Costs of the Urban Waste Water Treatment Directive Reform - Removal and Management of Micropollutants

Mona Arnold, Mika Naumanen and Inka-Mari Sarvola.

Background

- The European Parliament and the Council approved the new Urban Waste Water Treatment Directive (UWWTD) in autumn 2024. The updated directive particularly expands the obligations of large treatment plants to remove harmful substances, known as micropollutants. The directive proposes an extended producer responsibility (EPR) system for the pharmaceutical and cosmetics industries, whose products contribute micropollutants to urban wastewater. According to the polluter pays principle, producers will cover at least 80% of the investment and operating costs. Additionally, producers will bear the costs of collecting and verifying product information and other costs related to implementing the extended producer responsibility.
- A method to assess which pharmaceutical or cosmetic product ingredients can end up as micropollutants in nature has not yet been developed. There is also no list of such ingredients (*hereafter "harmful substances")*.

Directive Obligations

The obligation to remove micropollutants applies to all plants with a population equivalent (PE) of over 150,000 (7 plants in Finland) and the remaining 10,000-150,000 PE plants (approximately 70 plants in Finland) based on risk assessment.

The removal at plants with over 150,000 PE will be implemented in phases:

- 20 % > 150,000 PE plants by 31.12.2033
- 60 % > 150,000 PE plants by 31.12.2039
- All > 150,000 PE plants by 31.12.2045.

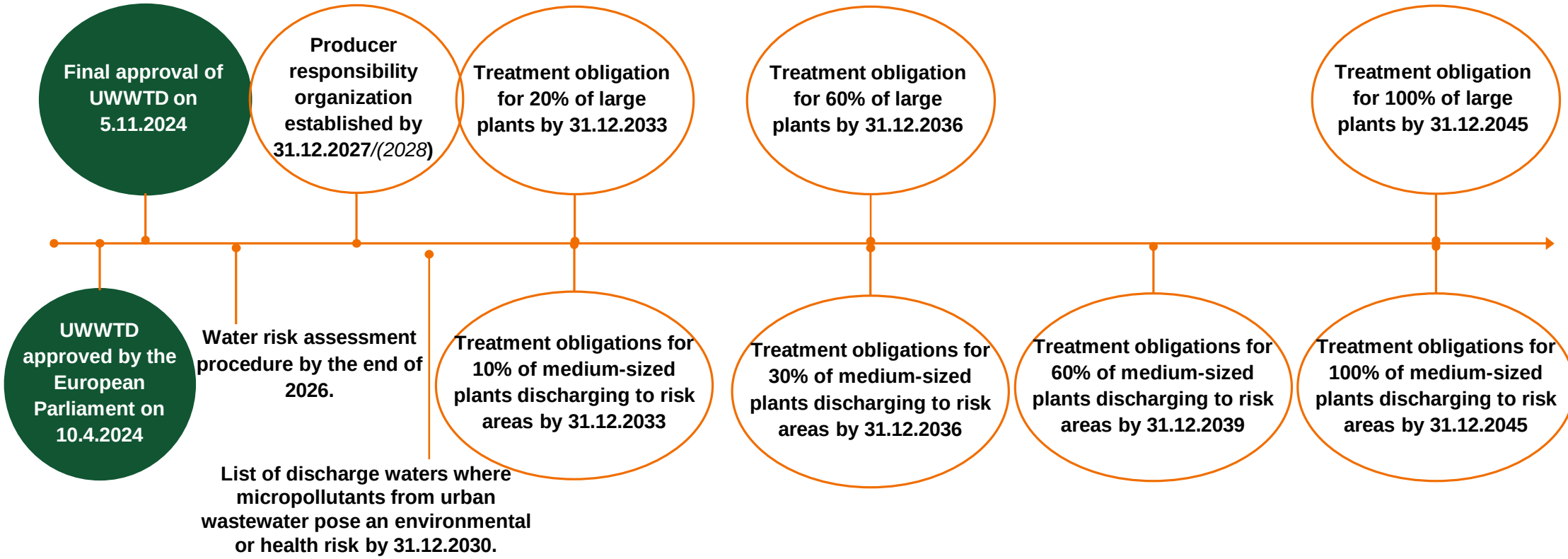
- A list of discharge waters where the concentrations or accumulation of micropollutants from urban wastewater pose an environmental or health risk must be made by 31.12.2030
- All producers participate in the producer responsibility organization. Exemptions can be granted to producers who demonstrate one of the following:

a. The amount of the substance in products placed on the Union market is less than 1 ton per year
b. The substance in their products is rapidly biodegradable in wastewater and does not generate micropollutants at the end of the product lifecycle.

