DANUBE WATER PROGRAM

IAWD

CONFERENCE WORKSHOP REPORT

WASTEWATER MANAGEMENT: FINANCIAL SUSTAINABILITY

Workshop held on February 3, 2022

Disclaimer:

The current Report has been prepared by Radoslav Russev in his capacity of a short-term consultant to the World Bank.

The Report has been based on a review of recent literature, a number of interviews with water managers from SEE and, not least, personal experience of the author in the WSS sector. Throughout the document certain opinions and reflections of the author are shared that may not necessarily present the official opinion of the WB or the sources referred to.

CONTENT

ABBREVIATIONS

AM – Asset Management

CEE – Central and Eastern Europe

CHP – Combined Heat & Power (installation)

DRBMP - Danube River Basin Management Plan

DWP – Danube Water Program

EBRD – European Bank for Reconstruction and Development

EC – European Commission

ERDF – European Regional Development Fund

EU – European Union

GDP – Gross Domestic Product

IAWD – International Association of Water Service Companies in the Danube River Catchment Area

ICPDR – International Commission for the Protection of the Danube River

IFI(s) – International Financial Institutions

ISPA – Instrument for Pre-Accession (EU assistance program)

OPE – Operational Program Environment

O&M – Operations and Maintenance (processes)

SEE – South East Europe

SoS (Report) – “State of the Sector” Report by the Danube Water Program (latest update – 2019)

UBP – Utility Benchmarking Program

UWWTD – Urban Wastewater Treatment Directive

WB – World Bank

WSS – Water Supply and Sanitation (sector)

WW – Wastewater

SYNOPSIS

Selected Key Figures

Danube Basin Scope: How many countries, agglomerations and people	
800 thousand m2	Size of catchment area of Danube river
19	Countries in the catchment area
5,636	Agglomerations > 2,000 p.e. in the catchment area
85 million	People in the agglomerations > 2,000 p.e.
10.7 million	People not connected to a sewer system
5.5 million	People connected to a sewer system that is not appropriately treated
CAPEX, OPEX: The road to full financial sustainability	
58.5 billion euro	Total initial investment to reach UWWTD compliance
15 billion	EU investment in UWWTD compliance in the Danube Region (2000 – 2020)
1.613 billion euro	**Total annual reinvestment needs**
14.1 euro	**Weighted mean WW treatment OPEX per person per year**
11%	Share of energy costs withing total WWTP OPEX (before 2021)
>300%	Increase of electricity prices in the region (selected liberalized markets – Bulgaria, Hungary, other) for the period early 2021 - early 2022
Inflation rate + 5% for 15 years	Increase in sanitation fees to reach full cost recovery in Bulgaria (exemplary country on a steep path to sustained cost recovery)
What Else	
30%	Share of population in the Danube Region living in agglomerations < 2,000 p.e.

Summary Thesis of the Report

This report comes to the conclusion that **full financial sustainability in the wastewater sector across all countries in the Danube region is extremely difficult to reach if not outright impossible in the coming 10-15 years**. That is for two major reasons:

1. **Underestimated reinvestment needs**: while most countries have a certain plan how to build the WW infrastructure necessary to reach UWWTD compliance, the follow-up annual reinvestments do not appear to be included in tariff (or other) projections.
2. **Rapid increase of electricity costs** (likely to stay high in the coming years)

Note: these two reasons are, by far, not exhaustive. Other difficulties on the path for financial sustainability of the WW sector include the much higher operational costs per p.e. in the smaller WWTPs, the missing technical and process skills in lots of small water utilities in the region, the slow uptake of energy efficiency/recovery in the region, the evolving regulations that may pose additional CAPEX and OPEX requirements, etc. However, the above-mentioned two reasons are considered to be the upmost difficulties in reaching financial sustainability.

EXECUTIVE SUMMARY

At least from the early 1990s the investments in sanitation have been a major factor in the Water & Sanitation Sector in the Danube Region due to the implementation of the Urban Wastewater Treatment Directive (UWWTD) and the EU integration of CEE and SEE countries.

“Compliance” with the UWWTD has become one of the biggest investment drivers for more than 5 600 cities in the region, some of which still not in the EU. A 2018 assessment declared that despite massive investments in the sector another EUR 57 billion is still missing.

The current Report makes the case for two types of capital investments – initial investment to reach compliance but, equally (and probably even more) important – the case for gradual and sustainable reinvestment. The Report shows that, as of today, the tariff mechanisms, the regulatory requirements and the financial possibilities of the water utilities in the region do not guarantee for sufficient reinvestments.

Capital investment is one part of the equation. The other one is the OPEX – the combination of labour costs, energy, chemicals, repair works, outsourced activities and other O&M components. These range from EUR 10 to EUR 30 per capita per year in the service areas of WWTPs depending on size, technology, energy efficiency and other factors.

The Report shows that, under the most optimistic scenarios, the WW sector can reach full sustainability in around 15 years. However, the assumptions for tariff increases are clearly overoptimistic. And this is even before integrating into the picture the recent increase of energy prices and, more importantly, without a proper solution to all rural areas in which some 30% of the population lives.

To finish on a positive note, the report ends with a series of recommendations – from good operating practices through policy suggestions and technological opportunities for (at least partial) transformation of WWTPs into revenue centres through adoption of water re-use, energy and even nutrient recovery.

ABOUT THE REPORT

The purpose of this report is to compile data and opinions related to the financial sustainability of the wastewater treatment processes within water utilities in the Danube region. The ultimate goal is to support the dialogue among utility operators, policy makers and other relevant stakeholders on if, when and how the wastewater component of the utility services can become operationally and financially viable.

Initially, the report was intended as a post-workshop paper following the **"Financial Sustainability in the Wastewater Management in the Danube Region" Webinar**, organized by the Danube Water Program and ICPDR on Feb 03, 2022. The conclusive Section Five of the document contains recommendations that were expressed by participants at the event.

As the report was delayed it integrated facts and opinions expressed at the Danube Water Forum (June 28-29, 2022) and at events and documents within the Utility Management Training of IAWD.

Data-wise, this report is primarily based on a series of other documents – reports, presentations, databases, articles and opinions published in the Danube region in recent years. These include previous sector-specific reports commissioned by the World Bank ("WB"), the International Commission for Protection of the Danube River ("ICPDR"), the International Association of Water Service Companies in the Danube River Catchment Area ("IAWD"), structures of the European Union ("EU") and others. These sources have been shown in the Reference list at the end of the Report.

One specific information source deserves special attention – the State of the Sector (SoS) Report in the Danube Region published in 2019.

In order to gain a deeper and more up-to-date understanding of the specific situation within certain water utilities in the region a group of water utilities, participating in the Utility Benchmarking Program and the Utility Management Training of IAWD, were approached with specific questions. Their responses helped calibrate the overall picture. In addition to these regional utilities from three countries (Serbia, Kosovo and Czechia), the business plans for a small group of Bulgarian utilities were reviewed for understanding their cost and revenue structures.

