



IN PARTNERSHIP WITH



EVENT REPORT

# CIRCULAR WAYS

PROMOTING CIRCULAR  
APPROACHES IN WASTEWATER  
TREATMENT

Verona, Biblioteca Capitolare, 29 June 2023

# EXECUTIVE SUMMARY

---

Adopting circular approaches to wastewater treatment provides real opportunities to achieve societal objectives on waste minimisation, sustainable agriculture and energy generation, and holds clear environmental and geo-political benefits. However, the shift to circularity requires a complex combination of appropriate regulatory framework, new technologies and effective coordination between different sectors and stakeholders.

On 29 June 2023, Aqua Publica Europea organised, in partnership with Viveracqua and Acque Veronesi, the public seminar "CIRCULAR WAYS: Promoting circular approaches in wastewater treatment" in Verona, Italy, to explore the conditions for accelerating the shift towards a circular approach through insightful contributions from water operators, policymakers and stakeholders.

After a summary overview of the ongoing revision of the Urban Wastewater Treatment Directive (UWWTD) and of the evaluation of the Sewage Sludge Directive (SSD) by a representative from DG Environment, public water operators from Scotland and Hamburg

and a representative from the Veneto Region shared their approach to sludge management in the context of the circular economy and the wider journey to energy neutrality.

After the break, a representative from DG Research and Innovation presented a series of European projects related to circularity in the water sector and provided insights into the European Commission's research and innovation agenda in relation to circularity. This was followed by two presentations from public water operators from Como and Milan of innovative approaches related to the treatment and valorisation of sludge.

The seminar closed with a panel discussion with representatives from DG Research and Innovation, the European Sustainable Phosphorus Platform (ESPP) and the University of Verona. The panel concluded that there is no one-size-fits-all solution to circularity and that approaches can be combined according to contextual conditions, but that there is a crucial need for political choices on the appropriate mix to be made at national and local levels to bolster circularity.





## BACKGROUND

Wastewater treatment processes are essential to avoid that the water we discharge into the environment after domestic or industrial use deteriorates the ecological status of Europe's rivers, seas and eco-systems.

Adopting circular approaches to wastewater treatment provides real opportunities to achieve societal objectives on waste minimisation, sustainable agriculture and energy generation, with clear environmental and geo-political benefits.

However, the shift to circularity requires a complex combination of appropriate regulatory framework, new technologies and effective coordination between different sectors and stakeholders.

In light of the current revision of the Urban Wastewater Treatment Directive (UWWTD) and the publication of the evaluation of the Sewage Sludge Directive (SSD), the seminar "CIRCULAR WAYS: Promoting circular approaches in wastewater treatment" explored the conditions to reach the right mix through insightful contributions from water operators, policymakers and stakeholders.

# INTRODUCTORY REMARKS



## **BERNARD VAN NUFFEL**

*President of Aqua Publica Europea  
and of VIVAQUA*

**Bernard Van Nuffel**, President of Aqua Publica Europea and of VIVAQUA (Brussels), welcomed participants on behalf of Aqua Publica Europea and stressed the importance of adequate wastewater treatment for the protection of the environment, as well as the opportunities circular approaches could bring to the wastewater sector.



## **ROBERTO MANTOVANELLI**

*President of Acque Veronesi*

**Roberto Mantovanelli**, President of Acque Veronesi (Verona), welcomed participants in the city of Verona and conveyed the greetings of the Mayor of Verona, Damiano Tommasi, and the President of the Veneto Region, Luca Zaia. He then highlighted the importance of Aqua Publica Europea's work in supporting public water operators across Europe to improve their practices and performance, including on a key topic such as circularity in wastewater. He concluded that the objective of the seminar is precisely to learn more about best practices from utilities in Europe, but also to promote a dialogue with experts and institutions about how to address common challenges in the context of the evolution of the European framework.



# SESSION 1: CIRCULAR PERSPECTIVES



## NELE-FREDERIKE ROSENSTOCK

*Policy Officer at the European Commission's Directorate General for the Environment*

**Nele-Frederike Rosenstock**, Policy Officer for Marine Environment and Clean Water Services at the European Commission's Directorate General for the Environment, opened the first session by providing an update on the evolution of the EU legislative framework on wastewater and sludge.

### UWWTD

The Urban Wastewater Treatment Directive (UWWTD) is being revised because rooms for improvement have been identified in its evaluation, notably in the areas of circularity, energy use, sludge management and reduction of greenhouse gas emissions.