Measures implemented based on the risk assessment

- Treatment obligations for plants discharging to risk areas with 10,000 – 150,000 PE:
  - 10 % 10 000 – 150 000 PE plants by 31.12.2033
  - 30 % 10 000 – 150 000 PE plants by 31.12.2036
  - 60 % 10 000 – 150 000 PE plants by 31.12.2039
  - All listed 10 000 – 150 000 PE plants by 31.12.2045
- The risk assessment procedure will be developed by the EC by the end of 2026.

Implementation Timeline



Micropollutant Removal – technologies and costs

Inka-Mari Sarvola ja Mona Arnold

Objectives

- Assessment of technologies suitable for the removal of micropollutants
  - Description and comparison of technologies suitable for the removal of micropollutants, as well as the costs of installations/operations
- Based on an interview study, the wastewater treatment costs were assessed according to the current version of the wastewater directive and its likely implementation
  - Cost estimate for wastewater treatment, primarily based on estimates from treatment plants and technology suppliers/literature

Sources of information for the cost and technology study

- Interviews and email surveys
  - Wastewater treatment plants in Finland with a population equivalent (PE) of over 150,000
  - Three medium-sized treatment plants
  - Authorities and umbrella organizations
    - Ministry of the Environment
    - ELY Centre
    - Vesilaitosyhdistys, Kosmetiikkateollisuus ry, Svenskt Vatten, Dansk läkemedelsindustri, Verband Schweizer Abwasser- und Gewässerschutzfachleute – VSA, Verband der Chemischen Industrie e.V. – VCI
- Reports and assessments
  - Rajala, Haimi & Lindholm (FCG) 2023
  - Pistocchi et al. (JRC) 2022
  - UBA 2023
  - Svenskt Vatten 2021
  - Hug & Joller 2024
  - VVY 2016

Table 6: Interviewed Finnish wastewater treatment plants.

> 150,000 PE
HSY (Viikinmäki ja Blomminmäki)
Turun seudun puhdistamo Oy
Tampereen Seudun Keskuspuhdistamo Oy
Jyväskylän Seudun Puhdistamo Oy
Lahti Aqua Oy (Kariniemi ja Ali-Juhakkala)
Porin Vesi
Oulun Vesi
10,000 – 150,000 PE
Säkylä
Mäntsälä
Lapinlahti

Technology options

- Granular activated carbon (GAC)
  - Granular activated carbon is used in filters through which wastewater is directed. Contaminants adhere to the activated carbon through absorption, but the filters must be replaced regularly to maintain absorption efficiency.
- Powdered activated carbon (PAC)
  - Powdered activated carbon is added to the sludge, where it absorbs contaminants if the contact time is sufficiently long. The activated carbon remains in the sludge and must therefore be considered in the subsequent treatment of the sludge.
- Ozonation
  - Oxidation of contaminants and other dissolved organic matter using ozone

➢ Combination of above listed technologies.

- Actualized investments abroad indicate that the differences in the costs of technology investments are quite small. Additionally, achieving the purification goal requires that the chosen purification solution is supplemented with post-treatment, which is usually implemented as a sand filter.
- No other market-ready solutions are known

Results of interviews with Finnish wastewater treatment plants – summary 1/2

- Out of the interviewed wastewater treatment plants with over 150,000 PE, four out of seven have conducted some form of preliminary study
- The total investment costs, including construction, range from 5 to 150 million euros per plant (Table 6)
- The construction cost alone is in the millions or tens of millions of euros (including excavation of underground facilities) per plant
- The operating costs are estimated to range from 0.6 to 9 million euros per year per plant
- Monitoring costs are estimated to be in the tens of thousands of euros per year per plant
- Reporting costs are estimated to be in the thousands of euros per year per plant

> 150,000 PE WWTPs (waste water treatment plants)

