

# Learning from International Best Practices



European  
Benchmarking  
Co-operation

2021  Water & Wastewater Benchmark



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# The European Benchmarking Co-operation

The European Benchmarking Co-operation (EBC Foundation) assists drinking water- & wastewater utilities in improving their services through benchmarking and learning from each other.

EBC Foundation is a not-for-profit foundation under Dutch law, governed by a Board composed of representatives from water utility associations FIWA (Finland), Norsk Vann (Norway) and Vewin (The Netherlands) and the European federation of national water utility associations EurEau.

Annually, EBC organises benchmarking exercises for water utilities from Europe and beyond. Next to its European core programme EBC facilitates regional benchmarking activities, in close collaboration with local partners.

## What does EBC's benchmarking programme offer?

EBC offers a learning-orientated utility improvement programme, which consists of two consecutive steps: performance assessment and performance improvement. In the assessment step, six key performance areas are analysed, to provide a wide view on a utility's performance. On top of this, EBC analyses context information, asset management indicators and progress towards the UN Sustainable Development Goals (SDGs).

Participating utilities can choose the benchmarking level that best matches their aspirations and available data: basic, standard or advanced. While at the basic level only elementary statistics and performance indicators are investigated, the advanced level offers a more detailed analysis.

To secure the high-quality standard of the programme EBC's benchmarking team and the participating utilities closely work together on data collection, data quality control and performance reporting.

In the performance improvement step utilities meet their peers in the annual benchmarking workshops as well as during topic specific Knowledge Picnics, where they can exchange knowledge, best practices and innovations in technology, management and operations.

The EBC-programme is aligned with the IWA/AWWA-benchmarking framework and applies the IWA Performance Indicator System, enabling exchanges between different regional programmes. ●



# Participants 2021 exercise

## Belgium

- Brussels Waste Water
- Société wallonne des eaux
- VIVAQUA

## Cyprus

- Water Board of Larnaca
- Water Board of Lemesos
- Water Board of Nicosia

## Finland

- Helsinki Region Environmental Services Authority, Water Services (HSY)

## France

- SEFO (group Aqualia)

## Germany

- Hamburg Wasser
- hanseWasser Bremen GmbH

## Greece

- Athens Water Supply and Sewerage Company SA (EYDAP)

## Italy

- Societa Metropolitana Acque Torino S.p.A

## Norway

- City of Oslo, Agency for Water and Wastewater Services

## Oman

- Oman Water & Wastewater Services Company

## Poland

- Aquanet S.A.
- Miejskie Przedsiębiorstwo Wodociągów i Kanalizacji w m.st. Warszawa S.A.
- MPWiK S.A. W Krakowie
- Municipal Water and Sewage Company S.A. Wrocław

## Portugal

- Aguas do Porto

## Romania

- APASERV Satu Mare S.A.
- Compania Apa Brasov
- Compania de Apa Olt

## Russian Federation

- Joint-stock company Mosvodokanal

## Spain

- Canal de Isabel II
- Empresa Metropolitana de Abastecimiento Y Saneamiento de Aguas de Sevilla S.A.

## Sweden

- Sydsvatten AB
- VA SYD

## Switzerland

- Services Industriels de Genève

## The Netherlands

- Brabant Water N.V.
- Evides Waterbedrijf N.V.
- N.V. Dunea
- N.V. PWN Waterleidingbedrijf Noord-Holland
- N.V. Waterbedrijf Groningen
- N.V. Waterleiding Maatschappij Limburg
- N.V. Waterleidingmaatschappij Drenthe
- Oasen N.V.
- Stichting Waternet
- Vitens N.V.

## United Arab Emirates

- Abu Dhabi Sewerage Services Company
- Al Ain Distribution Company

## United States

- Charleston Water System

# Facts & figures

## Drinking water

Total number of consumers  
supplied with drinking water by  
the participating utilities



**61.285.100**

Which equals to  
**13.7%** of the **EU27 population**

Annual turnover  
of the participating  
drinking water utilities



**€ 4.846.309.145**

Annual investment  
by participating  
drinking water utilities



**€ 1.898.684.629**

## Wastewater

Total number of consumers  
connected to a WWTP operated  
by the participating utilities



**40.656.167**

Which equals to  
**9.1%** of the **EU27 population**

Annual turnover  
of the participating  
wastewater utilities



**€ 3.143.978.662**

Annual investment  
by participating  
wastewater utilities



**€ 1.193.764.801**

# Foreword

The year 2021 again was an exceptional year for society, for the water sector and for EBC Foundation. The ongoing pandemic forced water companies to focus on their core business and keep the core operations going, despite the sometimes exceptionally reduced staff availability. Many investment projects had to be delayed due to supply chain disruptions, or were postponed awaiting more favourable times. But in general the sector managed to continue providing essential services.

As could have been expected, the ongoing pandemic also affected EBC's benchmarking programme, as the usual networking activities were mostly limited to online contacts. Despite the many restrictions, the benchmarking exercise IB2020 still attracted more than forty participants from nineteen countries in Europe and beyond. New to the programme in this difficult year were the water companies Aguas do Porto from Portugal, SEFO (FCC Aqualia group) from Spain and Olt Water Company from Romania.

Like in 2020, due to the many restrictions and hesitations of people to travel abroad, it was not really possible to organise a face-to-face annual benchmarking workshop - a vital part of the EBC programme, being a networking programme. As a proxy, the concept of smaller sized Knowledge Picnics to exchange knowledge and experiences between practitioners on specific topics again proved its value in the online environment.



**Hans de Groene**  
Managing director Vewin  
Chair of the Board of  
EBC Foundation

On the content side of the programme, in 2021 the successful SDG-pilot that was carried out in the previous year was thoroughly evaluated by a MSc-student from Wageningen University together with programme participants, Waternet and KWR Water Research. This review resulted in several improvements and in the decision to permanently add the SDG-indicator set to EBC's annual performance assessment. This way, the programme offers utilities a more profound analysis of the sustainability of their company and their services, as well as a tool to set substantiated targets.



Next to the core activities in Europe, EBC actively shared its benchmarking knowledge and -experiences with colleagues on other continents. In 2021 EBC continued supporting VEI/PAWD on the development of a national benchmarking project in the Philippines and carried out a study for the Swiss development agency HELVETAS on the development of a national information system for the water & sanitation sector in Peru. By the end of the year, EU-funding was awarded to Water Operator Partnerships (WOP's) in Bahir Dar (Ethiopia) and Lima (Peru), for which EBC will facilitate a benchmarking component together with lead partners HSY (Finland) respectively Canal de Isabel II (Spain).

As evidenced by the more than 250 utilities that have participated in the EBC-programme over time, benchmarking is appreciated as a tool to independently assess performance of water services, and to get in touch with colleagues to share and exchange challenges and solutions in management and operations. Encouraged by the enthusiasm of participating utilities, EBC will invite utilities for the next benchmarking cycle IB2021 in the first quarter of 2022.

EBC continues to support utilities in their aim to improve water services and welcomes new participants from Europe and beyond to join the programme! ●

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“ EBC provides access to an individual evaluation report, divided by themes, in which the company's performance is analysed in comparison with other participants. This report is a great support to identify performance gaps and best practises that will guide us to improve efficiency and to achieve a competitive advantage. The KPIs and the graphical PIs form a key part of the revision of our strategic planning process.”

Inês Costa - Aguas do Porto

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# Introduction

Since 2007, the European Benchmarking Co-operation (EBC) operates an international benchmarking programme for European water- & wastewater utilities, with the objective to help improving their services. This publication briefly reports on EBC's European core programme.



[see map](#)

In 2021 EBC organised its 15th international benchmarking exercise, welcoming 41 participants from 19 different countries. Four utilities in the group are from countries outside Europe (Oman, United Arab Emirates and the United States of America).

The 2021 benchmarking exercise processed data from the year 2020. The project was co-ordinated by EBC and supported by ABF Research in Delft, The Netherlands.

EBC offers three levels of participation (basic, standard and advanced) to make the benchmarking programme accessible to all type of water utilities, no matter if they are used to advanced data collection, or just begin with basic data collection. During the data collection process, participants are supported by EBC through an expert helpdesk assuring a high quality of the data.

