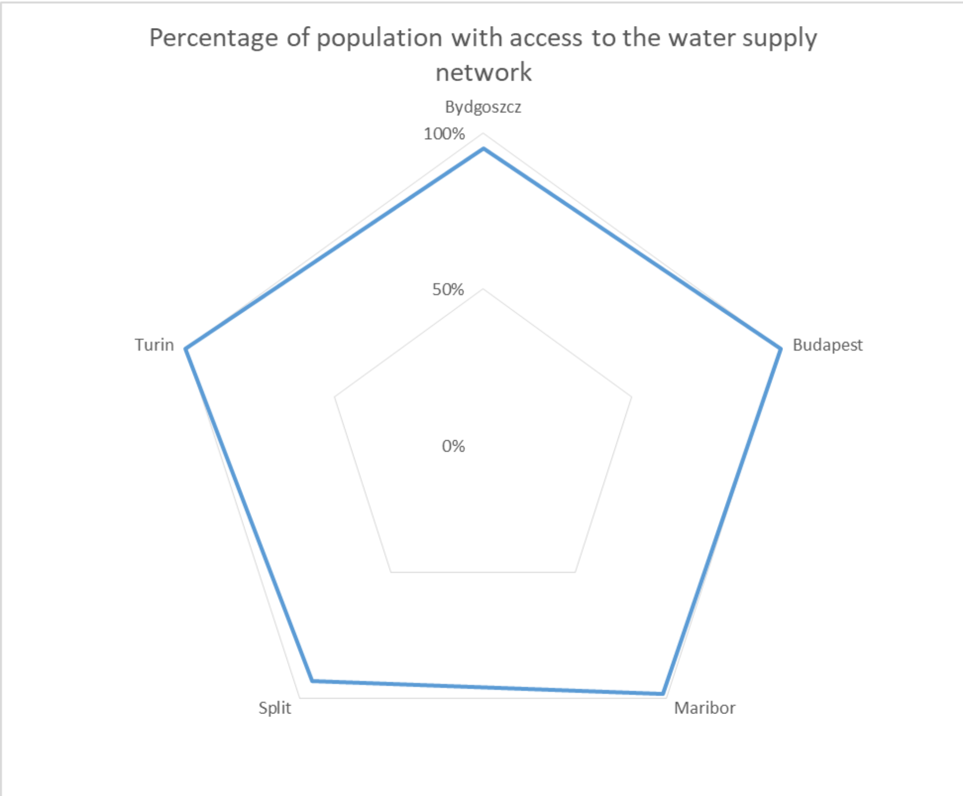
	Chemical	Ecological
Bydgoszcz	Good	Adequate, good
Budapest	Poor	Poor
Maribor	Good	Good
Split	-	-
Turin	Generally good, 2 cases of no good	Adequate, good or very good

B.7.Percentage of population with access to the water supply network

Fresh clean water is available for 100% of the population in Budapest and Turin.

In Maribor, Bydgoszcz and Split the percentage is high, form 93% to 98%, but there are still improvements to be done.

Bydgoszcz	95 %
Budapest	100 %
Maribor	98 %
Split	93 %
Turin	100 %



B.8.What kind of water purification/treatment are in use, what is planned?

Bydgoszcz
Underground water intake (Mała Nieszawka) - raw water is fed in a 1-stage system from the intake to the network through treatment in the process of filtration and disinfection. Surface water intake (Drwęca) - water from the Drwęca river intake, after preliminary mechanical purification in the intake chamber through a 1st stage pumping station, is pumped through pipelines to tanks, where the process of preliminary ozonization takes place. Then, if necessary, the water reaction (pH) is corrected. The next treatment stages are coagulation, flocculation and sedimentation, followed by filtration on open gravitational haste filters, secondary ozoneation and re-filtration (carbon filters). The end of the treatment process is water disinfection (chlorination). Water intake "Las Gdański" - The water pumped from the deep water intakes in the pipeline system is fed into a contact tank, where it undergoes aeration and degassing processes. From the contact tank it is pumped into a closed filter system via the 2nd stage pumping station. Water filtration is carried out on a system of twelve double, closed pressure filters. Each of these filters has a multilayer filter bed (anthracite, quartz sand and pyrolusite) allowing for full removal of iron, manganese and ammonia compounds from the water. The water treatment plant is equipped with a system of periodic water disinfection with sodium hypochlorite solution, prepared for use in case of incidental contamination. Before water is injected into the network, the water is disinfected with UV rays. This allows for the abandonment of constant chlorination of water fed to the city. Thus, the taste of the water is significantly improved without changing its composition and value. The water supply station "Czyżkówko" draws water from the Brda River using a shoreline intake. The task of the infiltration intake is to filter the river water naturally through the ground and mix it with groundwater resources. In the aeration hall there are 6 cascade and pipe aerators. The task of the aerators is to degasify and guarantee full aeration of water received from the artificial infiltration area before it is given to the system of 1st degree filters. I-stage filtration system consists of 14 filtration chambers each with a filtration area of 46 m2, backfilled with a 1.6 m high multilayer deposit consisting of: • the bottom layer - pyrolusite with a height of 0.4 m, • central layer - quartz sand with a deposit height of 0.9 m • upper layer - anthracite with a deposit height of 0.3 m. The water coming from the aerators is evenly distributed to the surface of each filter through a trough system. The main task of I0 filters is to remove all mechanical suspensions from the water, including Fe(III) iron compounds oxidized in aerators, and to remove manganese and ammonia from the infiltration water. The task of the ozone installation is to oxidise organic compounds in the water using ozone. Filtration is carried out by gravity through a 1.8 m high activated carbon deposit. The task of II degree filters is to remove organic compounds oxidized during the ozonisation process. The water treated on the II stage filters flows by gravity into clean water tanks. The gaseous chlorine, stored in barrels, is supplied under negative pressure to the distribution chamber, where two injectors produce chlorine water for disinfection of drinking water.