The author of the current report has been involved in the Bulgarian water supply and sanitation sector ("WSS") in the last twenty years and that is why the sector developments and utility performance of this country has been referred to in a number of places in the document.

1. CONTEXT

1.1. Urban Wastewater Treatment Directive: The Ultimate Investment Driver

Within the WSS sector the experts involved in Asset Management ("AM") and Investment Planning often use a framework of "investment drivers" – reasons for a utility (or a municipality or another public stakeholder) to undertake an investment. The major investment drivers are (1) asset replacement – when a facility has reached the end of its useful life, (2) expansion of service coverage – when new customers are added to the service area, (3) compliance – when new legislative or contractual levels are to be met, (4) customer service improvement, and (5) efficiencies. Most often an investment project in the WSS sector is determined by a couple of these factors with one of them being the leading one.

In the last couple of decades, the by-far prime investment driver in the WSS sector in the Danube region has been compliance with the Urban Wastewater Treatment Directive (Directive 91/271/EEC), referred to as the UWWTD. The specific requirements for agglomerations of certain size - primary and secondary treatment in settlements above 2,000 people equivalent (PE) and more stringent tertiary treatment (removal of nitrogen and phosphorus) in agglomerations above 10,000 PE – has been the single biggest factor for massive investments in expanding sewer systems and developing wastewater treatment plants ("WWTPs") in Central and Eastern Europe ("CEE"). The timeline for developing such infrastructure has been one of the hottest negotiation points for every country in its EU accession path – one of the components under Chapter 27 Environment. Typically, two deadlines have been set for each new EU member – one for agglomerations above 10 000 PE to become compliant, and another, more relaxed one, for the ones above 2 000 PE. Almost all countries have inevitably failed to reach compliance on time and this breach has often led to penalty procedures. However, albeit with substantial delays, the situation with WW treatment in the Danube basin has been gradually improving and the UWWTD has been the factor behind that.

1.2. Agglomerations and Compliance Reached

In total, more than 5 600 cities, towns and villages within the Danube River Basin fall under the category "agglomerations above 2 000 PE" in the catchment area of the river that spans over 800 thousand km2 in 19 countries throughout the continent. Some additional statistics on the distribution of the agglomerations by size classes is presented on the following table, published in the recent (2021) update of the Danube River Basin Management Plan ("DRBMP").

Table 3: Distribution of agglomerations and population equivalents in the DRB according to size classes (reference year: 2018)

Size classes (PE)	Agglomerations		Population Equivalents (PE)	
	number	%	number	%
2,000 – 10,000	4,381	78	17.62 Mio	21
10,000 – 100,000	1,142	20	31.23 Mio	37
≥ 100,000	113	2	36.32 Mio	42
Total	**5,636**		**85.17 Mio**	

Table 5: Generated urban wastewater load and number of centralized collection and treatment systems in the Danube River Basin (reference year: 2018)

Type of collection and treatment system			Generated load (PE)	Number of centralized collection and treatment systems
Collected by sewer	Collected by sewer and treated in UWWTP	Tertiary treatment	54,345,005	2,220
		Secondary treatment	7,264,840	888
		Primary treatment	1,155,336	100
	Collected but not treated		5,492,920	751
Not collected by sewer	Individually collected and treated	IAS	3,487,062	-
		Local systems	2,750,534	-
	Not collected		10,669,765	-
Total			**85,165,464**	**3,959**

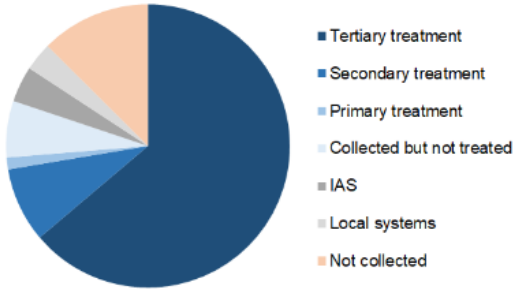


Figure 6: Share of the collection and treatment stages in the total population equivalents (PE) in the Danube River Basin (reference year: 2018)

So, in order for the WSS sector to reach compliance with the UWWTD the wastewater discharge from more than 85 million people in all 19 countries in the Danube Basin has to be treated to a certain standard (more than 67 million live in agglomerations above 10 000 PE). The level of compliance varies greatly from country to country and from agglomeration to agglomeration. The situation, as of the end of 2021 is summarized in the scheme to the left (published in the Update of the DRBMP).

And while there are countries and regions in which all small agglomerations have been fully compliant for decades (Germany, Austria), the situation with recent EU members is different. In the six Western Balkan countries and Moldova, i.e. the Danube countries that are still not members of the EU, lots of agglomerations, including ones above 100 000 PE do not treat their wastewater to the UWWTD standards and in many cases even capital cities lack wastewater collection infrastructure.

Due to the importance of the Directive and the necessity to provide up-to-date information on compliance status, the European Commission ("EC") is publishing recent updates on the situation at country and agglomeration level at https://uwwtd.eu/(country_name)/stats.

It is also worth noting here that at the time of writing this report the UWWTD is under review with the consultation phase recently expired. Certain changes will be implemented and some of them may require additional investment (disinfection, additional treatment of certain toxic substances, etc.) so an agglomeration that has reached full-compliance status in previous years shall be again subject to capital investments driven by compliance. With the evolution of our understanding on new contaminants, the necessity to re-use wastewater for irrigation and other factors this investment cycle, driven by extended regulations, is expected to continue in the coming decades.

2. MAJOR FINANCIAL METRICS RELATED TO SUSTAINABILITY

When measuring the investment and current-expenditure levels the WSS sector is used to the terms Capital Expenditure ("CAPEX" which is identical to investments) and Operation Expenditure ("OPEX" which is, effectively, running costs). In recent years, the term TOTEX = TOTal EXpenditures is also gaining popularity which reflects the fact that the long-term financial sustainability of the sector requires a combined view of the two types of expenditures that complement each other and often provide trade-off opportunities (e.g. increased up-front efficiency CAPEX can result in future OPEX savings and vice versa – delayed CAPEX, for example in replacing pumps, air blowers, etc, may result in increased OPEX due to inefficient operating processes).

This chapter of the report looks at both CAPEX and OPEX.