The benchmarking process started early 2021 with an invitation to European water utilities to join EBC's benchmarking exercise. The data collection started in May, using the benchmarking platform [www.waterbenchmark.org](http://www.waterbenchmark.org). As always, EBC paid a lot of attention to the data quality. After the initial collection phase, with several checks online, the submitted data were subject to three rounds of analysis and correction, resulting in a validated data set which was used for the final company reports and for this public report. Data entry results that could not be verified by the EBC team were deleted from the dataset for the public report.

Like every year, in the 2021 benchmarking exercise several improvements have been made in the set of questions and definitions of various indicators were clarified. This year extra attention was paid to data quality. In the data entry reference values were added and anonymous validation reports were introduced.

Two local Knowledge Picnics were organised in The Hague and Krakow. In the first Picnic in The Hague delegates discussed the societal impact of water services and optimal use of the EBC data. In the second Picnic in Krakow combined sewer overflow management was discussed. Additionally, two online Knowledge Picnics took place. In these Picnics, several water companies presented their experiences with CO<sub>2</sub> pricing to reduce the carbon footprint and the use of artificial intelligence when analysing videos to detect damage in sewer systems.





At the Knowledge Picnic in The Hague the Benchmarking Co-ordinator of the Year Award was handed to Águas do Porto. The EBC-team congratulates the winning team and encourages them to continue their good work!

In November participants could make the last corrections in their dataset. The final reports were distributed mid December. ●

Participants at the Knowledge Picnic  
in The Hague, The Netherlands

# Map

41 participants from  
19 different countries.

-  Belgium (3)
-  Cyprus (3)
-  Finland (1)
-  France (1)
-  Germany (2)
-  Greece (1)
-  Italy (1)
-  Norway (1)
-  Poland (4)
-  Portugal (1)
-  Russian Federation (1)
-  Romania (3)
-  Spain (2)
-  Sweden (2)
-  Switzerland (1)
-  The Netherlands (10)

## Outside Europe:

-  Oman (1)
-  United Arab Emirates (2)
-  United States (1)





# Drinking water

This section contains an overview of this year's performance assessment on drinking water services. Data of other services that the participating companies may have provided (i.e. wastewater or gas distribution) are excluded from the analysis. EBC's benchmarking programme focusses on six key performance areas: access, water quality, reliability, service quality, sustainability and finance & efficiency. This public report only shows a subset of the available performance indicators for each of the six key areas, to illustrate key findings. In an ideal situation the group of participants that compares performance would be the same over time. The group of utilities that participated in the 2021 exercise however differs from the one in previous years. Hence, the current group level results cannot be compared with those of previous years. In the individual company reports, participants can however track changes both in their own and in their peers' performance.

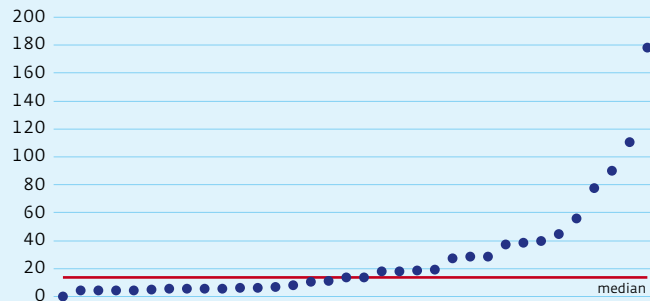




## Reliability

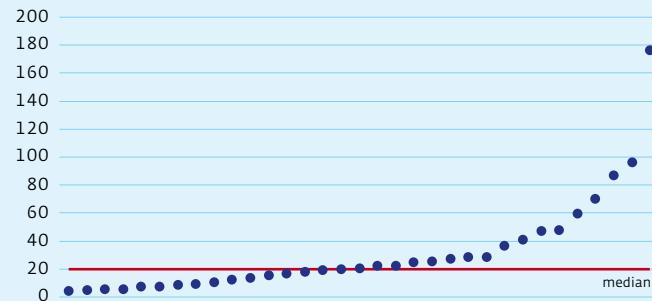
Reliability also is an essential performance area for a water utility. The customers expect a continuous supply of safe and clear water. First of all, EBC uses mains failures as an indicator of reliability. Mains failures are breaks and leakages of mains pipes, valves and fittings leading to interruption or low-pressure supply. Measuring mains failures is just a first indicator of reliability, as these failures do not always affect the service to the customer (redundant pipelines, nightly interruptions). Results for mains failures vary widely within the current EBC group with values ranging from 0 to 178 failures per 100 km. Factors that may influence the mains failure rate include the network condition, soil condition, traffic load and water pressure. It is also worth mentioning that an improvement in monitoring failures may (at first) cause an increase in mains failures, as not in all cases failures are currently properly registered. The median value is 13,7 No. / 100 km.

**Figure 3:** Mains failures (No./100 km)



In addition to mains failures the programme looks at distribution losses and (at the advanced level) at customer minutes lost. Utilities in the current EBC group face distribution losses between 4,6 and 176,4 m<sup>3</sup> / property / year. The median value for the group is 20,2 m<sup>3</sup> / property / year.

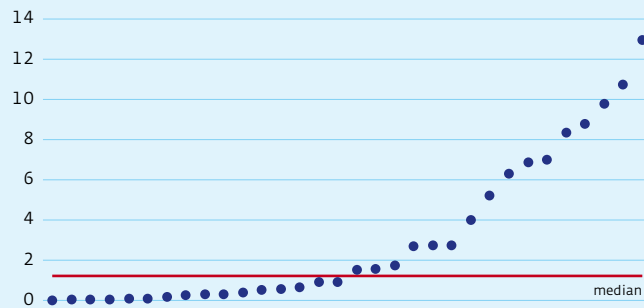
**Figure 4:** Distribution losses per mains length (m<sup>3</sup>/km/day)



## Service Quality

If the service of a water utility is not up to the required standard of the customer, the customer can file a complaint. Hence the number of complaints filed by utilities' customers is an adequate measure for service quality. EBC measures service complaints. These complaints are related to the actual supply of drinking water, including water pressure, (medium to long term) continuity, water quality and (short term) interruptions. Complaints on billing are also measured but not taken into account in this indicator. The majority of the current EBC group scores very well with a median value of 1,23 complaints / 1000 properties. The emergence of social media also created a new channel of communication between consumers and utilities. Many water utilities are increasingly using social media to better inform their customers. Hence, through these new channels, mutual understanding is facilitated and formal complaints may be prevented.

**Figure 5:** Service complaints per connected property (complaints/1000 properties)



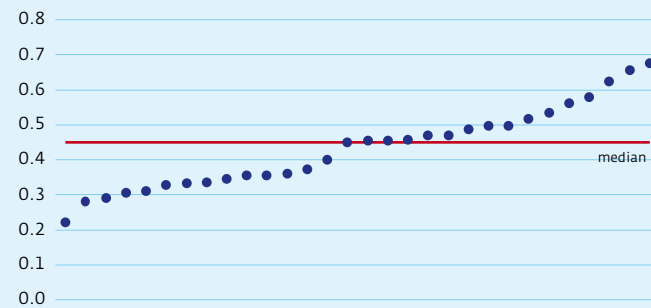
## Sustainability

Sustainability is a key point on the agenda of many water utilities. It can be approached and measured in various ways. The EBC programme uses the widely recognised Triple Bottom Line approach, which investigates social, environmental and economic sustainability.

### Social sustainability

Water is a basic necessity, and customers usually do not have viable alternatives to their local water supplier. This unilateral reliance leaves it to the utility to make sure its product is affordable. Hence, EBC measures social sustainability of the drinking water services by showing the water bill as a share of household consumption expenditures. In the current EBC group this ranges from 0,22% to 0,68%, with a median of 0,45%.