Budapest
Budapest's water supply is based on riverbank-filtrated water resources. The raw water from radial collector wells on Csepel Island needs to be treated to reduce the iron and manganese content. The wells on other water bases such as Szentendrei Island or Margaret Island produce water with so good quality that only disinfection is required to maintain microbiological stability. For disinfection, either UV radiation or chlorine can be used. Since UV radiation as well as O3 (ozone) treatment have only on-site effects, chlorine usage is widespread to avoid secondary pollution from the distribution network. The Budapest Waterworks tries to minimise the chlorine usage with an innovative operation system to meet the public health requirements and lower the amount of residual chlorine in all parts of the distribution system at the same time. The optimisation of the location and dosage of chlorination can ensure the same quality regardless of the daily and seasonal changes in water consumption.
Maribor
Natural way - Iron and manganese are extracted from water by oxidation and filtered by sand filters. Once a year, for two weeks in summer months, we perform preventive disinfection of the water supply system with chlorine gas.
Split
Croatian Waters co-financed drinking water disinfection facilities at the spring of the Jadro river. The existing chlorination system was based on gas chlorine (Cl2). Due to problems with the merging of new bottles, increasingly stringent handling measures have raised the question of its acceptability. Therefore, in Water supply and Sewerage LTD Split, decided to start installing new technology for disinfected water, using sodium hypochlorite (NaOCl), a method of membrane electrolysis from fresh water and tableted salts. Here it is important to recharge that hypochlorite, such as yarrow salt, is practically harmless, produces on-site hypochlorite, and the device is flexible and adapted to the current needs of the system (of course, with the necessary reserves in the capacity of the produced hypochlorite). It was purchased with two electrolysis devices, operating in 1 + 1 mode (working + spare), and the size and importance of the area located in the Jadro are absorbed by water (supply of Split, Solin, Kastela and Trogir). A test run of the devices has been completed, tuned with each parameterization required, so that the full operational drive of the new devices is expected after consumption of current gas chlorine supplies.
Turin
Over the years, SMAT has built drinking water plants for almost all types of pollutants, namely: • pollutants of natural origin: arsenic, iron, manganese, ammonia, sulphates, odorous substances, natural organic substances, microorganisms such as algae, bacteria, protozoa; • anthropogenic pollutants: nitrates, organic micropollutants such as chlorinated compounds, aromatic compounds, pesticides and related metabolites. 93 drinking water plants are currently in operation (some plants simultaneously remove several pollutants) which can be classified, in relation to the complexity of the process adopted, in categories A1, A2 and A3 on the basis of Legislative Decree 152/2006 and subsequent amendments.

The processes adopted by SMAT to guarantee the quality of the water supplied to users are as follows: aeration, chemical oxidation with chlorine, chlorine dioxide or ozone, clarification and precipitation, filtration on sand or on exchange resins, reverse osmosis, ultrafiltration, adsorption on activated carbon and other materials, disinfection with hypochlorite, chlorine dioxide and ultraviolet.

Almost all the water withdrawn by SMAT for drinking purposes is subjected to at least disinfection treatment to maintain the microbiological quality in the distribution networks. This process occurs mostly through the use of sodium hypochlorite and, in some cases, chlorine dioxide or ultraviolet (UV) radiation. About a third of the water withdrawn must also undergo drinking water treatment for the removal of chemical pollutants.

For groundwater, other types of processes have been added to traditional sand and activated carbon filtration systems in recent years: among the main innovations in the field of water treatments we mention the use of granular ferric hydroxide for the removal of arsenic, while for surface waters the adoption of membrane treatments, which are preferable also in consideration of the effects on the quality of the resources expected due to climate change.

B.9.Tap water quality - lab test results

Each FUA provided lab test results of the tap water quality.