2.1. Investment Needs (To Reach Compliance)

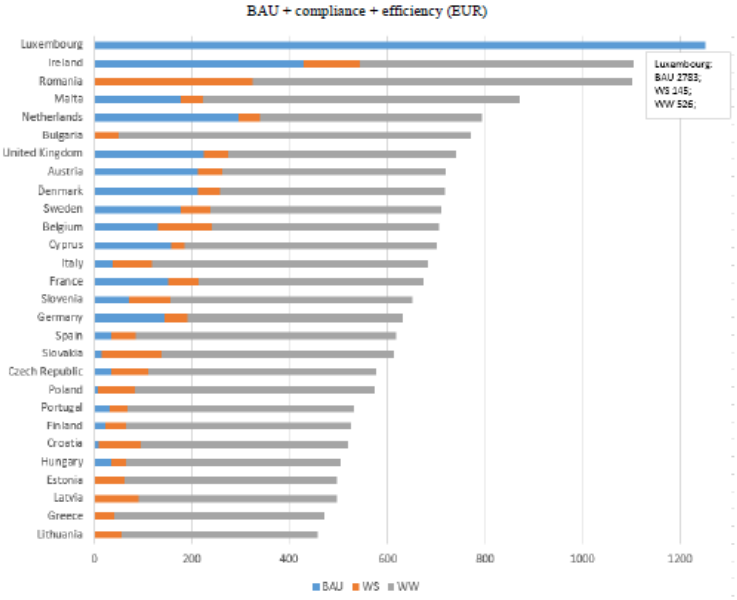
Historically, the investments in WW infrastructure in Central and specifically in South East Europe have been viewed as catch-up CAPEX necessary to build new sewer systems and treatment plants.

Back in 2018 a WB report delivered the following message: "A total of EUR 42.5 billion has already been invested to implement the UWWTD. However, despite this important investment effort, an additional EUR 57 billion is still needed to reach and maintain full UWWTD compliance since 2040."

Another important information source, the 10th Report on the implementation status and programs for implementation of the UWWTD estimated that "the investment required to reach full compliance with the UWWTD for the 27 Member States and the UK comes to a cumulative additional total of EUR 253 billion between 2020 and 2030."

Undoubtedly, the bill to reach UWWTD compliance has been one of the most demanding CAPEX requirements for new EU members in the recent decades. One common way of outlining the investment needs has been the application of per-capita indicators.

The graph below, taken from an OECD analysis included in the above-mentioned 10th UWWTD Implementation Status Report, ranks the EU countries based on their per-capita needs for Water Supply and Wastewater. As it can be seen, in certain cases such as Bulgaria the vast majority of the investment need is exactly in WW.



Source: OECD analysis based on European Commission and Eurostat data.

Explanation of scenarios:
- *the BAU scenario (business-as-usual) captures what should be spent by 2030 with population growth*
- *the WS scenario (water supply) captures what should be spent by 2030 to meet the requirements of the recast DWD*
- *the WW scenario (waste water) captures what should be spent by 2030 to meet the requirements of the UWWTD*

Fig – 10 Additional expenditures by 2030 per capita for waste water (ww) and drinking water systems (ws) [EUR/inhabitant] Source: OECD (2020)

Let us put these figures, in the case of Bulgaria, in perspective: back in 2018 (when the report was prepared) the Nominal GDP per capita was EUR 8 600. So, a capital requirement for investment in Water and Sanitation of almost EUR 800 is close to 10% of the annual per-capita GDP for the country.

Another CAPEX-related per-capita indicator that is useful for putting the investment requirements in understandable country context is the "expected investment". It is typically derived based on the combination of utility investments, municipal and national investments, and, most of all – funds from Operational Program Environment that often finance more than 90% of the capital needs of an agglomeration related to UWWTD compliance.

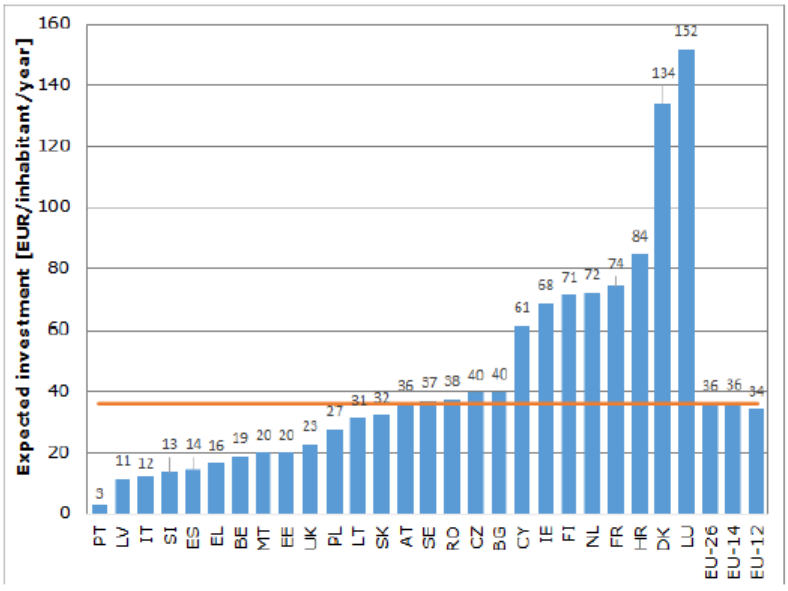


Fig – 9 Member States' programmes for implementation – expected annual investment costs per capita for installing and renewing waste water collecting systems and treatment plants [EUR/inhabitant/year]

Note: Germany and Hungary did not provide any data on expected investments.
The orange line running across the graph is the average annual expected investment cost in the EU.

The table below, presented in the 2019 SoS Report, prepared by the DWP, shows EU contribution towards investments in WW infrastructure in the EU member states for the period 2000 – 2020.

TABLE 15: EU FUNDS USED TO CO-FINANCE INVESTMENTS IN WASTEWATER INFRASTRUCTURE IN DANUBE RIVER BASIN EU MEMBER STATES (2000–2020) IN MILLION EUROS

Target countries	2000–2006 ISPA, ERDF	2007–2015 CF, ERDF	2014–2020 Budgets CF, ERDF	Total EU contribution
Bulgaria	246	1,122	1,000	2,368
Czech Republic	397	229	0	626
Croatia*	21	200	1,100*	1,321
Hungary	493	410	900	1,803
Romania	1,044	2,382	3,810*	7,236
Slovenia	117	351	250	718
Slovakia	259	546	200	1,005
Total Danube Region	**2,577**	**5,240**	**7,260**	**15,077**

SOURCE: THE WORLD BANK 2018B.

For most countries that joined the EU in this period, there is a logical sequence – from pre-accession funds to the Cohesion instruments. Such a path is being currently followed by the future member states in the Western Balkans.

2.2. Reinvestment Needs

When future EU member states negotiated the timeframes to reach UWWTD compliance and in the early years of their membership the logical focus of the environmental authorities has been investment needs. Particularly in countries and cities with no historic investment in WWTPs and sewer systems rehabilitation of existing sanitation assets was not a major concern.