**Figure 6:** Affordability based on household consumption expenditures (%)

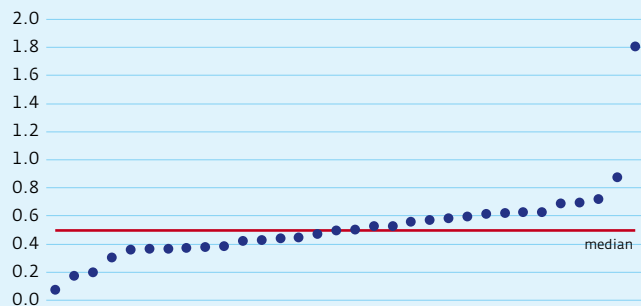




## Environmental sustainability

At advanced level the EBC programme measures environmental sustainability through several indicators, which include electricity use for water production, energy recovery, inefficiency of use of water resources, the reuse of treatment residuals and climate footprint. Figure 7 shows the electricity used by pumps in the abstraction, treatment and distribution of water, per m<sup>3</sup> that is produced. The use of electricity is influenced by the type of water resources, geography and treatment processes. Pumps are the most voracious consumers of electricity, which makes their efficiency an important factor in the reduction of electricity use. This benchmarking exercise showed a median electricity usage for pumping of 0,5 kWh / m<sup>3</sup>.

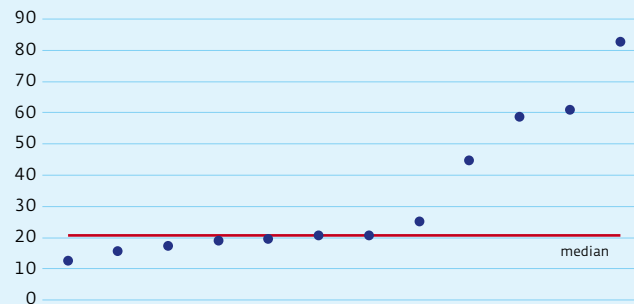
**Figure 7:** Electricity use for production and distribution per m<sup>3</sup> water produced (kWh/m<sup>3</sup>)



At the advanced level, the EBC-programme analyses the climate footprint of drinking water services. Utilities report on each of the three components, the scope 1-, scope 2- and scope 3-emissions, which are counted together to determine the total carbon footprint.

Figure 8 shows the total climate footprint of the participants of this years' benchmarking exercise in kg CO<sub>2</sub> equivalent per property per year. The climate footprint ranges from 12,5 till 82,7 CO<sub>2</sub>-eq. / property, with a median value of 20,6 kg CO<sub>2</sub>-eq. / property.

**Figure 8:** Climate footprint per m<sup>3</sup> drinking water sold (kg CO<sub>2</sub>-eq./m<sup>3</sup>)



### Economic sustainability

While making sure that water is amply available to the public, and taking their environmental footprint into account, water utilities need to make sure their activities are economically sustainable.

Assets need to be maintained in good condition. For this, the programme looks at the percentage of main rehabilitation, which is the share of the network that has been renovated or replaced because the condition of the mains deteriorates. Higher percentages of main rehabilitation can be caused by a higher average network age. All utilities in the current EBC group rehabilitate between 0 and 2,9 % of their network. The median value is 0,79 % / year.

Economic sustainability also requires collecting sales revenues to cover total costs by a ratio of 1 or more. About two third of the EBC participants meet this criterion. With a ratio below 1, utilities will have to rely on other sources of income (e.g. subsidies, reserves or income from other activities). These utilities are less sustainable on the long run. The median value for the current EBC group is 1,01.

Figure 9: Total cost by sales coverage ratio

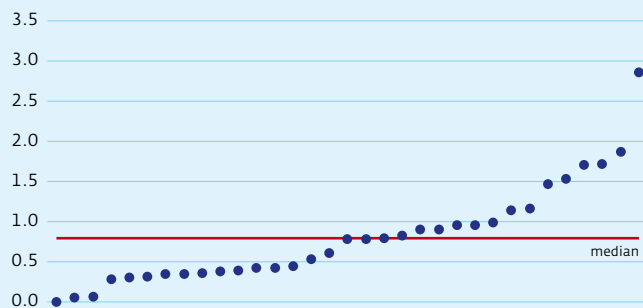
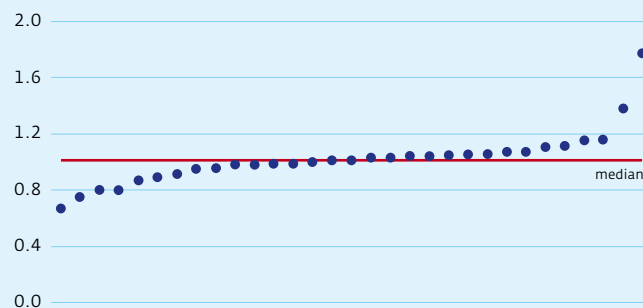


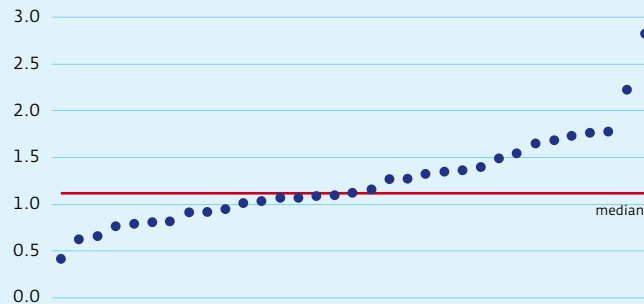
Figure 10: Mains rehabilitation (%/year)



## Finance and efficiency

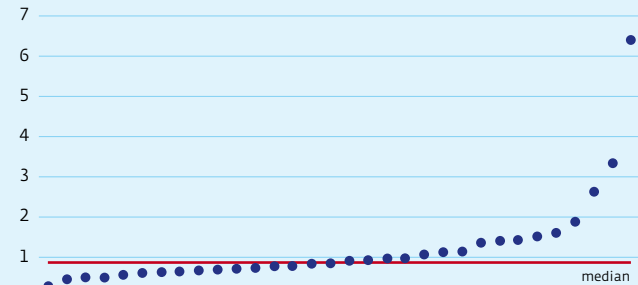
EBC's performance assessment framework contains an extensive set of indicators in the field of finance and efficiency. This set includes total cost, running cost, personnel intensity and charges. Since water utilities are committed to provide water of the highest possible quality at the lowest possible price, water charges are an important financial performance indicator. Average water charges for direct consumption are calculated by dividing total direct revenues by the sold volume. Many utilities have a tariff structure with a fixed connection fee and a variable rate per unit sold. As a result the price per m<sup>3</sup> a household actually pays will often depend on its consumption. The median price of water for the current EBC group is 1,12 € / m<sup>3</sup>.

**Figure 11:** Average water charges for direct consumption (€/m<sup>3</sup>)



Personnel intensity is a relevant performance indicator on the efficiency side. It is measured as the number of full-time employees (fte) per 1000 properties. The scores on this indicator are calculated using a standard 40 hour full-time working week. In the current EBC group the personnel intensity ranges from 0,29 to 6,41 fte per 1000 properties with a median value of 0,88 fte / 1000 properties.

**Figure 12:** Personnel intensity (fte/1000 properties)





# Wastewater

This section presents an overview of the performance comparison of this year's benchmarking exercise for wastewater services. For these services EBC uses the same six key performance areas as for drinking water: access, water quality, reliability, service quality, sustainability and finance & efficiency.

Data is gathered on the wastewater activities specifically. This means that measures and costs of other services that a participant may provide (i.e. drinking water or district heating) are excluded. The performance indicators shown in this section are only a subset of the available indicators.

The group of utilities that participated in the 2021 exercise differs from the one in previous years. Hence, the current group level results cannot be compared with those of previous years. In the individual company reports, participants can however track changes both in their own and in their peers' performance.

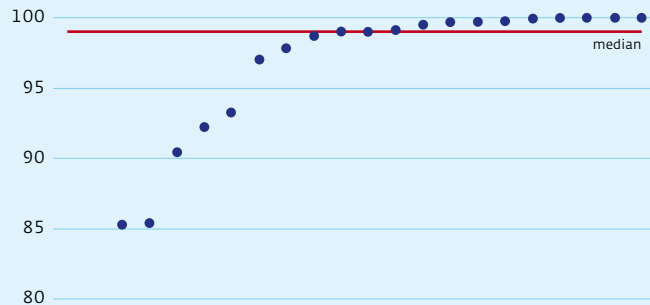


## Access

Access to wastewater services is of vital interest from a public health perspective.