In its proposal published in October 2022, the European Commission proposed that agglomerations carry out integrated urban wastewater management plans that should include an indicative objective that storm water overflow represents no more than 1% of the annual collected urban wastewater load based on a hierarchy of actions focusing on nature-based solutions. This would require capturing more stormwater in wastewater treatment plants and, as a result, potentially increase the presence of microplastics in sludge.

The European Commission also proposed to extend the scope of the UWWTD to smaller cities (down to agglomerations of 1000 p.e.), meaning that more wastewater would be captured and more sludge would be produced, as well as to improve EU standards to control individual systems used for the collection and treatment of wastewater where there is no collecting systems.

The European Commission proposed to reinforce nitrogen and phosphorus standards to address the problem of eutrophication and to progressively introduce quaternary treatment in large wastewater treatment plants to curb micropollutants. Quaternary treatment would be financed by the cosmetic and pharmaceutical industries through an Extended Producer Responsibility (EPR) scheme.

With regard to energy, the European Commission proposed systematic auditing of wastewater treatment plants and collecting systems and the introduction of an energy neutrality target at the national level by 2040, which would require a better uptake of biogas and anaerobic digestion, contributing to reducing avoidable greenhouse gas emissions from the sector by 46%.

The European Commission finally proposed provisions to better track and reduce pollution at source to improve sludge quality, incentivise the better use of sludge (reuse first, incineration as a last resort) and promote water reuse. Recycling rates for recovery of phosphorus and nitrogen would be decided later on by the European Commission through a delegated act.

The cost-benefit analysis showed that the proposal would cost €3,8bn a year, but would bring €6,6bn a year in benefits. Affordability should not be endangered, including in countries that rely extensively on water tariffs such as Denmark. Public budgets would continue receiving support from EU funding at a level of €2bn a year.

### **SSD evaluation**

The European Commission also recently published an evaluation of the Sewage Sludge Directive (SSD). The evaluation showed that the levels of heavy metals in sludge have significantly decreased and that a lot of Member States go beyond SSD standards.

In Europe, 40% of sludge is currently used on fields, 27% is incinerated (an increasing practice in some Member States like Germany) and 10% is composted. Sludge use in agriculture is the most efficient use thanks to the replacement of mineral fertilisers with recovered phosphorus whilst mono-incineration is the costliest.

The SSD remains broadly aligned with the objectives of the European Green Deal and the Zero Pollution Action Plan, but there are shortages to address microplastics, pharmaceuticals and pathogens in sludge. The evaluation also identifies room to improve the EU added value of the Directive as many Member States go beyond its requirements. The SSD is still considered relevant, but more could be done regarding the list of contaminants it includes and their risk to the environment and health.



**JON RATHJEN**

*Deputy Director for Water Policy & DECC Operations at the Scottish Government*

**Approaches to circularity**

After Rosenstock's presentation, the rest of the first session was dedicated to exploring concrete examples of circular strategies at regional and local level.

**Jon Rathjen**, Deputy Director for Water Policy & DECC Operations at the Scottish Government (Scotland), outlined Scottish Water's journey from considering sludge as a waste to be thrown away to a resource and highlighted the importance of capturing and storing phosphorus as a valued resource even in the absence of an immediate economic market.

As Scottish Water operates 1.850 wastewater treatment plants across Scotland, collecting and accumulating sludge is a major challenge. Transport decarbonisation and the creation of collection centres across the country are key to creating a carbon positive experience.

Across its network, Scottish Water is now producing 3% of Scotland's energy thanks to a wide range of interventions such as biogas production, heat recovery from sewage, wind production, solar energy and hydropower whilst it was buying 1% of Scotland's electricity only 10 years ago.

Rathjen presented a model of the next-generation wastewater treatment plant, which is about maximising resources recovery. The mission of operators is no longer to treat volumes of wastewater to a standard, but to maximise the value we get out from this resource, he said, stressing the need to build trust with people about how waste is being used.

Scottish Water is about halfway through its journey, but is already seeing return on its investments with emerging technologies such as advanced anaerobic digestion and renewable energy generation starting to pay back.



**GUDRUN WINKLER**

*Senior Advisor to the Head of the Systems and Technology Department at Hamburg Wasser*

**Gudrun Winkler**, Senior Advisor to the Head of the Systems and Technology Department at Hamburg Wasser (Hamburg), presented the operator's approach to circularity in wastewater and sludge management. Hamburg Wasser runs Germany's largest treatment plant – it treats 150,000,000 m<sup>3</sup> of wastewater per year and carries out sludge treatment, including digestion and incineration. It has been energy neutral since 2011.