However, the topic of "reinvestment needs" gradually gained its importance. WW assets have life of various duration – electrical and mechanical equipment (such as pumps, air blowers, etc.) typically lasts some 20-30 years, large concrete structures (such as bio basins) – up to 50 or more years, and street sewers and collectors – more than 80 years. Despite large asset life, the sector had to start planning for reinvestment needs and the table below (2019 SoS Report) outlines these needs.

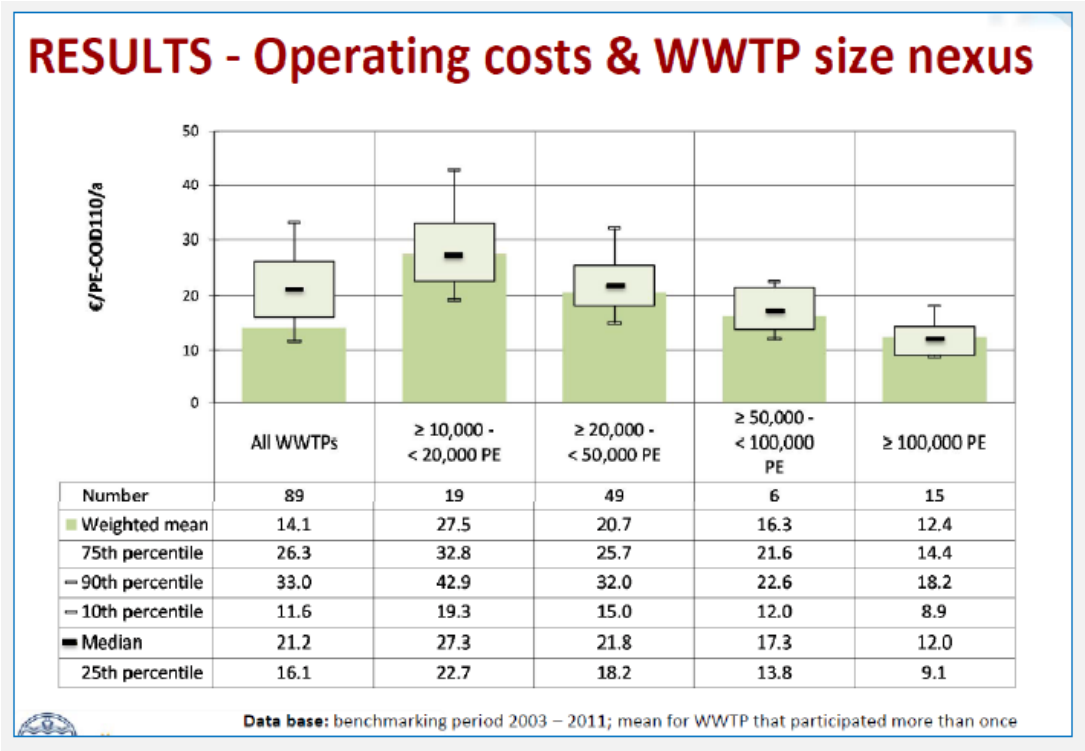
Target Countries	Reinvestment need on historical installations, M EUR		Reinvestment need on future installations, M EUR		Total annual reinvestment need, M EUR	Total Initial Investment values, M EUR
	Sewer network	WWTP	Sewer network	WWTP		
Austria	203	212	0	0	415	14,388
Bulgaria	67	41	16	43	167	5,849
Czech Republic	94	80	0	1	174	6,286
Croatia	0	0	61	19	81	3,459
Hungary	112	61	0	1	173	6,825
Romania	117	50	141	169	476	17,252
Slovenia	18	4	2	11	35	1,304
Slovakia	47	29	0	14	90	3,236
Danube Region	**658**	**476**	**221**	**258**	**1,613**	**58,599**

Source: 9th TA-UWWTD; Own assessment

Table 3.10: Calculated Reinvestment Need for Sustained Compliance with UWWTD

2.3. WW Opex Structures

Once commissioned, no infrastructure asset is OPEX-free. There are asset classes, such as street sewer systems, that may incur mainly maintenance costs – periodic inspection, cleaning and sporadic emergency maintenance. WWTPs, on the other side, are extremely operations-heavy facilities, with labour, chemicals, energy and sludge disposal being the largest components.



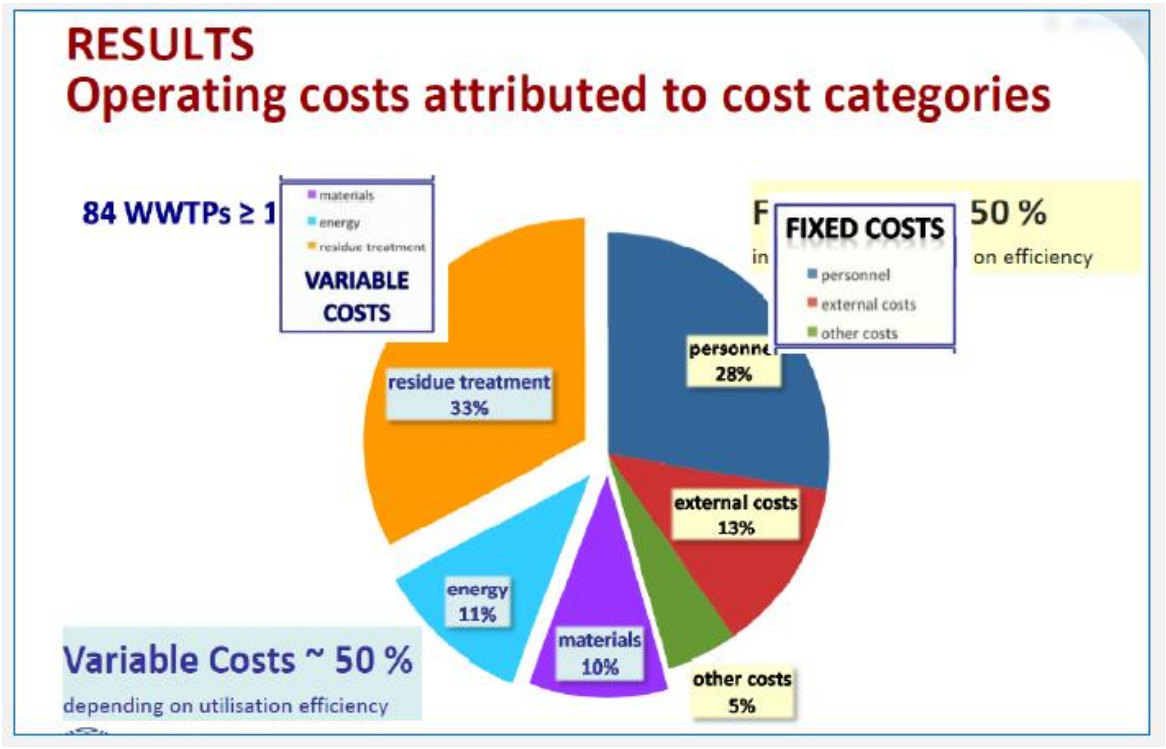
In the O&M cost structures of WWTPs size matters a lot and economies of scale are clearly observed. As, technology-wise, there are lots of similarities in the processes of treatment plants in the Danube region, comparisons of the OPEX structures in the region provide meaningful benchmarking data. The 2017 Report – Wastewater Management in the Danube Region, provides some useful data. As it can be seen from the table above – the operating cost to treat the environmental load per PE per year can vary from levels below EUR 10 (for WWTPs serving agglomerations above 100 000 PE) to more than EUR 30 for small plants.