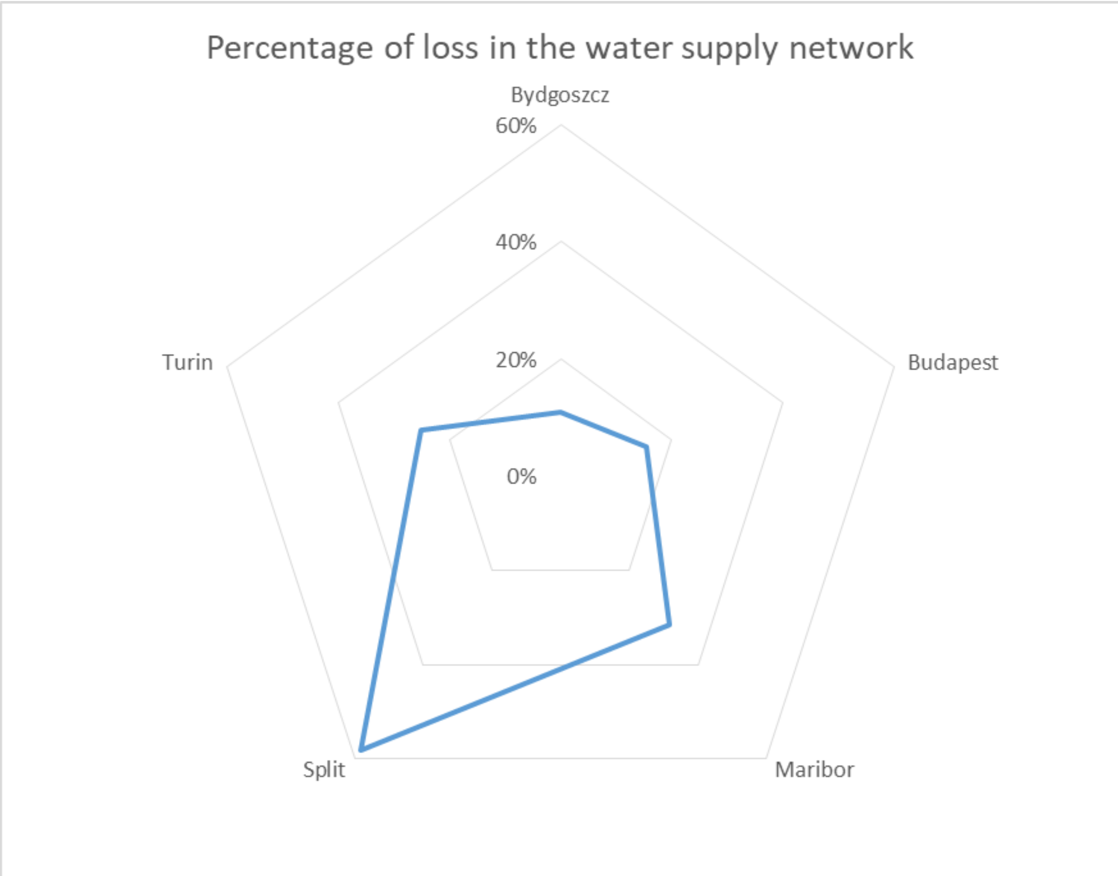
		Bydgoszcz	Budapest	Maribor	Split	Turin (*)
PH	[-]	Min 6.9 Max 7.9	7.6	7,5	7,29	7.7
Fixed residue	180°C[mg /l]	-	-	-	-	316
Hardness	[°F]	Min 151 Max 412	139 mg/l CaO	15,9	-	23
Conductivity	[µS/cm a 20°C]	Min 263 Max 999	465	516	426,29	415
Calcium	[mg/l]	Min 71.2 Max 122	-	70	-	67
Magnesium	[mg/l]	Min 7.1 Max 26.2	-	17	-	14
Ammonium	[mg/l]	Min <0,025 Max 0.4	<0.04	> 0,013	0,019	<0.05
Chlorides	[mg/l]	Min 5.29 Max 231	25	27	18,42	19
Sulphates	[mg/l]	Min 2.6 Max 245	-	25	12,18	42
Potassium	[mg/l]	-	-	-	-	2
Sodium	[mg/l]	Min 6.65 Max 174	-	15	-	9
Arsenic	[mg/l]	Min <0.0005 Max <0.05	1,3	-	-	<1
Bicarbonate	[mg/l]	-	-	-	-	237
Residual chlorine	[mg/l]	-	0.2	0,0	0,32	0.1
Fluorides	[mg/l]	Min 0.14 Max 0.46	-	<0,2	-	<0.10
Nitrates	[mg/l]	Min 0.07 Max 31.7	8,8	14	2,89	17
Nitrites	[mg/l]	Min <0.006 Max <0.066	<0,03	<0,007	0,01	<0.05