Table 6. Utility interview results

^based on conducted interviews, if not stated otherwise in the notes

Utility	Plant	Person equivalent PE	Inventment and construction cost million € ^	note
Oulun Vesi	Taskila WWTP	204 934	**5-6**	Source: Rajala, Haimi & Lindholm (2023)
Porin Vesi	Luotsinmäki WWTP	243 442	**1.6-39**	Estimated based on Rajala, Haimi & Lindholm (2023) using the whole cost range.
Lahti Aqua Oy	Kariniemi and Ali-Juhakkala WWTPs together	246 000	**1.6-39**	Estimated based on Rajala, Haimi & Lindholm (2023) using the whole cost range.
Jyväskylän Seudun Puhdistamo Oy	Nenäinniemi WWTP	250 000	**18**	Estimation by AFRY (Switzerland)
HSY	Blominmäki WWTP	335 800	**20-21**	Estimated by scaling from HSY Viikinmäki WWTPs costs.
Tampereen Seudun Keskuspuhdistamo Oy	Sulkavuori central WWTP	430 000	**23-40**	Estimated based on costs for Turun Seudun Puhdistamo Oy (Rajala, Haimi & Lindholm, 2023) as the plants have the same PE capacity and both are located underground.
Turun seudun puhdistamo Oy	Kakolanmäki WWTP	450 286	**23-40**	Source: Rajala, Haimi & Lindholm (2023)
HSY	Viikinmäki WWTP	1 344 370	**145-150**	Source: EU-Interreg –project CWPharma2
Kokonaiskustannus			**237-353**	
			vs. the Finnish MoE's estimation 400	Government Union communication U120/2022VP, the assessment of which is based on VVY's report

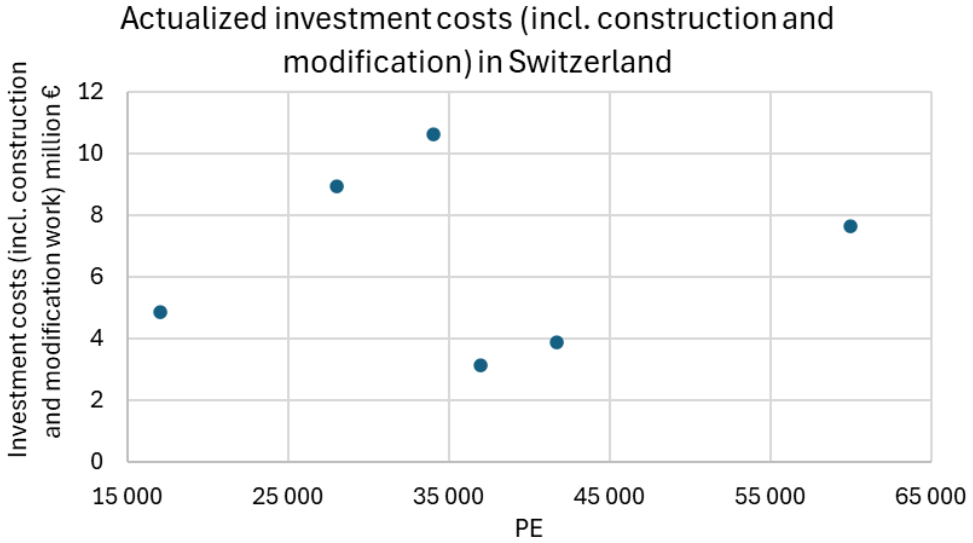
Results of interviews with Finnish wastewater treatment plants – summary 2/2

- There are no preliminary studies or cost estimates available yet for medium-sized treatment plants.
- The actual risk assessment for the discharge waters of treatment plants with over 10,000 PE must be completed by December 31, 2030. All treatment plants must conduct the first risk assessment.
- Preliminary estimates suggest that the risk assessment is unlikely to indicate a need for micro-pollutant removal at many treatment plants. However, everything depends on the chemicals under the environmental quality standards set by the directive and the levels given for them. For example, currently a European-level discussion is on-going about the harmful concentrations of diclofenac.