The weighted mean value of EUR 14.1 can be a useful benchmark level, particularly for new treatment plants of certain size.

In addition to size and corresponding economies of scale, however, various factors have an impact on the overall O&M structures:

- Scope of treatment: N&P removal add an additional stage that brings new costs
- Technology
- Sludge management solutions: some plants may store dried sludge on-site for decades while others incur heavy costs for transportation and handling
- Energy efficiency and availability of on-site energy generation through CHPs and even PV solar installations

Despite varying levels of the cost categories, the above-mentioned 2017 Report made an attempt to calculate an average O&M structure of a typical WWTP and it is presented in the graph below. One interesting conclusion was the relatively even split between fixed and variable costs.



In early 2022, when preparing the current Report, a group of SEE water utilities were approached and data from them was collected regarding their WWTP cost structures.

As expected, the data shows that there are large deviations from the average percentage share of the various O&M categories. In addition to size and technological solutions, other factors play a role. Newer treatment plants will, logically, have negligible costs for spare parts and repairs. Some utilities choose not to outsource so there will be a zero line for “external services” which does not mean more efficient services.

2.4. Rising Electricity Costs

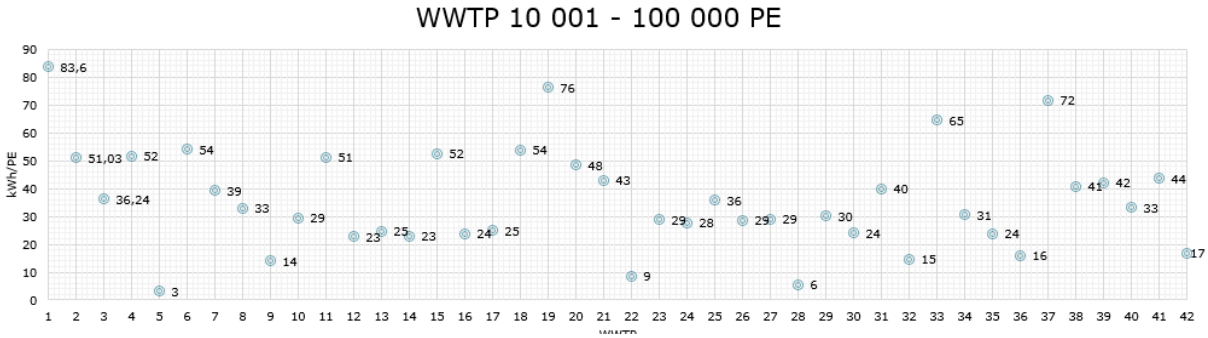
When analyzing operating cost structures in WWTPS, there is one major negative development in the last couple of years, i.e. one that has a sizeable impact on the cost breakdown shown above and the level of overall OPEX for a treatment plant – the sky-rocketing energy/electricity prices.

As pointed above, back in the years before 2021 energy used to account for a bit more than 10% of OPEX costs. As this is an important area of the analysis, it is worth giving a look to the absolute figures (kWh per PE or m3 treated) in addition to the shares of costs and monetary values.

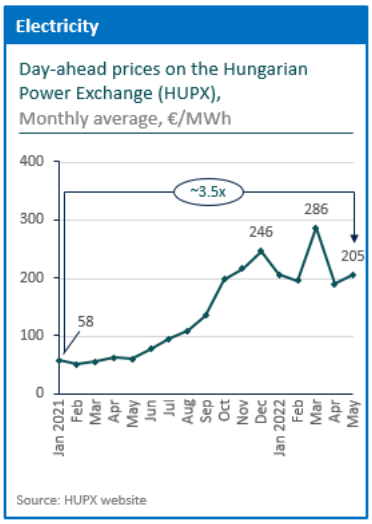
According to the EU Taxonomy Compass energy consumption should not exceed:

- 35 kWh/PE/year for WWTPs below 10,000 PE
- 25 kWh/PE/year for WWTPs in the range of 10,000 – 100,000 PE
- 20 kWh/PE/year for WWTPs above 100,000 PE

And while there are a multitude of plants that achieve these levels it can be reasonably suggested that a large group of properly managed facilities fail to do so. The table below is an extract of an energy-efficiency review of a large group of WWTPs in Central Europe:



The figures for very small WWTPs can demonstrate values often exceeding even three-digit numbers. So, the first area of consideration is the fact that the full UWWTD compliance inevitably means more treatment plants for much smaller agglomerations, absence of economies of scale and, ultimately, more kilowatt-hours per p.e. served.



What is even more worrying than the nominal consumption of energy and the misleading gross average figures (based on large WWTPs), is the recent sudden increase in the energy prices.

Since mid-2021 the electricity prices in most countries in the region sky-rocketed. The actual increase differs from country to country: from high two-digit percentages to more than three times (such as the case in Hungary, illustrated in the graph). The timing of the increase also varies – some countries, particularly those with illiberalized markets, managed to delay the shock. However, the increase in most Danube-region countries is a fact and most analysts expect that even after a certain normalizations the high electricity rates are likely to stay in the mid-term.

