**United Nations University**
Institute for Integrated Management of Material Fluxes and of Resources

POLICYBRIEF
No. 2, 2025
A training outcome of the Knowledge Academy for the Resource Nexus (KARE)

# Mitigating Water Stress Public-Private Partnership for Circularity of Wastewater

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## Highlights

- Water scarcity affects one-third of the global population, with agriculture and industries being the largest consumers of freshwater.
- Only 2.4% of treated wastewater is reused in the EU, while 80% of global wastewater is discharged untreated, posing environmental and health risks.
- Public-Private Partnerships (PPPs) can support sustainable municipal wastewater reuse by minimizing cost, infrastructure, and technical issues.
- Advancing wastewater reuse through PPPs enhances urban resilience, supports water circularity, and contributes to achieving Sustainable Development Goal 6 - Clean Water and Sanitation (SDG6).

Water scarcity is a well-known and pressing global problem, affecting around one-third of the world's population. With rising demand from industrial and domestic activities, the situation is further expected to worsen. The water stress also negatively impacts human and economic health (UNDP, 2006).

Agricultural activities account for approximately 70% of the total water usage and the intensified usage of water in industries accounts for another 22% of the consumption of global freshwater (FAO, 2016). Power generation, manufacturing, mining, and construction industries are the main consumers of the water. Furthermore, the rate of industrial water abstraction in Asia and South-Central America in comparison to European Union varies highly as shown in Figure 1. This demand is regularly increasing globally because of industrial intensification.

One alternative to mitigate water stress includes incorporating wastewater into industrial usage. Yet, until today around 80% of the of the wastewater produced globally is released to the environment without treatment, posing a threat to environmental and human health (UN 2017). In the EU, only 2.4% of the treated wastewater is being used, indicating a great potential for further utilization

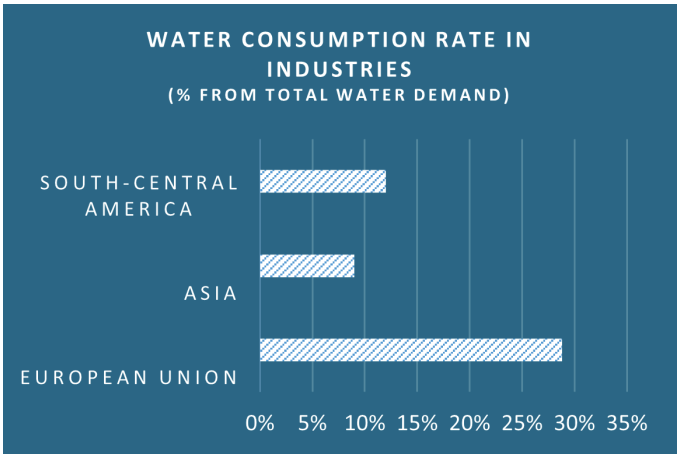


Figure 1 Rate of water consumption in Industries (FAO, 2000; 2012)

(Deliotte 2015).

Wastewater has already been used in the industrial sector by many organizations in the form of different water reuse schemes. Here we expand on the alternative of reusing municipal wastewater in industry by bringing the public water utilities and the industrial users under a Private–Public Partnership (PPP). The inclusion of the private sector in water resource management has been widely advocated (Majamaa Groot and van den Broek 2009, Otoo Mateo-Sagasta and Madurangi 2015) and it has become one of the key strategies for implementing the European Green Deal (EC, 2020). PPPs are known to facilitate the sustainable management of urban water resources through the participation of the private sector in water infrastructure projects, and for the transfer of technological know-how and financial capacity (Regan Smith and Love 2011, Li et al 2020).

When asking the question **"How can a PPP for wastewater treatment and industrial use be implemented?"** it is important to consider what drives and what poses a barrier to the scheme. Barriers and drivers form a system of factors and cause-and-effect chains, which affects the outcome of the water reuse project.

### Resource Nexus perspective

The **Resource Nexus perspective** is essential for addressing interdependencies between **water, energy, and materials**. Wastewater is not just a waste product but a resource that, when managed holistically, can contribute to **water reuse, energy recovery, and nutrient cycling.**

- **Cost factors**

Naturally, in any infrastructure project, the most important aspect to consider is financial capacity and cost-risk allocation. Costs related to the capital expenditure, such as the pipeline infrastructure connecting the WWTP to the industry or the potential change within the industrial process to enable reclaiming water, have the highest impact in terms of capital allocation. Another important part of the project's financial feasibility are the O&M costs, which are related to the operation of the facility and the expenditure on chemicals for treating damages related to biofouling, corrosion, or scaling of the cooling system.

