nextGen

Circular Water Solutions

NextGen policy brief:

Solutions for a Water-Smart, circular and resilient Urban Wastewater Treatment and Sewage Sludge Directives

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The Horizon 2020 project NextGen[1] aims to boost sustainability and bring new market dynamics throughout the water cycle in its 10 demo cases and beyond. The project will assess, design and demonstrate a wide range of water-embedded resources, including energy, raw material and reuse water. The NextGen deployment is paired with the definition and cultivation of a successful framework for involving and engaging citizens or other stakeholders, and also addressing social and governance challenges.

1 The NextGen project on circular water solutions has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°776541. This policy brief (September 2022) is prepared by the NextGen partners Water Europe, Cranfield University and KWR Water Research Institute. The content of this publication is the sole responsibility of the NextGen consortium and can in no way be taken to reflect the views of the European Union.

NextGen circular water solutions to maximise impact

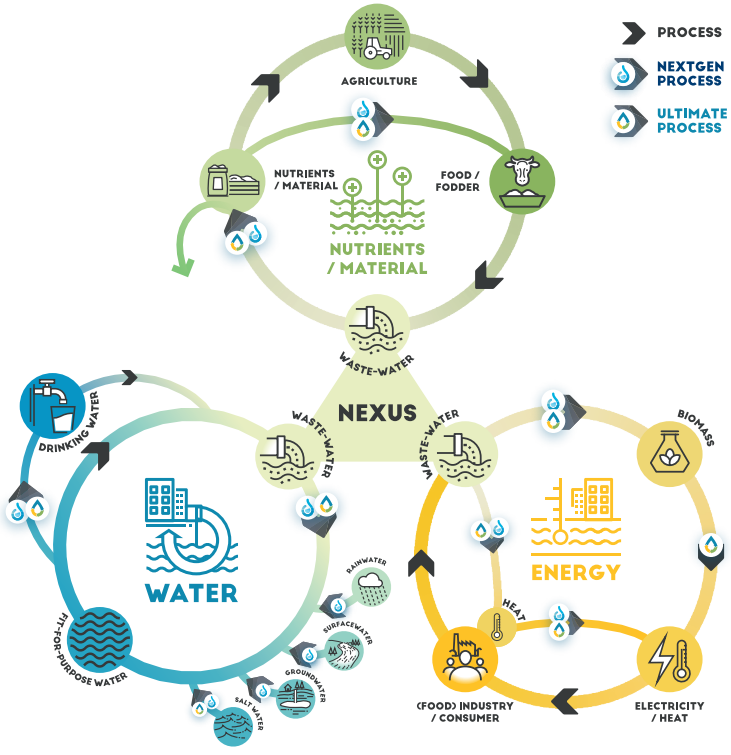
Appetite for the world's most important resource continues to grow – from water use in industrial processes and agriculture to intensity of urban demand. By 2030, according to the UN, total global water demand is expected to exceed supply by 40% and approximately half of the world's population will suffer from water stress. In Europe, 30% of the territory will suffer water scarcity by the end of the decade[2]. NextGen wants to:

- Contribute to a future European Roadmap for Water in Circular Economy.
- Offer innovative solutions in line with the new EU Strategy on adaptation to climate change.

The goals of the NextGen project are closely connected with two European Directives that are currently up for revision:

The Urban Wastewater Treatment Directive (UWWTD) has set an international reference case in the global effort in wastewater management, exemplified in the UN Sustainable Development Goal indicator 6.3.1. Today, 95% of the EU's urban wastewater is collected and over 85% is treated according to the Directive' requirements.

The Sewage Sludge Directive (SSD) has performed well in its objective to encourage the safe use of sludge while complying with high environmental standards, and providing beneficial side effects such as improving effluent and water quality, soil organic matter and water retention.



However, both directives are facing new challenges and concerns that they are no longer fit for purpose, particularly in regards to the circular economy and the exploitation of the Value in Water.

The results[3] of the NextGen project demonstrate that the European citizens are ready for "circular solutions utilised in the water and wastewater sector – the use of recycled water for drinking purposes, and the use of recovered nutrients to grow food".

2 Water Europe vision, page 13.

3 NextGen D4.2 Final report on societal acceptability (2021).

Both directives need to focus on the objectives of a fully circular water economy, and a profound modernisation of monitoring and treatment methods, in order to make the most of the Value in Water – the energy, nutrients and resources embedded in wastewater – and to reuse wastewater itself. In its 10 demo cases (reported in Annex 1), NextGen is testing several solutions to best exploit the Value in Water. NextGen is based on decentralised solutions, each of which are adapted to the local situation and take into consideration the environmental, social and economic benefits.