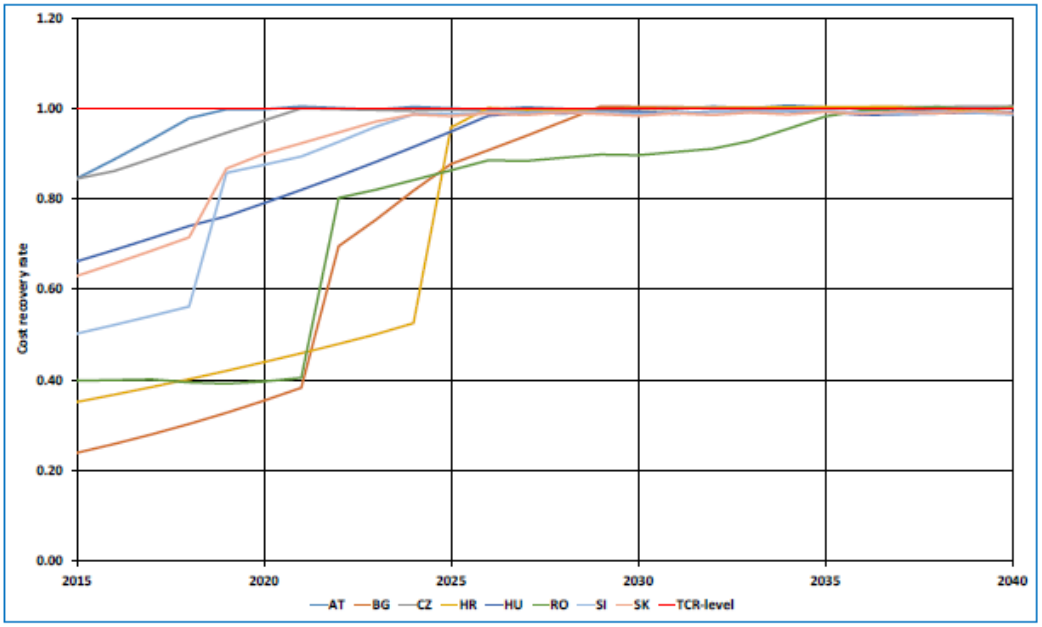
A number of, typically large, WWTPs in the region have methane-capture facilities and corresponding on-site cogeneration facilities (CHPs). Depending on the amount of methane captured and the efficiency of the generation process, various levels of "self-sufficiency" are being reached – from 30-40% to more than 70%. In the case of Sofiyska voda, for example, full sufficiency was reached with electricity production exceeding 115% of its needs. Probably, the development of gas-capture and cogeneration facilities are the single most realistic cushion for the energy shock alongside on-site PV solar capacities. Such developments, unfortunately, require time, funds and appropriate conditions (economies of scale, on-site conditions, operations capacity, favorable regulations and energy-trading rules, to name a few). The acceleration of their development is inevitable, but the mid-term shock to the water service providers is likely to stay.

2.5. Path to Sustainability Scenarios

When analyzing investment (and reinvestment) needs and OPEX levels the ultimate goal for water utility managers, regulators and policy makers is to design a path towards sustainability – a situation in which all operating costs will be covered alongside reinvestment and financial costs. And all of that should, ideally, be achieved without cross-subsides. (Note: a common practice in SEE water utilities is to allow for the "water-supply component" of the tariff to have a provision for a cross subsidy towards WW processes. This is typically done for political reasons as a new WWTP may serve only a fraction of the population in a city or region. So, in order not to allow major differences in the monthly bill, the utilities prefer to keep a relatively low component for wastewater services.)

In the above-mentioned 2017 Report on Wastewater Management in the Danube Region, various cost-recovery scenarios were considered for the period up to 2040. More specifically, the analysis identified four trajectories:

- OCR: Operational Cost Recovery (only)
- TCR: Total Cost Recovery
- BAU: Business as Usual
- SOP: Sustainability Oriented Pathway – an overoptimistic path towards achieving TCR in all countries in the Danube Region before 2040



Source: SOS Report 2015, own assessment

Figure 3.4: Long-term evolution of TCR ratios by countries of the Danube region – SOP scenario

To illustrate how difficult-to-achieve this scenario is, one shall consider certain assumptions on how it is to be reached in various Danube countries:

- In Austria, the plan assumed a 5-year annual increase of 5% every year (or the WW fee) above inflation
- In Czechia, the plan provided for 5-year annual increase of 5% above inflation, and then – 2% increase
- In Bulgaria, the plan assumed 5% above-inflation increase for 15 years in a row.

For political and other reasons that was clearly considered almost-impossible in 2017. The situation with the pandemic and the uncontrollable increase of electricity prices in 2021 – 2022 only make the situation much more challenging.

3. OTHER ASPECTS WORTH NOTING

3.1. Asset Valuation and Depreciation

The previous chapter of the Report placed an emphasis of reinvestment needs in WW infrastructure. Typically, in all capital-intensive industries the asset-reinvestment necessity is resolved through adequate depreciation policies and reinvestment programs in which, on theory at least, long-term depreciation should be equal or close to reinvested amounts.

The situation in the water sector in the Danube Region is different and a number of factors contribute to this unsustainable situation:

- Enormous catch-up investments and failure to quickly implement logical depreciation policies
- Historic investments and inadequate asset values (either in balance sheet or off-balance public assets)
- Political reasons: willingness to keep real depreciation out of the tariffs
- Failure of the regulatory and tariff models to integrate the reinvestment need in the tariff formulae

The case of Dobrich Water Utility (Bulgaria), outlined in the box below, is representative for most of these factors.

Dobrich Water Utility: WW Infrastructure – Depreciation Assessment

Dobrich Water Utility (Bulgaria) is a regional water operator that provides W&S services for eight municipalities within the Dobrich region. Total population served is around 200 000 people with a strong seasonal factor as the utility serves three coastal municipalities at the Black See.

In its service area, the utility is responsible for 6 WWTPS – one, the plant in the city of Dobrich itself, serves more than 75 000 PE, two municipal ones are in the range of 30 000 – 50 000 PE, and the remaining three are smaller.

When reviewing the regulatory business plan for the period 2022 – 2026 and the corresponding tariff model, the following observations were made:

- The book Value of “wastewater treatment assets” is below EUR 10 million.
- Annual (permitted) depreciation in the tariff: EUR 350 000 per year
- Actual investment (in recent regulatory years): below EUR 200 000 per year

A quick assessment shows that the replacement value for these existing assets would be around EUR 70 million (based on EUR 500 per PE). Obviously, there is a major discrepancy between the actual annual CAPEX (real investment made) of Dobrich Water Utility and the needed reinvestment. The following factors lead to that discrepancy:

- Some of the assets were constructed more than 30 years ago (such as the old WWTP in the regional centre). They have never been revalued for accounting and regulatory purposes.
- There is a regulatory limit of the so-called “permissible depreciation” in the tariff
- Actual impossibility (cash deficiency) of the utility to reach even the low investment targets in its WW category as per the tariff model

Similar reflections were shared by water utility managers from the interviewed operators in the region. In the cases with existing old WWTPs that are rehabilitated and expanded with EU funds, one common situation is that the new assets get proper depreciation levels but the old ones never got re-valued.

It could be concluded that failure to obtain up-to-date asset values is one of the key reasons for the underestimated depreciation levels.

3.2. WW in Rural Areas

This report has largely focused on WW investment needs (and corresponding financial sustainability) driven by UWWTD compliance. And while the Directive poses regulations for agglomerations above 2 000 PE, the situation with smaller settlements (typically in rural areas) deserves special attention.

The table below, taken from the 2021 Report - Wastewater collection, treatment and reuse in rural areas of CEE, GWP CEE Report, shows that almost one third of the population in selected Eastern European countries lives in agglomerations below the lower threshold of the UWWTD.

Table 1: Demographic characteristics of examined countries.