The percentage of resident population in the service area of utilities in the current EBC group that is connected to the sewer system managed by those utilities is high. The median value is 99%.

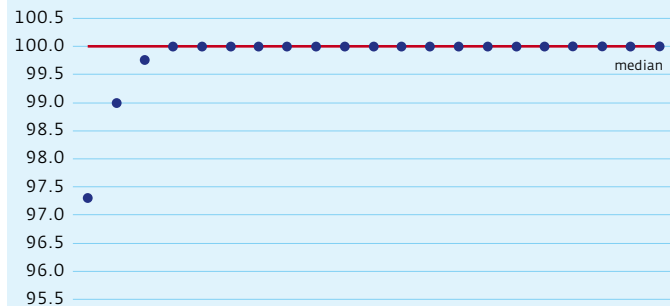
**Figure 13:** Resident population connected to sewer system (%)



## Wastewater quality

The wastewater (in many cases mixed with storm water) that is collected by a utility needs to be treated. The treated water should be in compliance with discharge consents to minimize negative impact on the environment. These consents vary between and within countries, which means the same percentage can have different meaning for the different utilities. The compliance within the current EBC group is generally high with a median value of 100%.

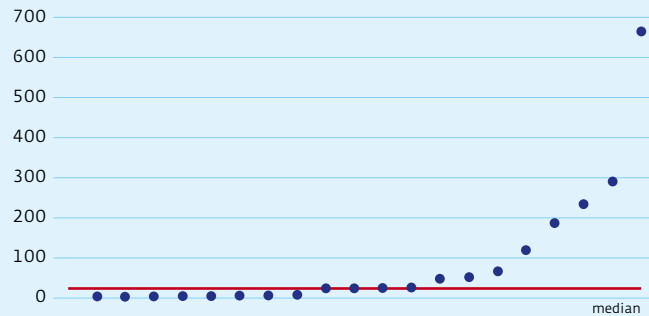
**Figure 14:** WWTP compliance with discharge consents (%)



## Reliability

To assess the reliability of wastewater services EBC uses sewer blockages as the main indicator. These blockages include all occurrences under the company's responsibility, whether they are due to collapse, root ingress, grease or debris. Utilities within the current EBC group strive to improve monitoring. This may (at first) result in an increase in the detection rates, as not all blockages are currently properly registered. However, eventually this should improve the service of the water companies. Utilities can also reduce blockages by educating customers (especially in the case of blockages caused by grease). The results on sewage blockages vary widely within the current EBC group between 1 and 666 blockages per 100 km sewer, per year, with a median value of 25 No. / 100 km sewer.

**Figure 15:** Sewer and connection blockages (No./100 km sewer)



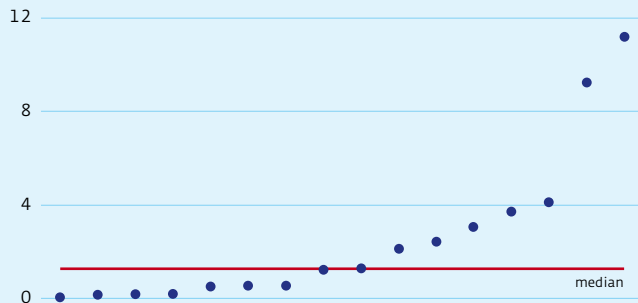


## Service Quality

Service quality for wastewater services is measured using the same indicators as for drinking water. The customer can file a complaint if the service of a wastewater utility is not up to the required standards. The majority of the current EBC group scores very well with a median of 1,27 No. / 1000 inhabitants / year.

Different types of complaints are occurring in different part of the wastewater chain. For instance, blockages and flooding complaints occur more often in the collection- and transport sewers, while the treatment facilities are often faced with complaints due to pollution, odour and rodents.

**Figure 17:** Total complaints (No./1000 inhabitants/year)



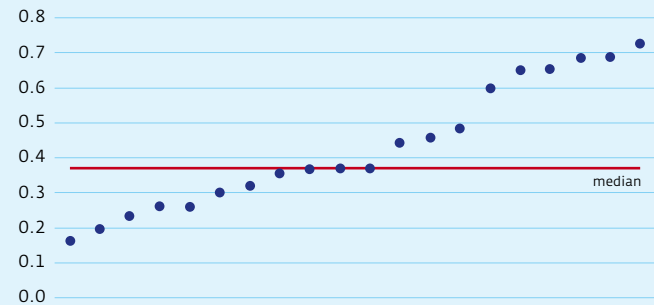
## Sustainability

Similar to drinking water services, wastewater services are benchmarked on sustainability using the Triple Bottom Line approach which takes into account social, environmental and economic sustainability.

### Social sustainability

The EBC programme measures the social sustainability of wastewater services by calculating the share of the wastewater bill in household consumption expenditures. This measure gives a good impression of the affordability of the wastewater services, accounted for differences in wealth between nations. The EBC group of current participants show a profound range from 0,16% to 0,72% with a median value for this indicator of 0,37%.

**Figure 18:** Affordability based on household consumption expenditures (%)

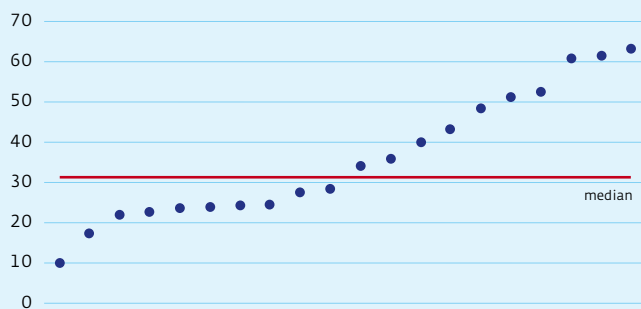


## Environmental sustainability

EBC's benchmarking programme measures environmental sustainability with several indicators. Examples are the electricity used for treating wastewater as well as generating electricity from it, the percentage of the sludge generated in the treatment process that is utilized in a sustainable way or the frequency of use of overflow devices to surface water. In this report we reveal the results for the energy consumption of the wastewater treatment plants as well as results for the climate footprint.

The energy consumption of the majority of participants is distributed between 10 kWh and 63,3 kWh per population equivalent served. The median value for the current EBC group is 31,4 kWh / p.e. served by WWTP. The energy consumption of the wastewater treatment plants can differ depending on the level of treatment, which in turn depends on the local discharge consents.

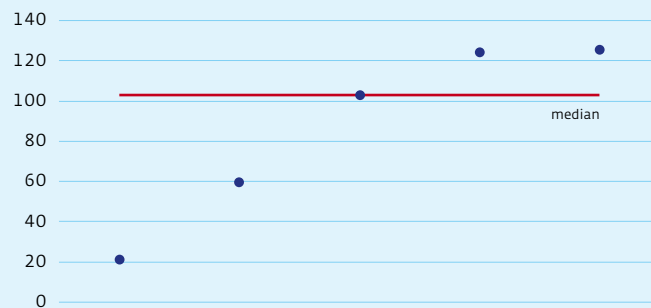
**Figure 19:** WWT energy consumption (kWh/p.e. served by WWTP)



At the advanced level, the EBC-programme analyses the climate footprint of wastewater services. Utilities report on each of the three components, the scope 1-, scope 2- and scope 3-emissions, which are counted together to determine the total carbon footprint.

Figure 20 shows the total climate footprint of the participants of this years' benchmarking exercise in kg CO<sub>2</sub> equivalent per property per year. The climate footprint ranges from 21,1 till 125,6 kg CO<sub>2</sub>-eq. / property, with a median value of 102,8 kg CO<sub>2</sub>-eq. / property.

**Figure 20:** Climate footprint scope 2 per population equivalent served (kg CO<sub>2</sub>-eq./p.e.)



### Economic sustainability

Like with drinking water utilities, wastewater utilities need to make sure their activities are economically sustainable.

