

# Closing the gap between Fork & Farm for Circular Nutrient Flows



GUIDELINES FOR THE IMPLEMENTATION OF CIRCULAR  
SANITATION IN CITIES AND REGIONS



Funded by  
the European Union



Local Governments  
for Sustainability  
EUROPE

# Introduction to circular sanitation

## The current linear approach to sanitation:

- ★ Plants require nutrients such as nitrogen (N) and phosphorus (P) to grow. Currently, Europe depends on mineral fertilisers imported from Morocco (mining of phosphorous rock), Norway and Russia (producers of nitrogen fertilisers related to natural gas supplies)
- ★ These same nutrients are abundantly present in human excreta that ultimately enters wastewater streams. Conventional linear sanitation systems treat wastewater primarily as waste, relying on energy-intensive nutrient removal processes and costly centralised infrastructure.
- ★ At the same time, demographic change, increasing nutrient loads, and rising operational costs are placing growing pressure on wastewater treatment systems and exposing the limits of the current model.



**Figure 1: The linear sanitation approach**

## Definition of circular sanitation:

- ★ Circular sanitation offers an alternative approach by treating human excreta and wastewater as valuable resources rather than waste streams. It **recovers nutrients, water, and organic matter for their reuse in agriculture** through fertiliser production and fertigation.
- ★ Circular sanitation solutions can be grouped into two main categories:
  - **Upstream solutions:** the source separation of urine and faeces to enable recovery and treatment.
  - **Downstream solutions:** recover water, energy, and nutrients from WWTP (wastewater treatment plants).
- ★ Existing technologies, infrastructure models, and operational innovations demonstrate that circular sanitation can be successfully integrated across different scales and settings.

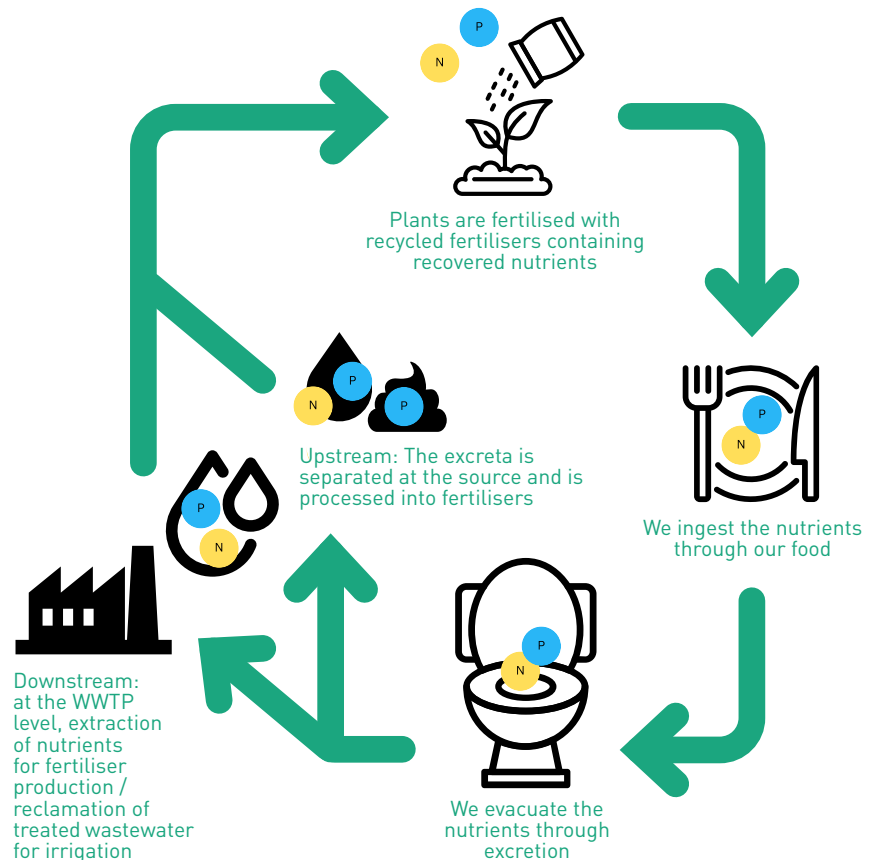


Figure 2: The circular sanitation approach

# Benefits of circular sanitation:

- ✧ **Costs:** Lower costs for wastewater treatment, fertilizer production, water supply, environmental remediation, and public health impacts.
- ✧ **Infrastructure capacity:** Reduces pressure on existing wastewater treatment plants
- ✧ **Infrastructure diversity:** Supports decentralised, flexible and cost-effective infrastructure
- ✧ **Resilience and strategic independence:** decreases the dependence on imported fertilisers, reduces freshwater demand for agriculture, promotes local nutrient and water value chains
- ✧ **Water pollution:** reduces nutrient overload in water bodies and decreases eutrophication
- ✧ **Economic development:** creates regional value chains, cost and energy savings, employment opportunities

| Collection method                        | Recovered resource                       | Reuse                                                                                                            |
|------------------------------------------|------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Urine-diverting flush toilets (upstream) | Yellow water / Urine                     | Fertilisation of crops & green spaces                                                                            |
| Urine-diverting dry toilets (upstream)   | Urine and faeces                         | Urine: Fertilisation of crops and green spaces /<br>Faeces: Production of compost, fertiliser biochar, or biogas |
| Water reclamation (downstream)           | WWTP effluent (nutrient-rich wastewater) | Irrigation of crops and green spaces                                                                             |