- **End-use considerations**

Apart from the implementation phase of the project, costs associated with the end user are found to be one of the most crucial components for incentivisation. Specifically, the difference in price between conventional and reclaimed water is often considered the primary barrier by the private sector to partake in the PPP. The additional costs associated with the treatment and transportation of the wastewater result in a higher water tariff from the conventional source. This would require an enabling governmental environment to guarantee revenue for the private actor through the project. To this end, lack of water availability is a driving factor for companies to seek alternative sources to sustain their competitive advantage. Taking economy of scale into consideration, large water-intensive industries operating in a stringent water-regulating environment would benefit from such a scheme. Furthermore, WWTPs with larger capacity in terms of volume of wastewater treatment would distribute more efficiently costs, resulting in a lower tariff of the reclaimed water.

- **Local infrastructure dependence**

The state of local infrastructure is one key aspect that defines the implementation of the scheme. Quality and quantity of wastewater are cost-determining factors that rely on the suitability of the infrastructure. Companies rely on constant and steady water flow, and therefore potential volume fluctuations in wastewater need to be addressed through buffer-tanks. Furthermore, the condition of the pipeline, as well as the connectivity with the company influences the costs associated with maintenance and construction, respectively.

### PPP win-win examples across the Globe

- **Netherlands:** A leading chemical company replaced desalinated seawater with municipal wastewater as a result of discussions with local water utilities (Majamaa, Groot, and van den Broek W 2009);
- **California:** Partnership between a wastewater treatment plant and a refinery repurposed the wastewater in their boiler feed, thus creating value for both and the community (Otoo Mateo-Sagasta and Madurangi 2015);
- **India:** Governmental policy forbidding groundwater abstraction led to a PPP for industrial water uptake in a large chemical company (Lahnsteiner and Mittal 2010).


Figure 2 Keys aspects for a successful PPP

- **Engagement of stakeholders**

Technical, financial, and governmental aspects are only partially explaining the dynamics of a PPP. As in any partnership, the particular needs of the involved actors have to be mostly met. To this end, timely communication of the needs and objectives related to the project is crucial. In addressing the global challenges of water stress and urban transformation, synergies need to be identified in order to increase resilience of urban areas. Fostering the industrial use of wastewater through a PPP will not only enhance the resilience of urban systems, but will also bring tangible progress towards SDG6. To guarantee success of this promising partnership the following must be kept in mind:

› Water reuse applications are not only economically and technologically dependent but multifaceted.

Even though economic criteria such as infrastructure costs, water price, and capital investments are undoubtedly the central factors influencing feasibility, other factors such as governance, communication, and environmental conditions are also fundamental aspects of a successful PPP.

› Fit-for-purpose policies are important for facilitating water reuse applications.

Fit-for-purpose water regulations that allow the reuse of water based on the quality requirements of the targeted use combined with financial incentives, such as reduced tariffs for reclaimed water use or subsidies to companies, provide the pathway for enhanced water circularity.

› Need for enhanced and clear communication for win-win partnerships.

Information sharing and interest alignment are essential for cross-sectoral collaboration. This is a crucial component that needs to be addressed, as the difference in priorities of the sectors is one of the main challenges to be overcome. A shared understanding and vision of the project also leads to the best finance model, which in turn could ensure the success of the project.

### Call for Action

1. Foster cross-sector collaboration through clear communication and shared vision. Open call for exchange of information and objectives, even prior to the publication of the tender by the public sector.

2. Adjust water price so that wastewater is financially viable to water intensive industries.

3. Adapt water reuse standards to accommodate water quality specifications required by industry.

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Acknowledgements:
We sincerely thank Serena Coetzee, Thato Masire, and Andrew Dunn for their support and expertise, which were instrumental in refining our work. Additionally, we would like to acknowledge the contributions of the co-authors Serena Caucci, Jonathan Clive Morris, Edeltraud Guenther, and Peter Krebs whose work formed the basis of this policy brief.

This policy brief is the output of training presented by Andrew Dunn (UNU-CRIS) and Thato Masire (UNU-FLORES) to NEXtra doctoral researchers at UNU-FLORES in 2024/25. The training was partially funded by DAAD (Deutscher Akademischer Austauschdienst).