Assets need to be maintained in good condition. For this, the programme looks at the percentage of sewer rehabilitation, which is the share of the network that has been renovated or replaced because the condition of the sewers deteriorates. Higher percentages of sewer rehabilitation can be caused by a higher average network age. The median value for sewer rehabilitation for the current EBC group is 0,25 % / year.

Total cost by sales coverage ratio is an important measure for economic sustainability. With this ratio, one can identify if a utility is able to recover its costs from its sales revenues. These revenues consist of all charges to the customers for the collection, transport and treatment of wastewater. With a ratio below 1, utilities will have to rely on other sources of income like subsidies, reserves or income from other activities. More than half of the EBC participants score below 1, making these utilities less likely to be economically sustainable on the long run. The scores range from 0,43 till 1,37, with a median value of 0,95.

Figure 21: Total cost service coverage ratio

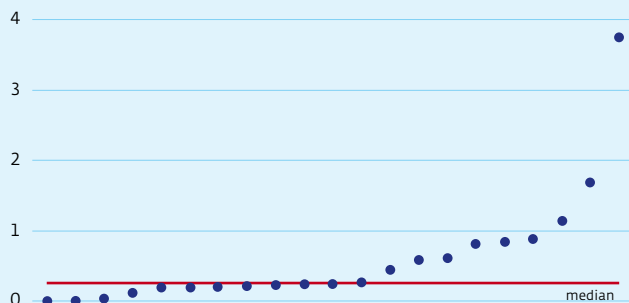
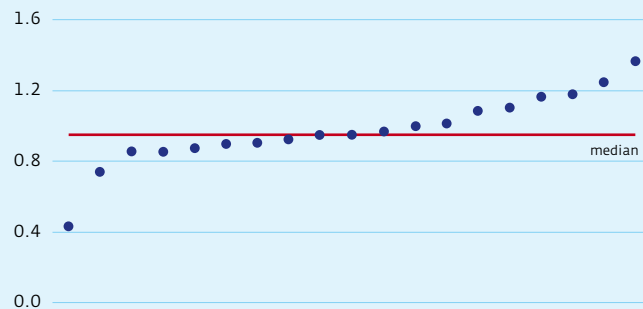


Figure 22: Sewer rehabilitation (%/year)

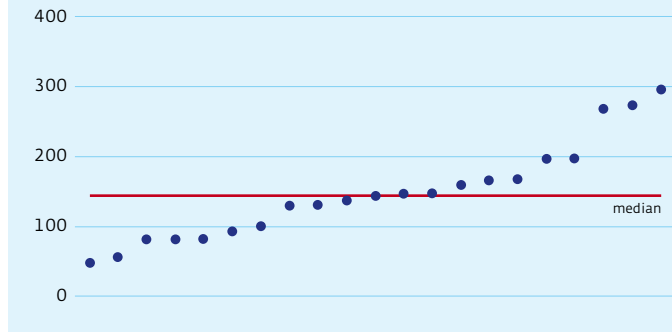


## Finance and efficiency

Like with drinking water utilities, finance & efficiency is a highly relevant topic for wastewater utilities.

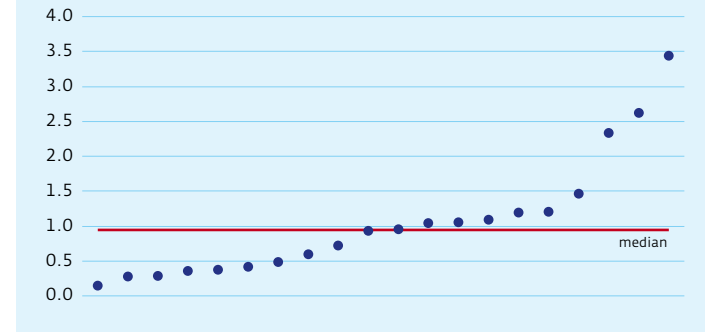
There is a high variance between the EBC participants for the charges for wastewater services per connected property. The average of the 3 highest charges registered is over 4 times higher than the average of the three lowest (€ 280 versus € 63 per property). The median value for the current EBC group is 144 € / property. Corrected for differences in purchasing power the gap between highest and lowest charges reduces to 3,3.

**Figure 23:** Average charges per connected property (€/property)



Personnel intensity is a relevant performance indicator on the efficiency side. It is measured as the number of full-time employees (fte) per 1000 properties. The scores on this indicator are computed using a standard 40 hour full-time working week. In the current EBC group the personnel intensity ranges from 0,15 to 3,44 fte per 1000 properties with a median value of 0,95 fte / 1000 properties.

**Figure 24:** Personnel intensity (fte/1000 properties)



# Performance against the UN SDGs

In 2019/2020, EBC and several leading utilities developed a framework and a set of indicators to measure performance of water utilities against the UN SDGs. Primarily, water utilities are expected to contribute to SDG 6 (providing Clean Water and Sanitation). In addition, in their daily activities water utilities also touch on and can positively contribute to other SDGs like Gender Equality, Affordable and Clean Energy, Industry Innovation and Infrastructure, Sustainable Cities and Communities, Climate Action and Life below Water.

A first pilot in 2020 showed the feasibility of collecting relevant data and reporting in this area of emerging importance. In 2021, together with Waternet (Amsterdam watercycle company) and KWR Water Research, a MSc-student reviewed the framework and indicator set in consultation with participants. This review did not reveal major flaws in the methodology and after implementing some improvements EBC decided to include the SDG-analysis in the benchmarking programme permanently.

Using the SDG-framework in the benchmarking programme helps utilities to track sustainable development from a wide perspective. It can count on a great deal of enthusiasm among our participants. The next benchmarking cycle (IB2021, starting May 2022) will give new participants the chance to join the discussion. Interested utilities are cordially invited to participate in EBC's next benchmarking cycle! ●

|                                                                                                                                            |                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>6 CLEAN WATER AND SANITATION</b><br><br>[zQS-003a] Population coverage, direct and via shared taps<br>(Target Value: 100%)              | [wQS-001] Resident population connected to sewer system<br>(Target Value: 100%)                                                                              |
| <b>1 NO POVERTY</b><br><br>[zG-EBC-012] Number of disconnections due to non-payments<br>(Target Value: 0)                                  | <b>2 ZERO HUNGER</b><br><br>N/A                                                                                                                              |
| <b>3 GOOD HEALTH AND WELL-BEING</b><br><br>[QS-018] Quality of supplied water<br>(Target Value: 100%)                                      | <b>4 QUALITY EDUCATION</b><br><br>[uB-EBC-002] Skills- and training strategy for staff<br>(Target Value: Yes)                                                |
| <b>5 GENDER EQUALITY</b><br><br>[Pe-EBC-007] Female staff<br>(Target Value: N/A)                                                           | <b>7 AFFORDABLE AND CLEAN ENERGY</b><br><br>[zOp-EBC-003] Electricity use for drinking water production and distribution per property<br>(Target Value: N/A) |
| <b>8 DECENT WORK AND ECONOMIC GROWTH</b><br><br>[Pe-022] Working accidents<br>(Target Value: N/A)                                          | <b>9 INDUSTRY, INNOVATION AND INFRASTRUCTURE</b><br><br>[zFi-EBC-065] R&D-expenditures as % of turnover<br>(Target Value: 2%)                                |
| <b>10 REDUCED INEQUALITIES</b><br><br>[uB-EBC-012] Company policy on promoting an inclusive workforce<br>(Target Value: Yes)               | <b>11 SUSTAINABLE CITIES AND COMMUNITIES</b><br><br>[uCi-EBC-054] Resilience plan<br>(Target Value: Yes)                                                     |
| <b>12 RESPONSIBLE CONSUMPTION AND PRODUCTION</b><br><br>[zOp-EBC-004] Residential use of water resources per capita<br>(Target Value: N/A) | <b>13 CLIMATE ACTION</b><br><br>[uCi-EBC-055] Climate adaptation plan<br>(Target Value: Yes)                                                                 |
| <b>14 LIFE BELOW WATER</b><br><br>[wEn-EBC-002] Wastewater – at least primary treatment<br>(Target Value: 100%)                            | <b>15 LIFE ON LAND</b><br><br>[uCi-EBC-064] Area ecologically managed<br>(Target Value: N/A)                                                                 |
| <b>16 PEACE, JUSTICE AND STRONG INSTITUTIONS</b><br><br>[uB-EBC-013] Anti-corruption and anti-bribery policy<br>(Target Value: Yes)        | <b>17 PARTNERSHIPS FOR THE GOALS</b><br><br>[uFi-EBC-045] Proportion of turnover spent on support to developing countries<br>(Target Value: 1%)              |



# Good practices





# Using AI in analysing video images to detect damage in sewer system



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**CCTV inspection is the most popular way to check on the sewer network technical condition. According to International Water Benchmark 2020, approximately 8% of the metropolitan sewer networks are inspected each year. It means that it takes more than 12 years to get a complete picture of the sewer network technical condition. Top companies have twice as good stats, but year-on-year - this information becomes outdated. Hence, it is important to increase the efficiency of inspection techniques. One way to do this is to use artificial intelligence to identify sewer network damages.**

## AI for sewer networks



Two water companies have recently made an attempt to utilize AI in damage detection: hanseWasser Bremen GmbH from Germany and the Municipal Water and Sewage Company<sup>1</sup> of Wrocław, Poland. Both of them have used external technology components.