Medium sized 10,000-150,000 PE treatment plants

- The assessment is based on the actual costs of medium-sized treatment plants in Switzerland*. On average, the total investment costs have been 6 million CHF (7 million euros)**.
- Roughly estimated, 10-100% of medium-sized plants in Finland may need to invest in the removal of micro-pollutants***, resulting in a total cost of 46-463 million euros compared to the 250 million euros mentioned in the U-letter

Figure 1. Actualized investment costs in Switzerland.



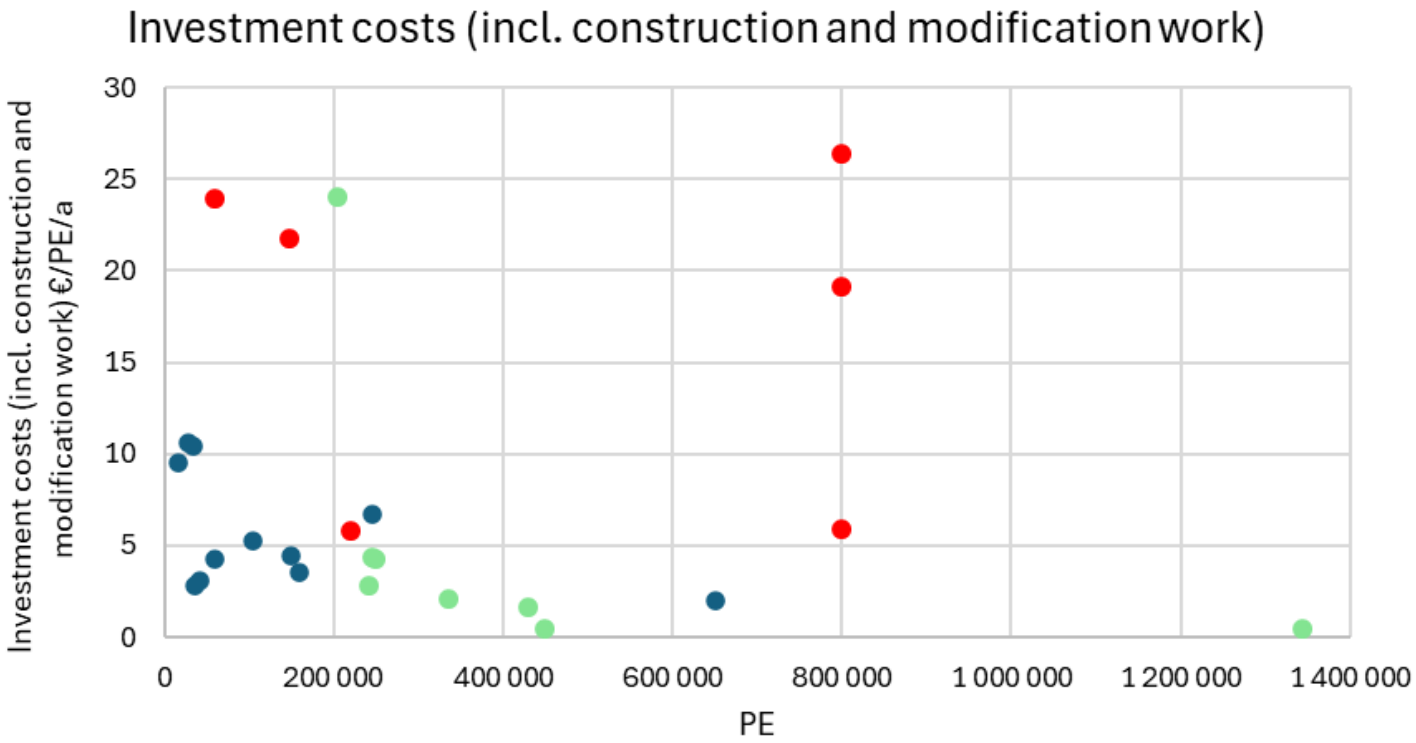
*Medium-sized treatment plants in Finland are roughly the same size as the medium-sized plants in Switzerland that have made investments (Hug & Joller 2024 and VSA).

**Sources: Hug & Joller 2024 and VSA. CHF converted to euros at the exchange rate on October 11, 2024

***Currently, there is a discussion about the presence of diclofenac and stricter removal obligations. If this is decided, the purification obligation will practically apply to all medium-sized (71) treatment plants in Finland.