Country	Population	Settlements < 2000 PE (%)	Population in settlements < 2000 PE (%)
Bulgaria	6,888,147	90%	26%
Croatia	4,284,889	97%	39%
Estonia	1,300,000	99%	31%
Hungary	9,890,640	75%	17%
Latvia	1,900,000	91%	43%
Moldova	2034100	33%	no data
Montenegro	621,700	98%	20%
Poland	37,660,000	no data	27%
Romania	19,186,201	38%	10%
Slovakia	5,459,781	85%	30%
Slovenia	2,108,977	98%	52%
Ukraine	41,342,500	95%	32%
average			30%

Typically, centralized wastewater collection and treatment is inefficient for small agglomerations (CAPEX per PE sometimes goes to more than EUR 5 000). That is why most countries develop environmental guidelines for individual appropriate solutions such as septic tanks, aerated ponds, reed beds, etc.

The uptake of such individual solutions is, however, very slow as it can be seen from the table below (part of the above-mentioned report):

Table 5: The presence of nature-based solutions (marked green) in the countries of Central and Eastern Europe. Where the data were available also the number of systems is given.

	Bulgaria	Croatia	Estonia	Hungary	Latvia	Moldova	Montenegro	Poland	Romania	Slovakia	Slovenia	Ukraine	Total
Soil infiltration				12								300	>312
Willow systems											1		>1
Waste stabilization ponds				3							2		>5
Aerated ponds											10		>10
Treatment wetlands		8				7	5	8,000		150	180	80	>10.430
Sludge treatment reed beds		8			10		4	1					>23
Vermifilter						1							1
Ecosan technology						70							70

Obviously, the coverage of settlements < 2 000 PE with appropriate wastewater treatment will be a long process even compared with the UWWTD compliance. This creates both a risk to the WSS operators in the region but also an opportunity as the water utilities are well positioned to service individual solutions.

3.3. Missing Engineering and Operations Expertise

In the interviews with selected water utility managers when preparing the current Report one risk factor was often mentioned – the difficulty (impossibility) to hire qualified staff such as WW managers, process engineers, SCADA and laboratory experts.

In some cases (examples like Bulgaria) the difficulty was coming from the fact that construction companies and technology vendors are better placed to attract experts with such competences due to significantly higher remuneration. In other cases, such experts are almost impossible to find and even lots of water engineers had not studied wastewater-related subjects in their education.

Clearly, the competence gap was given a high priority when listing the challenges in the sector.

3.4. Transforming WWTPs into Profit Centers

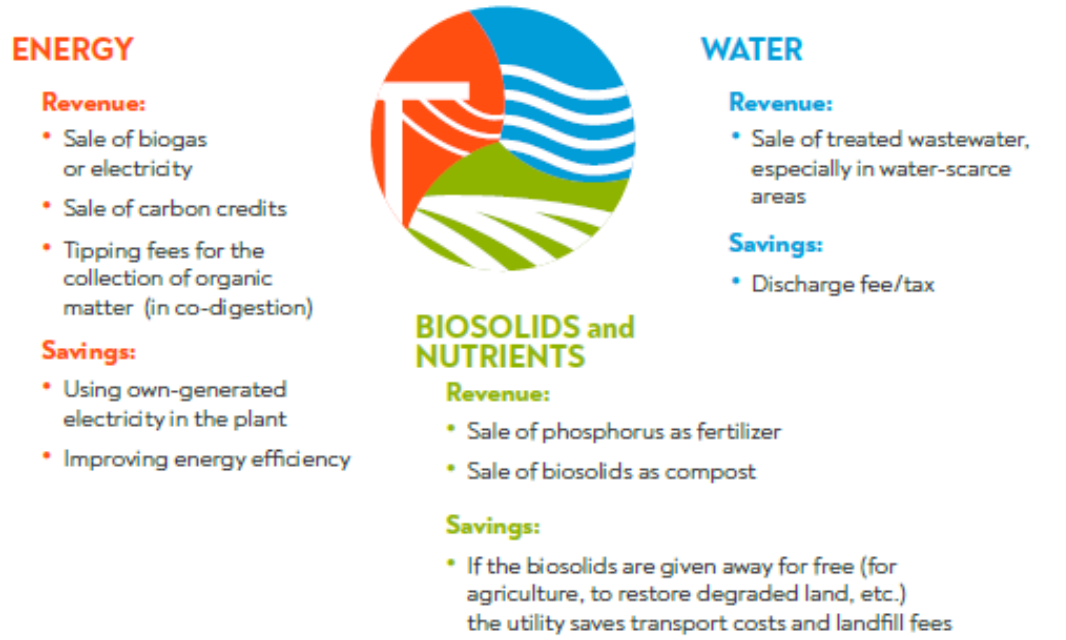
WWTPs are a huge CAPEX and OPEX driver of water utilities globally. In the Danube Region, specifically, sanitation (which includes sewer networks in addition to the WWTPs) is expected to be the biggest investment driver at least for another couple of decades as the water-supply infrastructure is largely in place and UWWTD compliance will be a major factor.

However, WWTPs can be looked upon from a different angle. A number of initiatives and analyses in recent years aim to draw the attention of utilities, regulators and policy makers in this direction.

A 2020 World Bank Report – From Waste to Resource, provides useful insights on the topic.

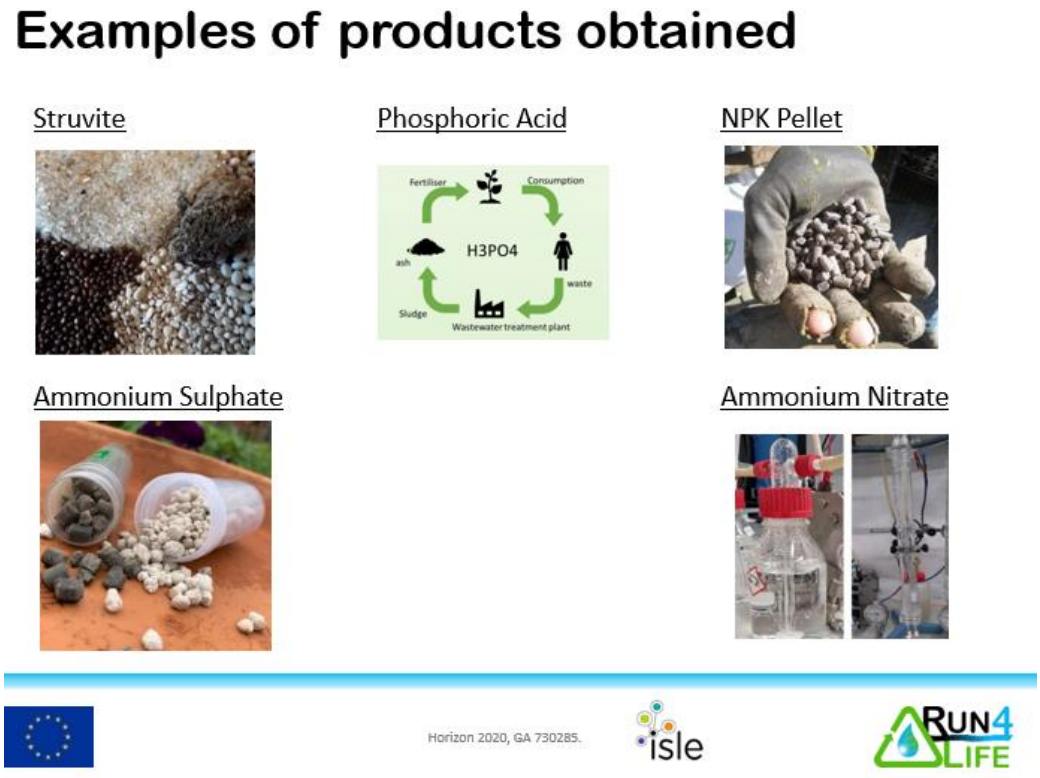
The schematic below nicely shows the three major potential revenue streams of WWTPs – energy, water (re-use, mainly for irrigation) and nutrients.