While the CCTV-Inspectors almost work like before – lowering the camera into the sewer and taking a closer look at any potential damage, the identification of the damage can be outsourced to an AI. That saves labour, either on site or later in the office. So the aim was to develop highly effective algorithms for recognizing damage of the sewer network.

<sup>1</sup> Miejskie Przedsiębiorstwo Wodociągów i Kanalizacji S.A. we Wrocławiu (MPWiK S.A.)



## Municipal Water and Sewage Company of Wrocław

Every year the Municipal Water and Sewage Company of Wrocław uses CCTV inspection to evaluate the technical condition of approximately 100 km of sewer network.

The company decided to test AI damage recognition seeing an opportunity to increase the length of inspected sewer network annually.

The pilot project was conducted as part of the accelerator program – named IndustryLab II. The Municipal Water and Sewage Company cooperated with start-up Molfar AI and the accelerator – DGA. The project was funded from Smart Growth Operational Programme 2014-2020.



The product of this 6 month project was the first version of a cloud service fitted to the Municipal Water and Sewage Company's standards of CCTV inspections. The video footage and some essential data about inspected sewer conduits (i.a. size, shape, material) are the inputs to three-stage processing. The final result of these operations is the report similar to this made manually by CCTV operators on-site.

Training artificial intelligence was a laborious process. In the end, verification of damage recognition performance was carried out on a collection of over 200 videos. Each of the results was evaluated by experienced operators - the average score was 4.13/5. Such a result helped the Municipal Water and Sewage Company to decide on the next steps, i.e. production implementation of Molfar's technology. The conditions for data exchange are currently being defined.

## hanseWasser Bremen GmbH

hanseWasser Bremen inspects approximately 230 km of sewer per year and is looking to increase the inspection performance with the given resources and prepare the inspection team for an expected labour shortage.

In contrast to the Municipal Water and Sewage Company of Wrocław, hanseWasser tested an already existing software solution. hanseWasser focused a bit more on the economic aspects and tried to quantify the time saved on site. Additionally the detection quality was subjectively compared.

The pilot project mainly consists of different types of comparison between the manual and automatic detection. The quality was compared by examining already labelled videos again by the AI. In addition, the quality was tested by random sample checks.





The time saved on site is measured through double CCTV-Inspections – one with and one without AI detection. As this costs a lot of time, in addition, old videos are being analysed and the potential time save is calculated manually. As for a precise quantification, much data is necessary and data collection continues.

### Summary

The Municipal Water and Sewage Company of Wrocław and hanseWasser Bremen GmbH agree on the advantages of AI damage recognition; i.e.:

- higher efficiency – limitation of „manually” repetitive activities
- acceleration of inspection work
- mitigation of shortage in qualified personnel
- more inspections with the same resources
- unified interpretation of CCTV materials
- less error-prone method. ●

# Reduction of CSO load - the role of hydraulic modeling


In 2021, Krakow Water implemented an integrated hydraulic modeling system. The modeling system is one of the largest and most complex in Europe. Nowadays, in Krakow hydraulic modeling is the basis for a reliable determination of connection conditions to sewage networks and the design of new technical infrastructure facilities. It is also helpful in the process of modernising existing storm overflows and designing new ones.

[www.wodociagi.krakow.pl](http://www.wodociagi.krakow.pl)

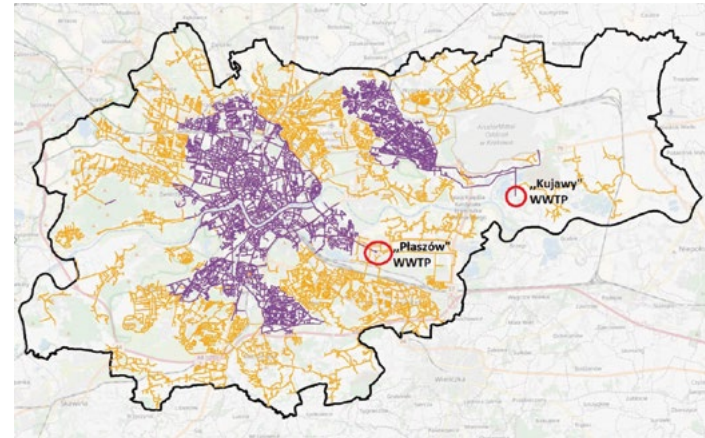


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## Krakow Water's Hydrodynamic Modeling System

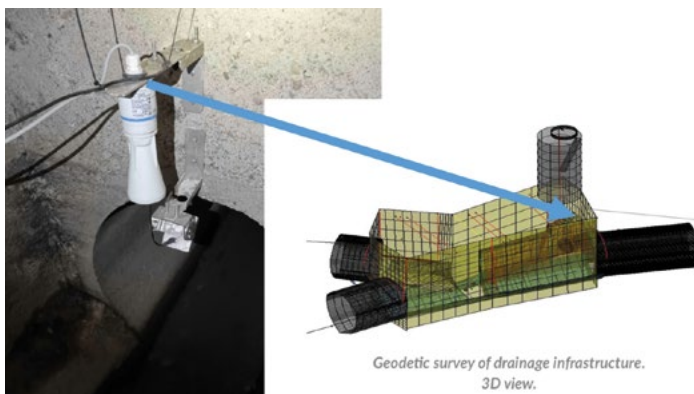
 Krakow has nearly 40 stormwater overflows located along 5 rivers. Due to historical conditions the center of Krakow is equipped with a combined sewer system. The major part of the sewage system goes to the "Płaszów" WWTP, and the other to the "Kujawy" WWTP. The outskirts of Krakow are equipped with a separate sewage system. The layout of the sewage system in Krakow is presented in Figure 1.

Managing such a large system can currently be based on hydraulic modeling. The created 1d + 2d modeling system was built on the basis of a GIS system almost 1:1 and integrated with billing and SCADA databases. To be reliable, the hydraulic modeling system has been calibrated to over 260 measurement units (Fig. 2).



**Figure 1.** Layout of the hydraulic model covering the separated and combined sewer systems of Krakow.





**Figure 2.** Location of measurement unit used in measurement campaign.

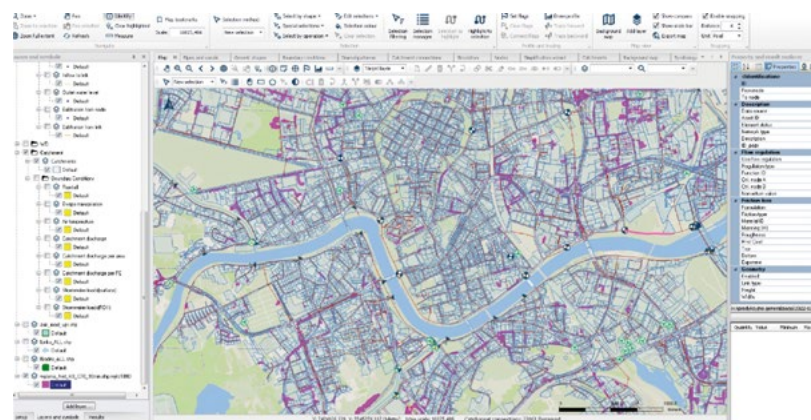
Key characteristics of the Hydraulic Modeling 1d + 2d project implemented in Krakow Water are:

- more than 260 measurement units used for model calibration;
- more than 250 pumping stations with control rules and pumps capacity curves;
- more than 89.000 hydrological catchments;
- more than 1.100 bespoke chambers and tanks mapped based on the volume curves;
- 163 overflow-discharge facilities considering the structure details;
- more than 60.000 billing points assigned to almost 170 flow irregularity curves;
- more than 71.000 network sections with a total length of more than 1.800 km for which approximately 400 non-standard sewer cross-sections were implemented.