Significant cost differences between plants

Figure 2. Comparison of investment cost estimates and actual costs in Finland, Sweden, and Switzerland.



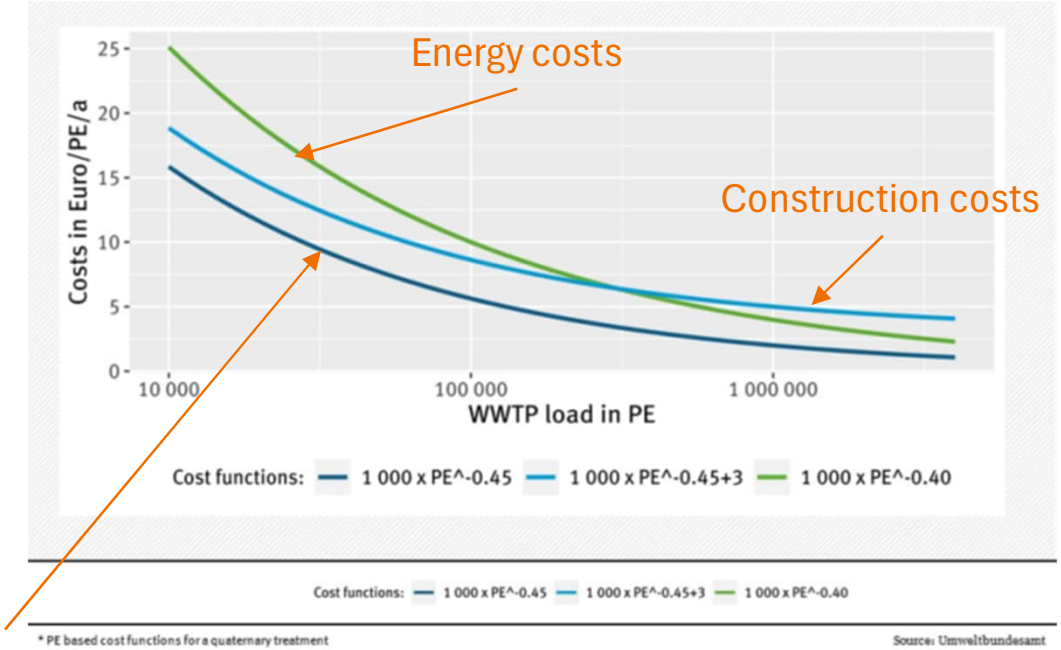
CHF converted to euros at the exchange rate on October 11, 2024, and the annual cost is roughly calculated over a 30-year payment period with 0% interest.
SEK converted to euros at the exchange rate on November 14, 2024, and the annual cost is roughly calculated over a 30-year payment period with 0% interest

Finnish cost estimates *(interviews and Rajala, Haimi & Lindholm (FCG) 2023)*
Swiss actual costs *(Hug & Joller 2024 and VSA)*
Swedish actual costs and estimates *(Svenskt Vatten 2021)*

Aspects affecting the costs

- Space required for new equipment
  - does it require new buildings or rock excavation
  - is there space on the treatment plant site for the new equipment, or does the wastewater need to be pumped to a treatment unit located elsewhere and then directed to the discharge site
- Existing infrastructure
- Energy and construction prices
- Technology choice has a small impact on costs