Figure 4.1 Potential revenue streams and savings from resource recovery for wastewater treatment plants



Source: World Bank.

And while energy recovery and water re-use have been on the radar of WSS professionals, the topic of nutrient recovery is rather new and under heavy technological development. One interesting example of EU-wide R&D project in the area is Run4Life – a Horizon-funded initiative in 4 Western EU countries that have successfully piloted the production of various nutrients from wastewater.



4. FINAL REFLECTIONS

Good Practices and Recommendations

This Report was put together for the purposes of raising awareness and fractions of it were used for moderating the ICPD/WB/IAWD-organized event "Financial Sustainability of Wastewater Management in the Danube Region", Feb 03, 2022.

In discussions with the participants in the event and in the process of compiling this Report certain summarized reflections, good practices and recommendations were made. The author of the current report would specifically like to thank the following contributors: Xavier Leflaive (OECD Environment Directorate), Christian Minelli (WAREG), Gabor Kisvardai (Hungarian Energy and Public Utility Regulatory Authority), Ivaylo Kolev (World Bank), David Tagg (Jaspers), Benoit Samanos (Suez), Ines Delic (Aquasan) and Teodor Popa (Apa Brasov). Some of their key reflections and recommendations can be summarized within the following priority points:

Phased Implementation and Careful Definition of Compliance Deadlines

This recommendation is particularly valid for EU candidate countries who are just opening Chapter Environment in the negotiation process. The examples of some of the most recent EU members (such as Bulgaria and Romania) demonstrate the difficulty of quick compliance with UWWTD, the risk of financial penalties for non-compliance with such deadlines and the financial burden associated with both. Phased implementation should be negotiable based on carefully defined national criteria that are in line with wider EU and/or regional principles. An example for that could be the agglomerations in the Albanian Adriatic coast – a clear priority for both Albania and the EU.

Adoption of National Criteria for "Sufficiently Concentrated Ares"

This point is the technical enabler of the previous one and, effectively, it means a more conservative and elaborated approach for defining the boundaries of the agglomerations (subject to UWWTD compliance). Experience in recent EU members show that demographic trends combined with low density in population concentration requires a careful re-think of the boundaries of the agglomerations. Failure to do so may result in extremely expensive and, in some cases, unnecessary investments in centralized sanitation infrastructure and oversized WWTPs.

Financial Sustainability Assessed at Two Levels: Project Level and Service Provider Level

The requirements of the OPE and all related guidelines establish well-known cost-benefit analyses. However, these are most often structured around the specific project. This recommendation rather refers to the long-term financial (and operations) impact on the utility that is to operate the newly constructed asset. In essence, the recommendation is that construction and operations requirements are jointly considered at both project and utility level.

Investments (and Grant Applications) Following Best Asset Management Principles

One principle that was suggested is the requirement for proper condition assessment of existing assets prior to financing of new ones. An example: if a water utility (municipality) owns and operates a big old WWTP in a relatively large agglomeration its operations and investment needs shall be well understood (through an asset register and a condition-assessment process) prior to receiving

funds for constructing a new WWTP. Eventually, such a requirement will allow utilities and their funders to focus on the most strategic needs rather than get tempted to build expensive new infrastructure that will serve a small fraction of the service area.

Create Conditions for Reinvestments

Two specific enablers were suggested in this direction:

- Asset Revaluation: understanding the real financial value by investigating notions such as historic cost, book value, replacement value allows for elaboration of realistic depreciation rates and values and integrating them in the sanitation tariff.
- Gradual Inclusion of Depreciation in the Tariff: for social and political reasons the full inclusion of the WW asset depreciation in the tariff is often unacceptable. A plan for a gradual inclusion may help a lot. To make matters even more realistic such an approach can be combined with delayed introduction of VAT on part of the service (example of Apa Brasov, Romania)

Careful Considerations of the Principles of "Solidarity" and "Regionality" vs. "Avoidance of Cross Subsidies"

Policy makers (and regulators) in the W&S sector typically advocate for "avoidance of cross subsidies". And while this principle has its sound economic logic, certain solidarity mechanisms and clever (and clear) cross subsidies may be both socially meaningful and fully compliant with EU-level and country-specific regulations. Examples include the introduction of a "solidarity" component in the water tariff as a national-level rule or the good principle of regional tariffs (one utility – one tariff) that, effectively, allow for the large-size sanitation systems to support the inefficient small ones through a unified regional tariff component that is calculated based on the full cost for all systems in the region.

Complementarity of the EU Sources: Infrastructure – Capacity – Research

The EU budget, through the OPE, is the single biggest contributor of funds for UWWTD compliance. Since the early 2000s the EU has donated more than EUR 15 billion for new sewers and WWTPs in the Danube Region. For recent and new EU member states this will continue to be the case in the foreseeable future. And while the big money goes to infrastructure, the countries in CEE/SEE often neglect opportunities for capacity and research-oriented finance such as Horizon, Life, the mechanisms under the Green Deal, etc. The funds available under such programs may be much smaller compared to the direct infrastructure grants, however, they target operations improvements, policy-driven research, benchmarking and other areas with longer-term impact on the financial sustainability of water utilities.

Regulation (and Policy Making) Pushing for Innovation

Historically, wastewater treatment has been perceived as a major cost driver for water utilities, municipalities and industries. With efficient CHPs, water re-use adoption and technological progress towards commercially-viable nutrient recovery from sludge, however, WWTPs are, at least partially, becoming revenue centres as well. It might be time for regulators and/or policy makers to consider a certain push towards such innovation and corresponding mechanisms that allow (or require) water utilities to pass through some of these savings to the end customers.

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