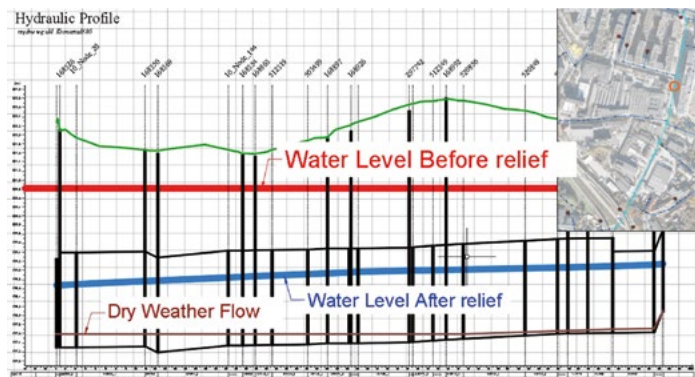
The basic functionality of the model allows for:

- verification of network topology;
- preview of the possible discharge, water level and sewage velocity at each section of the model;
- testing the speed of utilization of reservoirs retention volume;
- analysis of the operational regime of the pumping stations, flow regulators, orifices;
- analysis of the performance and capacity of the existing sewage networks;
- testing of new technical solutions;
- analysis of the impact of new investments on the performance of the sewage networks;
- specification of technical requirements for sewer connections adapted to the real capacity;
- analysis of flood risks.

**Figure 3.** Modeling Software - Window View.



**Figure 4.** Hydraulic profile with various system relief options.



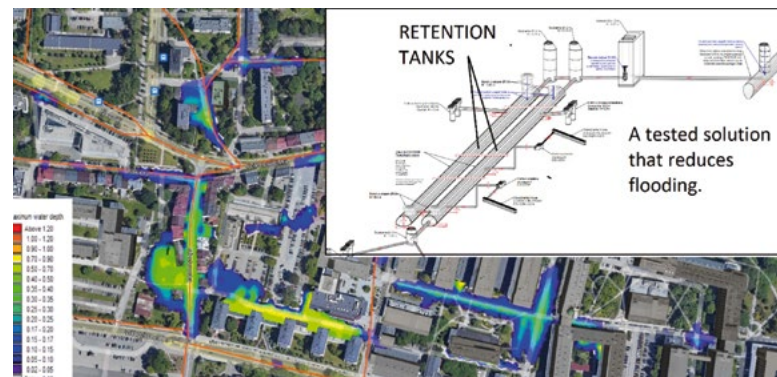
The possibilities that were created through hydraulic modeling as presented above are very large. For example, it is possible to compare the filling in the pipes after the construction of the reliefs and without, as shown in the hydraulic profile (Figure 4).

Testing various solutions on a hydraulic model brings a number of benefits, like the possibility of developing best technical solution as presented in Figure 5.

### Krakow Water CSO reduction program

The benefits of using the hydraulic model in Krakow contributed to the launch of a program for the reduction of discharges through storm water overflows. Further development of the smart systems for the purpose of real-time analysis and forecasting of rain events and their impact on the network performance and flood risk contributes to the development of the flood reduction program and real time control. It is not without significance for this program that Krakow Water has the largest rain gauge system in Poland, located in the municipal catchment area.

**Figure 5.** Flood map based on 2d modeling.

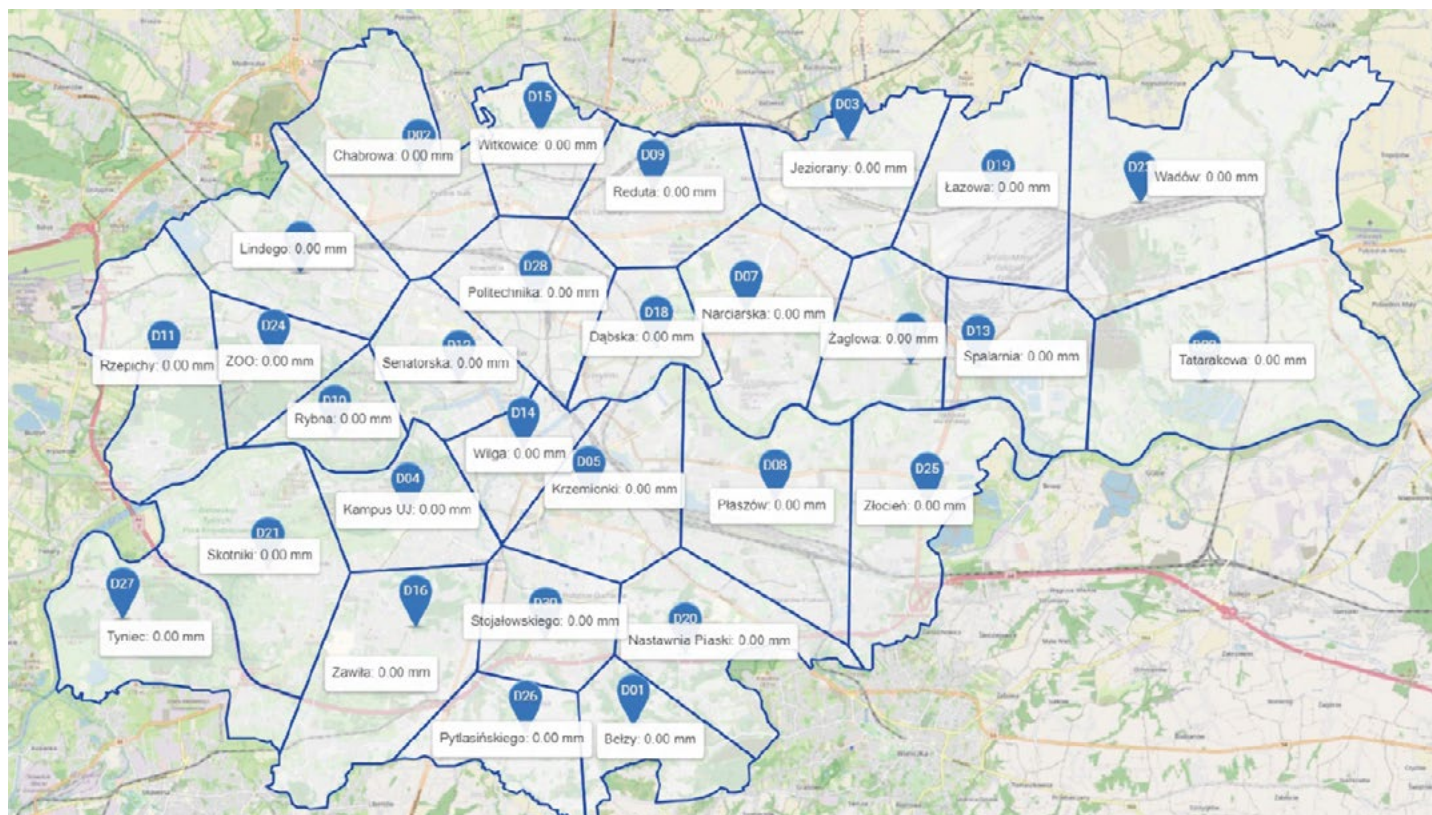


The data from rain gauges is used to run the model with real rainfall and this contributes to the possibility of long-term calculations and the analysis of discharges by storm overflows. The possibility of calculating the hydrological model with the use of real and synthetic rains then contributes to the optimization of the sewage system in Krakow. For example, these are movable overflow crests (increasing the crest causes greater dilution of sewage and less discharge) and real time control valves located on the network.