In 1997-1998, Hamburg Wasser set up digester gas power generation and sludge incineration to address expensive sludge landfill disposal and curb concentrations of pollutants, in particular heavy metals which level was too high to allow for agricultural use.

Its sludge incineration plant (VERA) is producing 62 GWh/year of electricity and 80 GWh/year of heat. It can deal with a maximum sludge capacity of 78,400 tonnes/year (dried sludge) and 36 million m<sup>3</sup>/year of digester gas. The multi-stage flue gas cleaning allows compliance with strong regulatory limits.

From 150,000,000 m<sup>3</sup> of wastewater, it results 20,000 tonnes of ash residues, 3,900 tonnes of gypsum and 340 tonnes of heavy metal sludge. Ash residues and gypsum are used for construction materials and for phosphorus recycling whilst sludge incineration allows for on-site heat and electricity production. Extra renewable electricity and upgraded gas are fed into the grid whilst a Hamburg-based company uses excess heat.

An extension of the plant is currently under construction (VERA II), which should be operational in 2025. It is the result of an inter-municipal cooperation with the wastewater treatment association Südholstein and the waste disposal company Lübeck. The energy production is estimated to increase to up to 100 MWh/year in electrical energy and 165 MWh/year in heat.







## PAOLO GIANDON

*Director at the Department for Environment and Ecological Transition of the Veneto Region*

It is clear that the reuse of resources, and in particular of sludge in agriculture, is a pivotal element to the circular approach, said **Paolo Giandon**, Director at the Department for Environment and Ecological Transition of the Veneto Region, who presented Veneto Region's new Waste Management Plan.

Giandon referred to the EU Soil Strategy for 2023, which states that recycling organic matters such as sewage sludge has many advantages because it reduces the use of synthetic fertilisers, helps replenish depleted soil carbon pools and improves the properties of soils (e.g., water retention) and the soil structure itself.

He also highlighted aspects in the evaluation of the SSD that are relevant for the Veneto Region, which adopted the EU waste hierarchy that puts reuse of resources at the top. If the SSD continues to be relevant, there is however a need to review the list of contaminants it includes.

In the Veneto Region, there has been a reduction in sludge use in agriculture and in composting in the period 2012-2017 because of regional and national circumstances. On the one hand, there have been disputes and controversies linked to the reuse of sludge in agriculture because of the difficulties to interpret the regulation, which caused concerns among operators.

On the other hand, there are increasingly strict laws for the use of fertilisers in agriculture deriving from the implementation of the Nitrates Directive.

Veneto's Waste Management Plan requires different uses based on sludge's quality:

- High quality sludge is used in agriculture to provide greater guarantees for farmers
- Sludge of suitable quality is mixed with other agricultural materials and used as a soil improver
- Sludge that does not comply with regional standards is used for energy recovery

Water reuse is another aspect of the circular economy. In Veneto, there is no pressure to apply the Water Reuse Regulation because urban wastewater is already discharged into the water grid used for agricultural irrigation.

Giandon highlighted the participation of the Veneto Region in the Horizon 2020 project B-Water Smart, which aims to accelerate the transformation to water-smart economies and societies in coastal Europe and beyond.

# SESSION 2: CIRCULAR DRIVE



## BERTRAND VALLET

*Policy Officer at the European Commission's Directorate General for Research and Innovation*

After reviewing existing approaches and strategies in different contexts, the second session was dedicated to exploring promising research avenues and innovation solutions.

**Bertrand Vallet**, Policy Officer for Circular Economy & Biobased Systems Unit at the European Commission's Directorate General for Research and Innovation, kicked off the second session with an overview of how circularity is addressed in ongoing Horizon 2020 projects.

He then presented Horizon Europe, the current EU funding programme for research and innovation. Most relevant calls for water operators are within cluster 6 "Food, Bioeconomy, Natural Resources, Agriculture and Environment" of pillar 2 where €97 million are dedicated to water in the 2023-2024 work programme.

He also mentioned the European co-funded "Water4All Partnership" where Aqua Publica Europa is a partner, the Partnership for Research and Innovation in the Mediterranean Area (PRIMA) and the mission "Restore our Ocean and Waters".

Horizon Europe's 2023-2024 Work Programme builds on the experience of previous projects to harness the innovation potential and market uptake of successful circular economy water related projects and to improve the reliability and effectiveness of alternative water resources supply systems and technologies beyond agriculture.