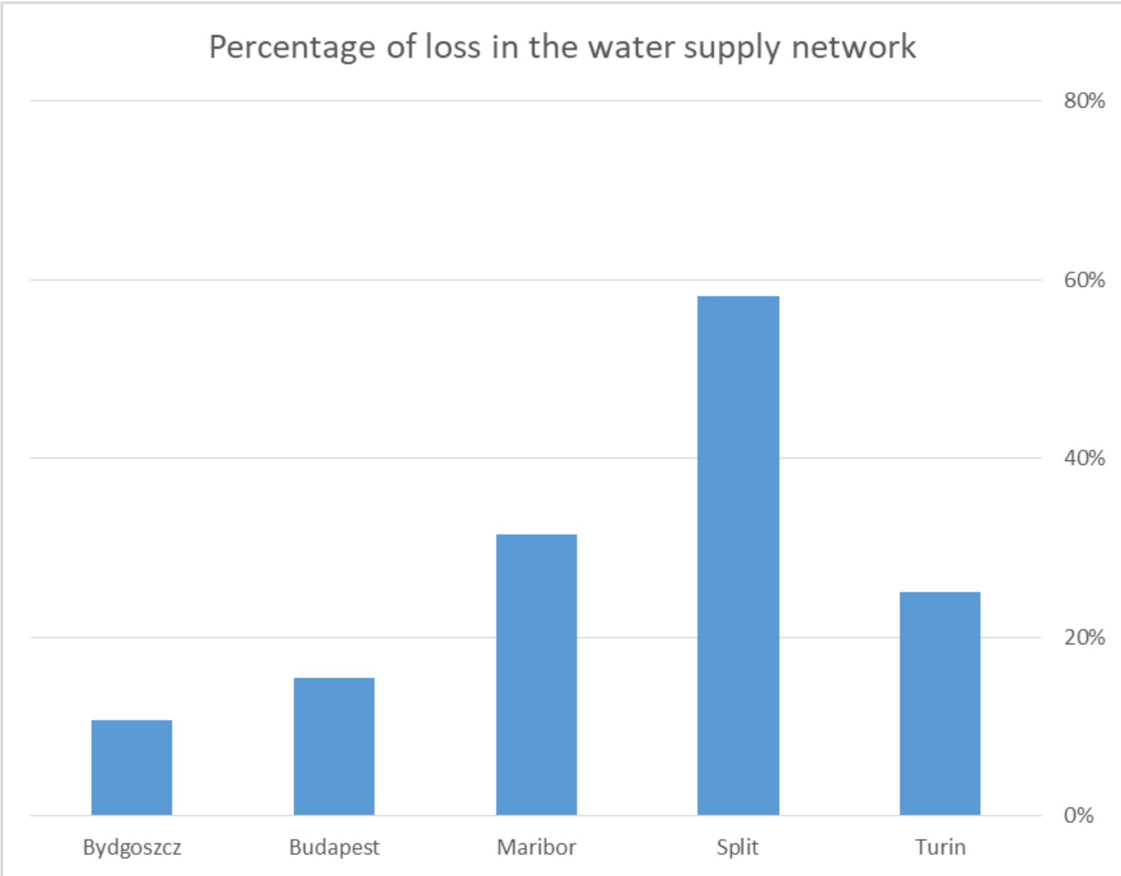
(*) Turin provided lab test results for 89 cities in the FUA, here the result for Turin city are reported

B.10. Percentage of loss in the water supply network

Water loss in the water supply network is a relevant issue especially in Split, where almost 60% of the water is lost due to pipe leaks. In Maribor and Turin the network requires important maintenance since the percentage of leaks are still high. Bydgoszcz and Budapest show the lowest level of leaks: this values around 10-15% are not far from the best performance achievable.

Bydgoszcz	10.7 %
Budapest	15.5 %
Maribor	31.5 %
Split	58.2 %
Turin	25 %




Percentage of loss in the water supply network
80%
60%
40%
20%
0%
Bydgoszcz
Budapest
Maribor
Split
Turin

B.11.Description of eventual dual system wastewater collection network within the FUA

Information about the dual system wastewater collection network are available for Budapest, Split and Turin. The dual system is well developed in Turin and partially developed in Budapest. In Split currently no dual system is present, but a future development in some part of the FUA is expected.

Bydgoszcz
-
Budapest
Mostly in the uptown districts of the capital there is a separated pipe system for rainwater and wastewater collection. In central areas rainwater and wastewater is collected by the same network and transferred to the wastewater treatment plants.
Maribor
-
Split
On the FUA Split area there is sewerage system that is mostly made for combined type of sewer, on some parts it is envisaged to modify and build a dual sewerage system for wastewater and rainwater.
Turin
The sewage system is the complex of works with which part of the rainwater (white) and domestic and industrial (black) wastewater are treated. In order to optimize the treatment of waste water, these are divided into two separate dedicated networks; in this way the dilution of black water (which makes the purification processes more expensive) and unnecessarily "dirty" rainwater (which by its nature is little polluted and requires simpler treatments) is avoided. The sewer has a development of 9.526 kilometers of municipal networks, white, black and mixed, corresponding to 4.2 meters per inhabitant served.

B.12.Qualitative description of the first flush rainwater collection technique implemented, if any

Information about the first flush rainwater collection technique are available for Bydgoszcz, Budapest and Turin.