In summary, there are many advantages using hydraulic models. To be a good tool, the model must be updated regularly and recalibrated. For this purpose, a modeling department was established in Krakow Water. Every day, the Modeling Department deals with the development of concept designs and updating of the hydraulic model. Also, it is responsible for the implementation of the real-time and predictive modeling system. ●



Figure 6. Location of Krakow Waters rain gauges.



# Participants' experiences



# Think blue to make your city green, resilient and innovative

Águas e Energia do Porto is a public utility responsible for the management of water and energy in the Municipality of Porto (Portugal), serving 157.949 customers and a population of about 500.000 city users per day. The company was established in 2006 to manage the urban water cycle, creating economic and social value and developing good environmental practices, aligned with the United Nations Sustainable Development Goals, Paris Agreement for Climate Change and European Green Deal.

[www.aguasdoporto.pt](http://www.aguasdoporto.pt)



**Inês Costa**  
Strategic Planning and  
Management Control Specialist  
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Águas e Energia do Porto continues the services provided by the former Porto SMAS (Municipal Water and Wastewater Services), whose activity dates to 1927. The water supply and wastewater systems have a centuries-old history. The domestic water supply to the city of Porto began in 1886 and was executed by the private French Company Générale des Eaux pour l'Étranger. For nearly twenty years after (1907), the initial wastewater system was concluded by the British company Hughes & Lancaster Limited. This was one of the first separated sewer systems in Europe: stormwater resulting from rainfall and sewage coming from houses are discharged in two separate sewer pipes.

Nowadays, Porto is on the way towards becoming a water-wise city. The aim is to ensure that water is integrated in urban planning and design to increase community livability and climate resilience. To this end, Águas e Energia do Porto follows an innovative management model: the integrated and sustainable management of the urban water cycle. We believe that water is a key driver for sustainable development and climate transition.

Besides supplying water with excellent quality, with a good level of non-revenue water and low energy consumption, and the operation of



Replacement of traditional meters with smart meters. In 2020, 43,5% of the company's clients had smart meters.

two WWTP with tertiary treatment, our utility is also responsible for stormwater drainage, rivers and streams clean up and rehabilitation, bathing water quality and seafront valorization, and environmental education promotion. The outcome of this strategy is improving climate change adaptation and mitigation with greater resilience to extreme climate events and societal disruption through increased use of water-smart solutions.

Porto endorsed the IWA Principles of Water-Wise Cities in 2019. It means that all water within the city is managed in a way that recognises the connection between services, urban design and the basin, with an approach that maximises the achievement of urban liveability outcomes, and resilience to unexpected social, economic or bio-physical shocks, while replenishing the environment.

Our company is considered one of the water sector leaders in Portugal and aims to be a utility with international recognition. As such, participation in benchmarking exercises is essential to achieve this goal. In addition to the use of Balanced Scorecard as a strategic management performance metric to identify and improve internal business functions and their resulting external outcomes, we have a broad experience in the annual performance assessment of service quality conducted by Portuguese Water and Waste Services Regulation Authority (ERSAR).

In this context, the Board of Directors of Águas e Energia do Porto took the decision to participate, for the first time, in the European Benchmarking Co-operation (EBC). We trust that the comparison with international utilities will actively contribute to the implementation of measures leading to improvements in our business. As shown in our national experience, benchmarking creates benefits for all stakeholders from customers to employees, shareholders and local community.

It should be noted that EBC provides access to an individual evaluation report, divided by themes, in which the company's performance is analysed in comparison with other participants. This report is a great support to identify performance gaps and best practises that will guide us to improve efficiency and to achieve a competitive advantage. The KPIs and the graphical PIs form a key part of the revision of our strategic planning process.

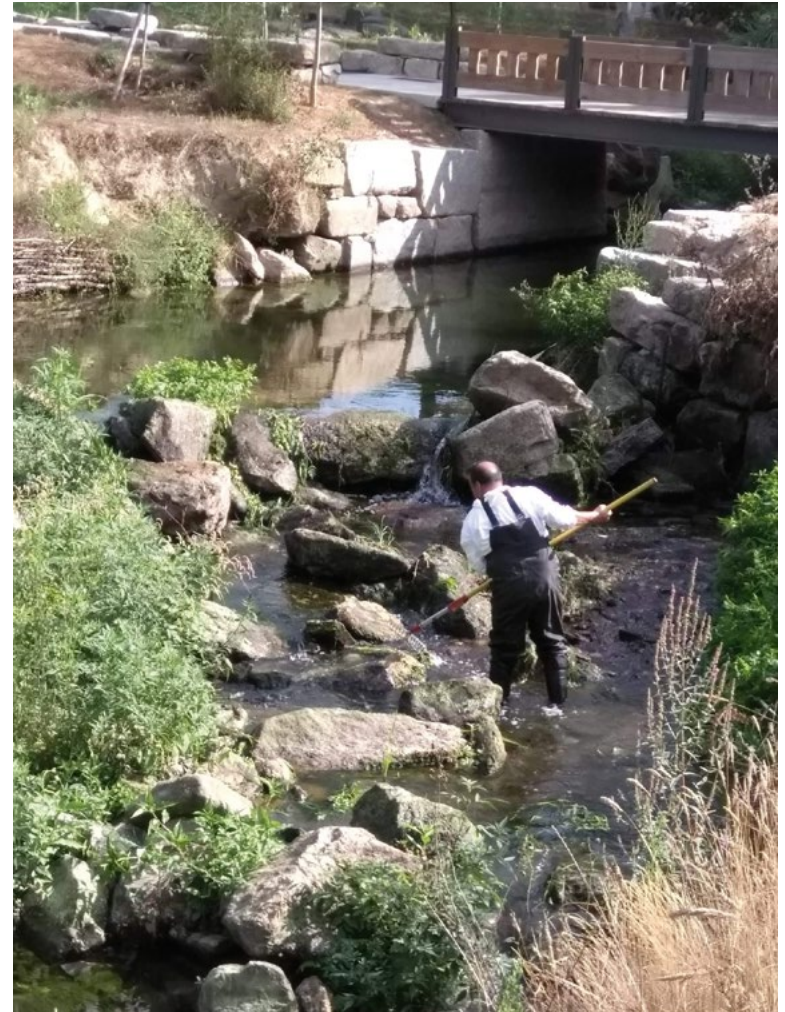
By looking at other companies that have proven their success, this benchmarking exercise has the ability to assist water utilities in discovering new opportunities that can help boost growth and improve service quality. We are confident that the in-depth analysis process is important to put Águas e Energia do Porto one step ahead in terms of new trends and challenges, namely regarding the SDGs applied to water and wastewater, the climate footprint assessment, and the impact measurement approach.





Cleaning up and rehabilitation of urban streams

Giving a platform for exchange of experiences and good practices among utilities from different countries, the EBC also provided a rich discussion of priority topics for water and wastewater services among renowned experts through webinars and the Knowledge Picnic. Last but not the least, we recommend the participation in this strong and credible survey because it is a source of employees' motivation and engagement, encouraging them to work towards more ambitious goals. ●



# Endnotes

**1. Share of (waste)water bill in household consumption**

**expenditures** is the percentage that the average (waste)water charges per property represents of the calculated household consumption expenditures.

**2. Average water charges** are calculated by dividing a company's revenues (direct revenues, residential, non-residential, or revenues from exported water), by the number of m<sup>3</sup> of authorized consumption, connected properties, or exported water (direct, residential or non-residential respectively).

**3. The total costs** are the sum of capital and running costs. Capital costs are defined as net interest plus depreciation, while running costs include personnel costs plus operational costs (external services, energy costs, purchased merchandises, leasing and rentals, levies and fees, exceptional earnings/losses, other operating costs).

**4. Average wastewater charges** are calculated by dividing a company's revenue (fees for collecting, transporting and treating the wastewater), by the number of properties connected to the sewer system managed by the utility (in apartment buildings, each household/property is counted separately).





# Colophon

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