Benefits for EU legislation: energy, raw materials & water recovery

The technologies demonstrated in NextGen provide several benefits to help reach the objectives of the Green Deal, particularly the circular economy action plan and the zero-pollution strategy. The revisions of the Urban Wastewater Treatment directive and Sewage Sludge directives should take account of the technical evidence from the Nextgen demo cases in term of energy recovery, exploitation of nutrient and reuse water which contribute to a circular, green and water-smart European legislation.

Key policy messages:

- NextGen unlocked the potential of the circular economy in the water sector, by demonstrating the recovery and reuse of water-embedded resources, such as water itself, energy, nutrients and materials in 10 demo cases spread across different European regions in 8 countries.
- NextGen demonstrated the benefits of circular water solutions in reducing water, energy and materials consumption, in prevention of pollution to water ecosystems (rivers, lakes, coastal waters) and the environment (including reduction of greenhouse gas emissions), and in providing added value of recovered resources to be used in other sectors (such as agriculture, energy, industry) to implement symbiotic approaches of the circular economy.
- NextGen has launched a Water Europe online match-making marketplace for products and services, that showcases circular water technologies (e.g. struvite precipitation, anaerobic Membrane BioReactor, sludge pyrolysis, sewer mining), environmental and economic assessment tools (such as Life Cycle Assessment / Life Cycle Costing, Cost Efficiency Analysis, Quantitative Microbial Risk Assessment), and best practices to implement circular economy solutions.
- NextGen 10 demo cases provide evidence-based knowledge on enabling framework conditions for the transition to a circular economy in the water sector, such as societal acceptability (e.g. of treated effluent reuse), circular value chains and business models (e.g. for recovered calcite), and supportive policy and regulations.

The assessment of the policy conditions enabling or hindering the recovery of resources at the NextGen demo cases revealed:

	What's helpful	What's hindering	What's needed
Energy (biogas, heat)	• Carbon neutrality targets	• Disappearing policy incentives and feed-in tariffs • Shift away from burning fossil fuels (biogas)	• Clearer pathways for the water sector to support a hydrogen economy
Biosolids	• Quality certification	• Concern that land application may become stricter or prohibited (fate of micro-pollutants) • Land availability (diffuse pollution prevention)	• Clearer pathways for the water sector to support a hydrogen economy
Other nutrient products (e.g. struvite, ammonia) **Other material products** (e.g. cellulose)	• Carbon neutrality targets ◦ Process benefits ◦ Carbon footprint of alternatives • Fertiliser Regulation (potentially) • Stricter discharge limits (Zero Pollution)	• Complex and burdensome process for end-of-waste status • Risk for utilities and technology developers	• Simplified route to end-of-waste ◦ Clearer examption from waste legislation? • Better governance mechanisms for sharing risk
Non-potable water (e.g. fertigation)	• Consistent quality standards between countries (Water Quality Regulation) • Stricter discharge limits (Zero Pollution)	• Insufficient granularity for different purposes • Challenging monitoring and reporting requirements • Concern that land application may become stricter or prohibited (fate of micro pollutants)	• Support for 'fit-for-purpose' approach • Risk management approach

NextGen: Recommendations for a water-smart, circular and resilient Urban Wastewater Treatment and Sewage Sludge directives

The EU Circular Economy Action Plan facilitates the introduction of circular water solutions. Further upscaling and uptake of innovations, however, requires a shift in the current regulatory framework from sustainable waste management and disposal towards value creation within and between sectors in the CE. Based on the results of its demo cases, and supported by the outcomes of two workshops on water policy and the circular economy [4,5,6] NextGen has put forward several recommendations to inform the revisions of the UWWTD and SSD, making them more effective against new challenges:

- **Improve alignment between directives and incentivise circularity.** The NextGen findings show that the policy and regulatory requirements covering circular economy technologies and their products are split between many different directives (urban wastewater, waste framework, water framework, energy efficiency, renewable energy, sludge, industrial emissions, etc.) and alignment between them is still poor. In the case of potential gaps or conflict, there is little guidance on which legislation should take priority, and it is unclear whether the order of importance needs to be decided upon at a national or regional level. Furthermore, while the uptake of circular systems is generally encouraged, it is not directly incentivised.

4 EASME, NextGen & Water Europe, Water Project Europe: Water in the Circular Economy Policy Development, 29 March 2021.

5 European Commission, Waste water and sludge: how to integrate in the circular economy and support new energy and climate ambitions?, 20-21 April 2021.