Bydgoszcz
In Bydgoszcz, rainwater outlets to the river (79 pcs.) Are equipped with sewage treatment consisting of a settling tank and a separator of oil derivatives. Rainwater discharged into the river may not exceed the following parameters: - total suspension - 100 mg / l - petroleum substances - 15 mg / l
Budapest
In practice, there is no separation of first flush rainwater. The collected water goes through the same system whether it falls in the beginning of a precipitation event or not. On the area where CH pollution can occur, for example car parks over 25 parking spaces or loading areas, oil (CH) separators or filters should be installed. Most common equipment is the underground filtering tanks, but separators built in gully or filter substrate channels are also in use. Example of filter substrate channel: commonly used equipment / filters. efficiency of treatment: - Total suspended solids (TSS): 99,5 % - Total petroleum hydrocarbons (TPHs): 99,9 % - Zn: 99,8 % - Cu: 99,8 %
Maribor
-
Split
-
Turin
Art.8 bis of the Environmental Energy Annex to the City of Turin Building Regulations stipulates that for new construction and major renovations it is mandatory to store and reuse for irrigation purposes of meteoric waters, in the minimum measure of 10 litres of accumulation per sqm of green areas. With the Regional Law N.1/R of 20/02/2006, specific treatment and delivery of first-time water relating to certain production activities is provided in the public sewer.

B.13.List of wastewater treatment plants and their population equivalent capacity

Every FUA provided information on their wastewater treatment plants and their population equivalent capacity.

FUA	City/town	Total treated load (i.e.)
Bydgoszcz	Bydgoszcz	651,063
	Toruń	447,000
	Nakło Nad Notecią	53,695
	Koronowo	20,823
	Nowa Wieś Wielka	16,800
	Kowalewo Pomorskie	10,100
	Szubin	9,717
	Łabiszyn	9,400
	Obrowo	6,147
	Wielka Nieszawka	5,333
	Czernikowo	4,492
	Lubicz	4,000
	Zławieś Wielka	3,500
	Łubianka	3,300
	Sicienko	1,500
	Chełmża	739
Budapest	Budapest Central Wastewater Treatment Plant	1,633,333
	Northern Pest Wastewater Treatment Plant	1,333,333
	Southern Pest Wastewater Treatment Plant	300,000
Maribor	Aquasystems	195,000
Split	Treatment plant Katalinića brig	110,000
	Treatment plant Stupe	135,000
	Treatment plant Duilovo	5,000
Turin	Castiglione T.se	1,931,129
	Collegno	168,246
	Rosta	84,729
	Pinerolo	91,722
	Chieri	54,135
	Feletto	54,820
	Pianezza	53,176
	S.Maurizio C.se	38,611
	Chivasso	28,487
	Carmagnola	27,778
	Ivrea	24,899
	Giaveno	22,350
	Cavour	19,277
	Nole	17,583
	Valperga	17,472
	Mazzè	16,568
	Oulx	13,213

B.14. Annual volume of waste water treated by the wastewater plants

Every FUA provided information on the wastewater volume treated by their plants.

Bydgoszcz	36 millions m^3/year
Budapest	154 millions m^3/year
Maribor	9 millions m^3/year
Split	31 millions m^3/year
Turin	358 millions m^3/year

B.15. Annual volume of freshwater extracted from the ground, surface water, and other sources.

Every FUA provided data on the total amount of water distributed yearly. Only Bydgoszcz and Turin have information about how the total amount is collected from different sources. In Bydgoszcz the water is extracted from the ground, from surface water bodies or from other sources with similar shares. In Turin groundwater is by far the prevalent source of fresh water.

	Groundwater	Surface water	other		total
Bydgoszcz	17.6 million m^3	18.6 million m^3	10.6 million m^3		46.8 million m^3
Budapest	-	-	-		166 million m^3
Maribor	9.5 million m^3	-	-		9.5 million m^3
Split	-	-	-		55.7 million m^3
Turin	125,8 million m^3	31,4 million m^3	20 million m^3 (Springs)		177.2 million m^3

B.16.Daily volume of freshwater used by each person for civil uses

This indicator shows a strong variability in the FUAs. In Budapest the daily use of water is extremely high as well as in Turin. In those cities, water saving communication campaigns seem to be extremely needed to lower water waste. Bydgoszcz and Maribor provided much lower value of the indicators.

Bydgoszcz	98 l/day per capita
Budapest	190 l/day per capita
Maribor	114 l/day per capita
Split	150 l/day per capita
Turin	171 l/day per capita

B.17.Percentages of water used by the civil, industry, and agriculture sectors

This indicator is available only for Bydgoszcz, Maribor and Turin FUA. The values are very heterogeneous: in Bydgoszcz the water used for agriculture is extremely significant compared to other FUAs, while Maribor has the highest percentage for Commercial and industrial use. Turin declare nearly 80% of water used for domestic purposes.