Vallet also provided insights into the European Commission's research and innovation agenda in relation to circularity. He pointed out several key priorities: large scale implementation of circular systems for water and sludge reuse, resilience of water resources systems in the context of climate change and the emerging energy and food crises, alternative water supply solutions, digital technologies as well as artificial intelligence and machine learning to optimise systems, knowledge and innovation on micropollutants in water systems and climate neutrality of water services.



## ENRICO PEZZOLI

*President of Como Acqua*

**Enrico Pezzoli**, President of Como Acqua (Como), presented a co-incineration sludge management plant project located close to a natural park in the province of Como in the north of the Lombardy region of Italy. The project's expected outcomes are increased synergy between public bodies, increased circularity and reduction of costs associated with energy purchase and sludge disposal (both sources of costs have significantly increased in recent years). The project will be co-financed through the NextGenerationEU instrument and a tender process has recently been launched to identify the companies that will carry out the project.

The project has six main components:

1. The collection of green and organic waste from the agri-food sector
2. The transport of waste to the plant
3. The production of biogas
4. The production of thermal energy and electricity
5. The refinement of biogas into biomethane
6. The use of biomethane for the transport fleet and input into the distribution grid

Horizon 2020 developed some of the circular solutions available today for wastewater treatment, but the work is not over. The current Horizon Europe programme now aims to enhance the functioning of the market for recovered resources, he concluded.

Vallet's contribution was followed by the presentation of two innovative projects currently being implemented by Aqua Publica Europea members.

As the plant is located in a natural park, some mitigation measures are also planned, including a partial restoration of the river bed into which the plant discharges.

The plant will be divided into two lines of production:

- Line A: anaerobic digestion of both sludge and organic waste, which will result in compost used as soil improver and in biomethane
- Line B: anaerobic digestion of both sludge and agro-food waste, which will result in biogas used to generate electricity and thermal energy

Once completely operational, the new plant is expected to produce 2,9 million KW/h of electric energy and 3,3 million KW/h equivalent of thermal energy. Biogas exceeding the plant energy needs will be transformed in biomethane, which will be partly used to feed the company's fleet and partly injected into the local gas grid.



## MARCO BLAZINA

*Chief Operating Officer for  
Wastewater Treatments at MM*

**Marco Blazina**, Chief Operating Officer for Wastewater Treatments at MM (Milan), presented the FANGHI project, which aims to test different approaches for thermal valorisation of sewage sludge to identify the one offering the most advantageous combination in terms of economic, health, environmental and energy sustainability as well as to experiment new sewage sludge treatment technologies to optimise material and energy recovery. This experimentation aims to find alternatives to traditional sludge disposal routes, such as agriculture and cement factories.

In Italy, sludge is mainly used in agriculture, but alternative treatment processes need to be explored and outputs need to be diversified as the system is under strain and sludge incineration plants are not as commonly accepted as in other countries (800,000 tonnes of sludge are produced every year just in the Lombardy region).

MM operates two large plants in Milan covering over 1 million p.e. In the Milano San Rocco wastewater treatment plant, 100 million m<sup>3</sup> of wastewater are being treated every year.

15,000 tonnes of dehydrated sludge are reused in agriculture and 5,000 tonnes of dehydrated sludge are used to produce concrete. In this context, the objective of ongoing experimentation by MM is to find alternative options for sludge management that integrate traditional ones: this is very important for water operators as a strategy to differentiate environmental and economic risks, in case a traditional route – like agriculture – becomes less viable as it happened in the past.

In the framework of the FANGHI project, MM is running a pilot hydrothermalcarbonization (HTC) plant: a thermal treatment process, which could be an alternative approach to traditional sludge valorisation processes. This treatment reduces 30% of sludge mass and results in hydrochar and in a slurry from which phosphorus can be easily extracted. Whilst it is suitable for agriculture use, currently there is, however, no market for hydrochar because suppliers are not used to work with such a high level of dryness.

MM is also running a sludge mono-incineration facility within the San Rocco wastewater treatment plant to treat dehydrated sludge (25%) and dried sludge (90%) from the wastewater treatment plant, which results in high-quality, non-hazardous ash and energy. The innovative aspect of this technology is that the incineration process is directly integrated in the wastewater treatment one: consequently, sludge is not leaving the plant to be treated elsewhere.

The technology seems to present some other advantages compared to traditional incineration, especially in terms of management procedure (the oven can be easily turned on and off and does not need a 24h control). Ashes produced from this process are then also used for research activities on the extraction of phosphorus. Despite initial concerns, MM managed to keep emissions below thresholds set in the regulatory framework.