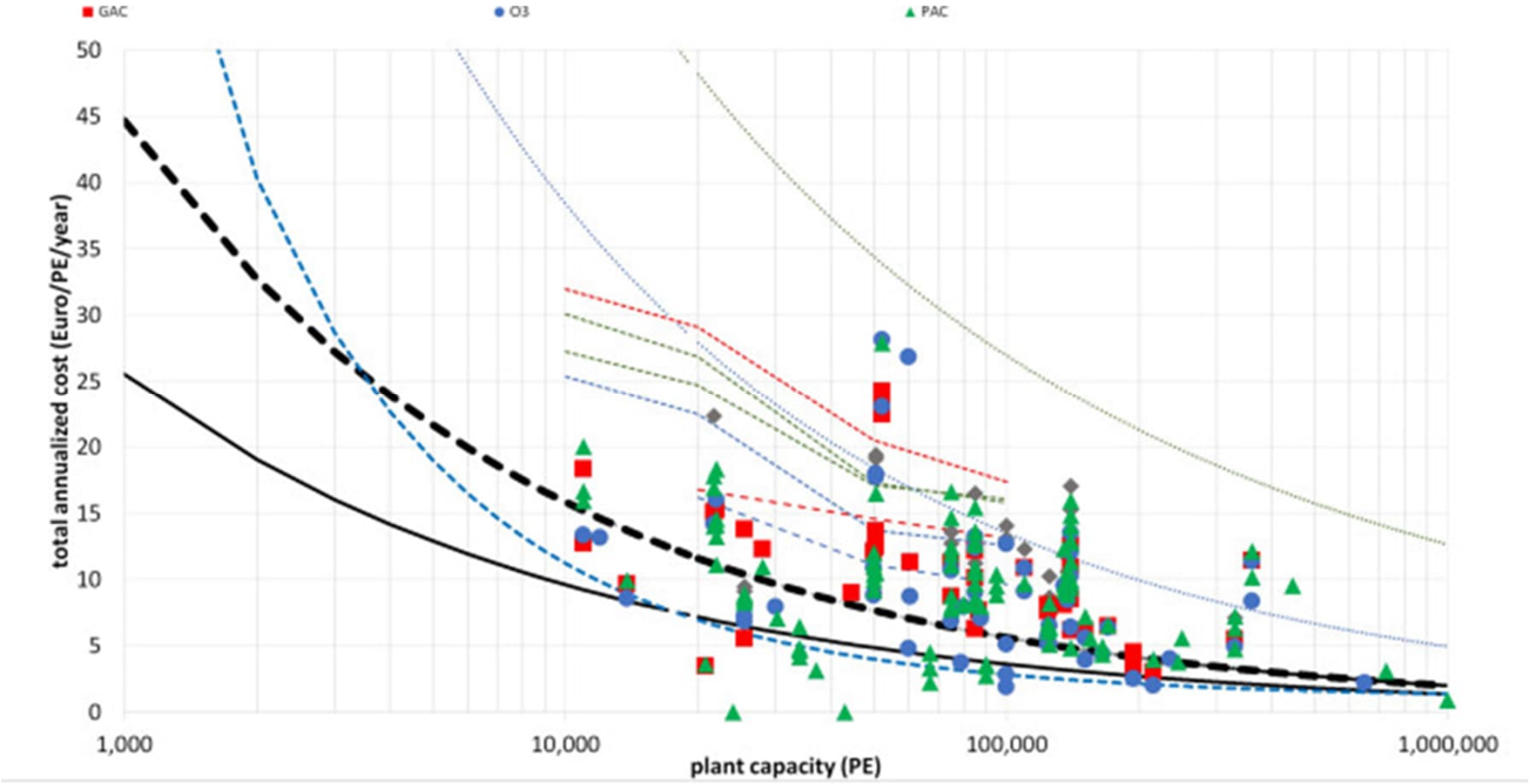
Figure 3. Aspects affecting the cost function. Source*: UBA 2023.*



Modelled by EC/JRC, Pistocchi et al. 2022

Example: The effect of plant size on the cost estimate

Figure 4. Cost curves fitted for different purification techniques based on actual costs. Source: Pistocchi et al. (JRC) 2022.



- As the size of the plant increases, the cost per PE decreases.
- There is particularly great variation in the costs of medium-sized plants.

Conclusion

Conclusion: Investment costs

- Market-ready technology options include powdered and granular activated carbon and ozonation, along with post-treatment such as sand filtration.
- Total investment and construction costs for large wastewater treatment plants (seven plants) are estimated to be approximately 237-353 million €.
- Total investment and construction costs for medium-sized wastewater treatment plants (71 plants) are estimated to be ca 46-463 million €, depending on the risk assessments, which require 0-100% of plants to invest in removal.
- Investments will take place between 2030 and 2045. However, due to the significant variation in investment costs across different plants (€1.6–150 million per plant) and the absence of utilities' finalized investment schedules, it is not yet possible to allocate costs to specific years.

Conclusion: Operating and Monitoring Costs

- Operating costs are estimated to be in the range of 0.6-9 million € per year per plant.
- Estimated monitoring costs are tens of thousands of € per year per plant.
- Estimated reporting costs are thousands of € per year and per plant.

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