	Domestic	Commercial and industrial	Public	Agricultural and breeding	Other
Bydgoszcz	40,9 %	10,1 %	12,6 %	36,3 %	
Budapest	-	-	-	-	-
Maribor	67 %	21 %	11 %		
Split	-	-	-	-	-
Turin	79.12 %	13.61%	5.83 %	1.35 %	0.09 %

B.18.Description of the issues, if any, raised by climate change

All FUAs are well aware of the potential issues raised in their territories by climate change and are developing strategies to overcome them. Potential issues are peculiar in each territory, especially Split, the only CWC FUA near the sea will tackle issues related to the fisheries and the expected sea level rising. Maribor FUA declares not to expect strong impact by the climate change, nevertheless is very active in tackling climate change.

Bydgoszcz
• Increase in value and number of days with maximum air temperature, • Increase in the length and frequency of heat waves, • The growing phenomenon of urban heat island, • Increase in the frequency of high intensity and short duration rains, • Flood hazard from rivers, • The phenomenon of drought resulting in water shortages in the region, • Landslides, e.g. caused by heavy rainfall, in areas at risk of mass movements, • Concentration of air pollutants and occurrence of winter smog, • Increase of frequency of thunderstorms with strong winds them.
Budapest
• Floods on Danube – flood protection – flood risk management • Critically low water level on Danube • Rising temperature - Heat island effect • Heavy rainfalls - Sewer overloads - flooding
Maribor
Climate change adaptation is for Maribor not just one topic, it is a topic that is a conglomerate of tackling different issues, such as mobility, waste management, air quality, energy efficiency and more, and this is what the city is currently doing and over the last years The city has a decree on the Air Quality Plan in the Municipality of Maribor that defines measures in three main areas: energy, transport and the support area of information and awareness. The city does not face challenges with droughts, flooding or other, that are the consequence of climate change, but this still that does not mean that the city is neglecting these topics. When, approx. every 5 years in the summer, is a day that brings a lot of rainfall, it could happen that the sewer system is overloaded and water can, at that moment, overflow. To address this issue the city and the public company Nigrad are investing in the expansion of the sewerage system, but still this is not a prevalent problem for the city, since the Maribor region is the area of Dravsko polje, that is mainly on gravel pebbles and the water drains into the groundwater.
Split
In light of climate change, the Functional Urban Area of Split records significant changes that will affect not only the lives of residents but also the economy, especially tourism. The number of days in the city of Split increased by an average temperature of 27 ° C from less than a year in the 20th century to 14 days in the 21st century. As a result, the city of Split is warmer by 1.3 ° C. According to the lecture of Dr. Ivica Vilibić, Scientific Advisor for the Institute of Oceanography and Fisheries, there is a possibility and an estimate that the sea level could be raised by half a meter by 2100. This estimate would significantly affect the population of the city of Split as well as tourism itself as a key economic branch in the form of rising sea levels and the increasing frequency of floods in the Riva

and Diocletian's cellars (key tourist sites in the city of Split).Climate change will also affect other industries that are vital to the FUA Split area. In the midst of longer and more frequent droughts (especially in the summer), there will be an increase in the need for water in terms of irrigation and a shortening of the vegetation period with a lower yield of all crops in agriculture.In the midst of reducing the availability of water caused by climate change, hydropower problems can potentially be caused by extreme hydrological conditions, droughts and floods. The aforementioned problem will also be affected by unfavorable rainfall distribution (lower availability in summer, higher availability in winter).This increase in temperature will also affect fisheries. A potential problem is the disappearance of some of the fish species as well as the reduction of freshwater fish. An increase in sea temperature or an increase in sea acidity in some areas will make it impossible to grow shellfish.
Turin
In 2018 Arpa Piemonte prepared the climate vulnerability analysis for Turin. The study highlights the rapidity with which local weather events are responding to global warming and indicates the forecast trend for the coming years. From this analysis it emerges that in the city environment the main climatic risks identified are heat waves and intense precipitation events. In parallel, the possible impacts were assessed, caused by the greater intensity and frequency of extreme events, on various areas: quality of life, socio-economic system, health, air quality, urban green, transport infrastructures, industrial processes, management of rainwater, etc. In the FUA context, the risk associated with drought and the scarcity of water resources should not be underestimated. The specific climatic challenges for the city concern the need to make the city fresher and livable even during a heat wave event and the city safer and able to manage the waters during extreme meteoric events.

C.FUA’s public perception syntesis

C.1. Habits

In all the FUAs, interviewees declared general good habits in using water within the household. The good habit of turning off water while brushing teeth is the most common especially in Bydgoszcz and Budapest (more then 95%), while some improvements can be achieved in Turin and Maribor (below 70%).

Drinking tap water is quite common, especially in Maribor and Split, while in Turin the percentage is still low (57%).

Other good habits such as collecting water after washing fruit and vegetables and using it for watering plants as well as watering the garden/flowers on the balcony with rainwater are rarely practiced.