### VERONICA SANTORO

*Brussels Representative at the European Sustainable Phosphorous Platform (ESPP)*

The seminar then closed with a panel discussion addressing the framework conditions to step up circularity.

**Veronica Santoro**, Brussels Representative at the European Sustainable Phosphorous Platform (ESPP), a membership-based organisation that promotes phosphorus

sustainability and nutrients' circularity, said that phosphorus circularity is essential because it is a limited resource, Europe is currently relying on input from third countries and most of the phosphorus goes to water streams causing significant environmental damages, which are aggravated by climate change.

Santoro provided several success stories of different approaches to phosphorus recovery: in Sweden, there is a certification system for wastewater treatment plants to ensure the quality of recycled digestate nutrients used in agriculture; in Spain and the UK, nutrients in water are used to grow biomass;



### DAVID BOLZONELLA

*Professor at the University of Verona*

Wastewater treatment plants are evolving from an end-of-pipe approach to become bio-refineries, said **David Bolzonella**, Professor at the University of Verona. There still lacks, however, an end market for outputs produced due to a lack of quality and regulatory standards.

in Belgium, Denmark and the Netherlands, struvite is recovered to be used as a fertiliser; in Germany, pyrolysis is used to create biochar and the incineration process is modified to increase phosphorus plant availability; and in Germany and in the Netherlands, phosphorus is recovered after incineration.

According to Bolzonella, while there is no silver bullet to sludge management, solutions need to fit local contexts and it is time for EU flagship projects in the real world with a full-scale application of existing technologies.



### BERTRAND VALLET

*Policy Officer at the European Commission's Directorate General for Research and Innovation*

Mainstreaming solutions is what we'd like to achieve, said **Bertrand Vallet**, Policy Officer for the Circular Economy & Biobased Systems Unit at the European Commission's Directorate General for Research and Innovation. He highlighted existing programmes such as LIFE and INTERREG that deal with full scale implementation, but invited stakeholders to provide input to guide the European Commission's strategic priorities.

Vallet then pointed out upcoming proposals that can increase the uptake of circular solutions such as the Soil Health Law and the Integrated Nutrient Management Action Plan (INMAP) that will seek to increase the fertility of soils and reduce nutrient loss. He also mentioned existing pieces of regulation such as the Water Reuse Regulation, the Fertilizing Products Regulation, which provides a framework for products

recovered from sewage sludge, and the Industrial Emissions Directive (IED), which seeks to better control indirect releases into sewers.

There is a need for a dialogue between stakeholders because new solutions have to be acceptable for everyone, said Santoro who called on the European Commission to organise and give credibility to such a dialogue on possible market pull policies, mechanisms for nutrient recycling whilst considering market distortion and the impact for farmers and consumers. This should include all public actors from the water sector and research bodies, completed Bolzonella. There are new ideas and technologies to develop – it is time to do it together. Vallet concluded that there was also a need of a critical mass of recovered materials to underpin investments in supply chains.

# CONCLUSIVE REMARKS



## ROBERTO MANTOVANELLI

*President of Acque Veronesi*

**Roberto Mantovanelli**, President of Acque Veronesi (Verona), thanked all speakers for their excellent insights and thought-provoking perspectives into circularity in the wastewater sector. This seminar showed that there is no one-size-fits-all solution to sludge management, but rather a plurality of approaches that should consider contextual needs and characteristics.

The best approach should be based on an analysis of local conditions and knowledge, but an approach must be chosen. That is why public authorities, water operators and society at large should collectively agree on a route based on local conditions to accelerate circular approaches and promote the necessary collaboration between stakeholders. This is crucial to increase environmental benefits, but also to ensure the recovery of critical resources, such as phosphorus, and to accelerate Europe's path towards strategic independence.

This is particularly true in Italy where the evaluation of the SSD has shown that landfilling is still an important management option despite its environmental cost and the consequent loss of valuable nutrients. We have important scientific and industrial skills in our territories – we should mobilise them to accelerate the transition towards a circular economy, which protects our health and our environment and provides economic development possibilities, concluded Mantovanelli.



JULY 2023



**EUROPEAN ASSOCIATION  
OF PUBLIC WATER OPERATORS**

**AQUA PUBLICA EUROPEA**  
Boulevard de l'Impératrice 17/19  
1000 Brussels, Belgium

[aquapublica.eu](http://aquapublica.eu)  
[info@aquapublica.eu](mailto:info@aquapublica.eu)