6 NextGen D4.3 Challenges and opportunities across policy and regulatory frameworks (2022).

- **Include the water / wastewater sector in energy efficiency and renewable energy strategies, but improve alignment with environmental ambitions.** NextGen demo cases showed there is considerable potential for production of biogas from sludge treatment, contributing to the EU ambitious targets for the production of renewable energy. Greater alignment is needed between the Renewable Energy Directive (RED II) and Sewage Sludge Directive regarding the production and application of biosolids that goes hand-in-hand with production of biogas.
- **Adopt the water fit-for-purpose principle.** In addition to reducing the unnecessary water abstraction and treatment processes and streamline water quality requirements. It will engender a new and innovative wastewater service innovation model, which will better reflect the value of water, in any form, and promote its circular life cycle use.
- **Introduce reporting requirements for recovered products.** While some transparency requirements have been introduced for water recycling schemes under the Water Reuse Regulation[7], there are no reporting requirements for other types of circular schemes (e.g. those focused on nutrient, materials or energy recovery). The revision of the UWWTD, for instance, could introduce a requirement to make information on such schemes publicly available, which could help build awareness of schemes, and help incentivise their adoption.
- **Extensive application of digital solutions to increase reporting.** Through constant monitoring of determinate parameters (specific

7 See also the recent guidelines to support the application of the Water Reuse Regulation (2020/741): https://environment.ec.europa.eu/publications/minimum-requirements-water-reuse-guidelines_en

pollutants, water pressure, energy usage), sensors can help optimise energy usage and warn of contaminations and leakages, ensuring the availability of the right quality and quantity of water for different uses. Digital solutions would allow for a more effective and systemic approach to emerging pollutants, allowing for rapid remediation and facilitating prevention. Monitoring can be expensive and difficult for micro-pollutants and hence should be coupled with talking pollution at source.

- **Create simpler and less costly routes to market for recovered resources.** One of the key barriers to the uptake of circular schemes is the cost and complexity of achieving legal 'end of waste' (EoW) status for materials recovered from water and wastewater systems (e.g. nutrient products, cellulose fibres). This legal status is often required to ensure the products can be brought to market. While some regulatory instruments have attempted to create smoother routes to EoW status and to market for some products (such as in the revised Fertilising Products Regulation[8]), many gaps and hurdles still exist. The resulting confusion and risk act as deterrents for potential scheme developers.
    - **Create viable EoW routes for all products recovered from wastewater and sludge.** While the EoW process is typically governed under the Waste Framework Directive, another alternative process could be created under a revised UWWTD, which could specifically manage risks as more of a 'one-stop-shop' for products recovered from municipal wastewater and sludge, including those not used in fertilisers (which could then be exempted from the EoW process under the Waste Framework Directive, similar to the exemption created under the updated Fertilising Products Regulation).
    - **Ensure that EoW status can be recognised across Member States.** One of the concerns raised by participants in this study was that, for some recovered products, EoW status had to be achieved on a country-by-country basis, adding significantly to the cost. If existing EoW status could be recognised across multiple Member States, it could lower the cost and risk associated with these schemes.
- **Support an effective regulation which provides encouraging financial incentives targeted toward water reuse schemes and circular water technologies.** This will drive investment and entrepreneurism toward the design and use of such schemes. Utilities must also be given better incentives for using sustainable water solutions. Utilities must also be rewarded for investing in creative and innovative ways for implementing circular water solutions. Adapt the EU ESG ((Environmental, Social and Governance) / green financing system to ensure that circular water solutions can fall within the landscape of green bonds, especially covered green bonds.

8 The recently revised Fertilising Products Regulation (2019/1009) opens the single market for fertilisers produced from recovered or organic materials, including those from (waste)water: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019R1009

Annex 1:

List of circular water technologies demonstrated at the NextGen demo cases *

Demo Case	Technologies		
Braunschweig (DE)	Two-stage digestion and sludge hydrolysis	Nutrient recovery: Ammonia stripping; Struvite precipitation	
Costa Brava (ES)	Multi-purpose water reclamation and reuse	Membrane filtration with regenerated RO membranes	
Westland Region (NL)	Closing the regional water cycle: urban water management, ASR for horticulture	HT-ATES: high temperature aquifer thermal energy storage	Material brokerage
Altenrhein (CH)	Ammonia membrane stripping	P-recovery by thermochemical treatment of sludge	Granulated activated carbon via pyrolysis
Spernal (UK)	Multi-stream anaerobic MBR for decentralized water reuse	Energy recovery from AnMBR	Nutrient recovery from AnMBR via adsorption and ion exchange
La Trappe (NL)	Metabolic Network Reactor to produce fit-for-purpose water	Protein production in Bio-Makery	
Gotland (SE)	Rainwater harvesting and decentralized membrane treatment	Energy efficient reclamation of wastewater	
Athens Urban Tree Nursey (EL)	Sewer Mining mobile wastewater treatment for decentralized reuse applications	Heat recovery from MBR	Nutrient recovery for urban agriculture
Filton Airfield (UK)	Integrated drainage system for urban water reuse	Heat recovery from sewer	Eco-sanitation systems with nutrients recovery
Timisoara (RO)	Sludge management with production of by-products and/or energy	Reuse of effluent for urban, industrial and agricultural applications	

* blue = water, yellow = energy, green = materials

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