Bydgoszcz
96% of respondents turn off the water while shaving and brushing their teeth, and 96% ensure that the water system is free of leakage and in good condition. 76% of respondents drink tap water. 64% of people use rainwater for plants watering. Only 45% of people reuse used domestic water.
Budapest
91% of responders turns off the tap during saving and brushing teeth, 95% responded of tight water installation at home and 81% drinks tap water. Collecting and reuse rainwater or grey water are not so popular, only 18 and 10 % of responded yes on this question.
Maribor
Approximately 65% of responders in the FUA level turn off the tap during saving and brushing teeth, whereas 22% turn it off sometimes, and 12% never. Using tap water for watering gardens and flowers on balconies is more evenly distributed, since around one third of respondents uses tap water for watering 38% of time, whereas around 29% never uses it and 33% sometimes. Water collected from washing fruit and vegetables is seldom reused for watering plants (only 18%), but a vast majority of people (90%) use tap water for drinking.
Split
More than 70% responders turn off the tap while shaving or brushing their teeth. Moreover, more than half of them responded (60%) that they make sure that water installations at their home are tightly closed (e.g. tube, taps) and more than 90% of them drink tap water. However, collecting water after washing fruit and vegetables and using it for watering plants as well as watering the garden/flowers on the balcony with rainwater are rarely practiced. Specifically, almost nine out of ten responders do not collect water after washing fruit and vegetables for watering plants and more than 70% of responders do not water the garden/flowers on the balcony with rainwater.
Turin
Nearly 70% of interviewees turn off the tap during saving and brushing teeth, 82% make sure to have tight water installation at home and 57% drink tap water. Collecting and reuse rainwater or grey water are not so popular, only 10% and 18% responded yes on this question

C.2. Facilities

The survey shows that facilities supporting water saving are not spread enough in the CWC FUAs.

Water meters are present in a variety of percentages from about 60% in Turin and Maribor to 92% in Budapest.

A significant rate of Split households do not own water-saving facilities (below 30%), and in Maribor the percentages are generally low (just 19% have water saving faucets and 21% showerheads). In other FUAs percentages are higher such as in Bydgoszcz where 74% of households have dual flush toilet, 55% and 48% of flats have, respectively, showerhead and water saving faucets.

In all the FUAs there is a wide potential of improvement about water saving facilities, also in terms of citizens awareness: a significant percentage of people (e.g. about 25% in Turin) has poor awareness about the existence of water saving facilities for households.

Bydgoszcz
Many households have facilities to save water. 74% of households have dual flush toilet, 55% and 48% of flats have, respectively, shower head and water saving faucets. 87% have a water meter.
Budapest
A significant rate of the households owns water saving facilities: 62% has dual flush toilet, 41% and 43% has water saving faucet and shower head and 92% has water meter.
Maribor
Water meters are quite widespread, especially due to the efforts and investment of Maribor Water Supply Company in the last years (60%). The standardisation of dual flush WC utilities in Slovenia's suppliers has resulted in 50% of households having installed at least one, whereas the water saving faucets and shower heads have not yeat reached FUA's houselolds (just 19% have water saving faucets and 21% shower heads).
Split
A significant rate of the households do not own water-saving facilities: about a third of the responders own a dual flush toilet, 10% of the responders own water-saving faucets and less than 20% own a water-saving shower head. A lot of the responders do not even know if they have the aforementioned facilities in their households. Most of them, what is almost two thirds of the responders, have a water meter.
Turin
57% of interviewees have dual flush toilet, while only 34% and 28% have water saving faucet and shower head. A significant percentage of interviewees, 23% for faucets and 26% for shower, don't know if they own water saving facilities. 59% have a water meter.

C.3. Water footprint

The knowledge about water footprint is low: the percentage of citizens not aware of water footprint values vary from about 60% in Turin, Budapest and Bydgoszcz to 80% in Split.

When citizens get aware of the water footprint of goods and products they show a significant willingness in contributing in lowering this impact by changing their habits. This percentage is in general around 90% or higher in all the FUAs.

Bydgoszcz
Many respondents did not know the concept of water footprint beforehand (66%) and most did not know the volumes of water usage in the production of consumer products (58%). Vast majority of respondents declared their willingness to change their habits (87%) to save water used in the production of goods.
Budapest
The impressive data of the water footprint of different products were not in the evidence of the responders: 60% had no information about the water needs of the products in the example, and 94% of them are open to change their habits to reduce the environmental impacts.
Maribor
More than 90% of respondents would be willing to change their habits in order to positively affect the impacts on water, but the awareness among them is quite low (25%) demonstrating that much has to be done in this area.
Split
According to the survey, four-fifths of the responders had no information about the water footprint of the products in the example/questionnaire (a piece of paper requires 10 liters of water, a steak 2.500 liters, 100 grams of bread requires 160 liters, coffee 130 liters, a t-shirt 1000 liters). On the other hand, almost every nine out of ten responders are open to change their habits in order to reduce their environmental impacts.
Turin
The impressive data of the water footprint of different products were not known by most of the interviewees: 57% had no information about the water needs of the products in the example. 91% of the interviewees are open to change their habits to reduce their environmental impacts.

C.4. Rainwater use, greywater and green roofs

The citizens of the CWC FUAs are pretty aware of the methods of reusing rainwater, especially in Maribor, where almost 100% of respondents are familiar with use of rainwater, which is quite a common practice in that FUA, especially in family houses. Rainwater reusing is not well known, below 50%, only in Turin. The awareness about the reuse of grey water is lower. In Turin only 33% of the respondent know about this possibility, while Maribor FUA still has the highest percentage, with about 95% of citizens familiar with greywater use. The knowledge of green roofs is higher in Turin as well (61%).

Even though not everybody knew of these three solutions, when the respondents were informed they showed extreme interest and positive attitude towards their spreading, with a percentage above 90% in every FUA and close to 100% in some cases.

Bydgoszcz
Respondents are aware of the methods of reusing rainwater (84%) and express positive attitude toward the popularization and use of such solutions (95%). A smaller number of respondents is aware of the possibility of reusing used water (grey water) in households (64%) and also many of them are positive about popularizing this type of solutions (91%).71% of respondents have heard of "green roofs" and 91% of respondents express positive attitude toward the promotion of this solution.
Budapest
The sustainable solutions of in city water management are well known and very popular in the groups of responders. The awareness of the technologies is over 80% (92% of rainwater collection and use, 80% of greywater and 84% of green roofs). 98% of responders agree with the spread of rainwater technologies, 95% are OK with greywater use and 97% would be happy with more green roofs in cities.
Maribor
Almost 100% of respondents are familiar with use of rainwater, which is quite a common practice in our FUA, especially in family houses each capturing and storing in around 1m^3 large water tanks the rainwater directly collected from their roofs. 70% of people also believe that having special rainwater-intended installations would be beneficial. About 95% of citizens are also familiar with the greywater use and green roofs installations, but only 55% are of the opinion that these installations should be more widespread, calling for further awareness raising in these areas as well.
Split
More than four-fifths of the responders knew about some possibilities of rainwater use (excluding drinking), such as watering plants, flushing toilets, washing cars and similar possibilities. Additionally, more than 95% of them believe that installations relating to it should be more widespread. According to the survey, more than 40% of the responders did not know about the possibility of water reuse at their homes (i.e. storing water from the shower or the sink for flushing toilets). However, more than 90% of them believe that installations relating to it should be more widespread. According to the survey, almost 80% of the responders knew about “green roofs” and more than 90% of them believe that "green roofs" should be more widespread.
Turin
Not all the sustainable solutions for the urban water management are well known and very popular in the Turin FUA. Only green roofs are known by most of the population (61%), while rainwater (46%) and grey water (33%) uses are less popular. More than 90% of the population think that all these three solutions should be more spread in Turin FUA.

C.5. Effects of climate change: are you afraid?

In the different FUAs the respondents show different levels of concern about climate change effects. In Budapest the concern about drought periods is generally quite high (87%), as well as in Turin (70%). Also in Bydgoszcz droughts are considered as the most serious negative effect of climate change, but the percentage is much lower than in Budapest (50%).

Bydgoszcz
The possible effects of climate change cause different concerns among respondents but not all of them to the same extent. The greatest number of strong concerns focus on periods of drought (50%) and on increase in water costs (46%). Floods are characterized by the highest number of weak fears (29%) and with one exception none of the fears that are considered weak exceed 17%.
Budapest
The possible effects of climate change in water management cause climate anxiety. The most threatening phenomena for the responders in Budapest FUA are the drought periods (87% are very afraid of it), water supply problems (82% are very afraid) and floods (77% are very afraid).
Maribor
The results in this section show overall concern about climate change (approximately 60% across the board are very concerned about floods, droughts, cost increase and supply shortages), but on the other hand obviously do not consider their actions affecting the environments.
Split
The responders are most afraid of water supply problems. Nearly 40% of them stated that they are very afraid and more than 40% are moderately afraid. The responders are either moderately or not afraid about the short but heavy rains (less than 15% of them are very afraid). Furthermore, they are in general moderately afraid of the drought periods and very or moderately afraid of floods. Most of them are moderately afraid of raising costs for water supply and wastewater collection (almost 60%).
Turin
The possible effects of climate change in water management cause climate anxiety. The most threatening phenomena for the responders in Turin FUA are the drought periods (70% are very afraid of it), floods (67% are very afraid) and heavy rains (62% are very afraid).

D. Conclusions

This report summarized the results of the Self assessment and the public perception survey conducted in each CWC FUA.

The results showed a wide variety of situations and local peculiarities. As a general overview all the FUAs still lack in many aspects towards a fully sustainable water management. This is true especially in terms of infrastructures (e.g. for rainwater collection and grey water reuse) and facilities.

Existing basic infrastructures such as fresh water pipes lack of maintenance and an inadequate financing is dedicated to that.

Cities administrators are aware of the issues that climate change will rise in the next future, not only in the water sector, and are operating and planning for mitigation strategies, but still the current efforts appear inadequate.

Citizens showed interest and willingness to act to contribute to a better urban water circle, especially to mitigate the effects of climate change. Nevertheless, they see a lack of infrastructure, facilities and funding that could allow a proper sustainable water management. The interest towards new technologies and techniques that could help a smart improvement of the urban water circles (e.g. green roofs) is well established.