Table 1: Technologies for circular sanitation

# Circular sanitation for local and regional governments

The transition to circular sanitation depends on effective collaboration across sectors such as spatial planning, water management, food systems, and agriculture. As key public authorities, cities and regions are well placed to lead this process by connecting diverse stakeholders, aligning policies and priorities, and creating the enabling conditions for circular sanitation solutions to be implemented at scale.



## Strategise

**Integrate targets for nutrient recovery, recycled fertiliser usage or water reclamation into:**

- ★ **Sectoral strategies and action plans** such as water, food, energy
- ★ **Cross-cutting strategies and action plans** such as urban development plans, climate and resilience strategies

### Examples

[Stockholm Water and Waste Targets](#) (SE);  
AESN [Water](#) and [Climate](#) strategies (FR);  
[Irish Food Vision](#) (IE)

[Ile de France Master Plan](#) (FR)



## Educate

### Raise awareness among key stakeholders through:

- ★ **Awareness raising** on the benefits and use of circular sanitation infrastructure
- ★ **Educational programmes** in schools, science parks and universities
- ★ **Knowledge sharing platforms** to make existing projects and learnings publicly accessible
- ★ **Public spaces and events** to showcase source separation and fertiliser application
- ★ **Community campaigns** to engage citizens and collaboratively imagine innovative sanitation systems

### Examples

[SVDP Workshops for end users](#) (FR)

[Sanitation360 World Toilet Day](#) (SE)

[Toilettes Fertiles Platform](#) (FR)

[Rediscovery Centre](#) (IE);  
[P-Bank](#) (DE)

[Toilet Time Travel](#) (CH)



## Mobilise

### Engage and collaborate with public and private stakeholders such as:

- ★ **Public authorities:** ensure collaboration across levels and sectors through multilevel governance, cross-department bodies and national networks
- ★ **Farmers:** involve farmers in valorisation processes to build trust and ensure that the outputs (recycled fertiliser, reclaimed water) meet their needs
- ★ **Start ups and businesses:** engage with innovators, property developers, construction and wastewater management companies to incentivise and guide circular sanitation approaches
- ★ **Research and academia:** involve in collaborative research projects to develop innovative technologies and local value chains for the valorisation of nutrients
- ★ **Practitioners:** facilitate capacity building and skill training activities for architects, plumbers and planners to provide technical knowledge on circular sanitation solutions

### Examples

[Mission Résilience](#) (FR);  
[ZierkullierBAR](#) (DE); [NetSan](#) (DE); [RAE](#) (FR); [VaLoo](#) (CH)

[KOLOS](#) (FR); [FNAB](#) (FR);  
[P2Green Pilot](#) (ES);  
[VivAgriLab](#) (FR)

[P2Green Pilot](#) (SE);  
[Superlocal](#) (NL)

[TeValU](#) (FR); [RecoLab](#) (SE);  
[Diverse water living labs](#) (EU); [Water Hub](#) (CH)

[Rés'eau 24](#) (FR);  
[Eawag Toolbox](#) (CH);  
[Urivalyon](#) (FR)



## Implement

### Adapt urban infrastructure to adopt circular sanitation in:

- ★ **Temporary and off grid infrastructure:** install portable toilets for urine collection from events and temporary pop ups, as well as remote areas and small settlements
- ★ **Public buildings:** install circular sanitation infrastructure in schools, universities, administrative buildings, cultural centres, sport stadiums, transport nodes or community centres.
- ★ **Spatial planning:** promote circular and decentralised sanitation infrastructure in spatial planning documents and large-scale building projects
- ★ **Wastewater management infrastructure:** adapt WWTPs to enable the recovery of nutrients e.g. through struvite precipitation, ammonium stripping, membrane-based separation, bio-based or physiochemical technologies.
- ★ **Outlet for recovered nutrients:** consider outputs from circular sanitation processes as sources of income (e.g. biogas, recovered water, heat, recycled fertilisers). Recycled fertilisers can be applied to green public spaces or sold to farmers to stimulate the demand and increase social acceptance.

### Examples

[Sanitation360](#) (SE); [Darmstadt](#) (DE); [Cologne](#) (DE); [Leipzig](#) (DE); [Abereus](#) (DE, AT, CH); [mountainous areas](#) (FR)

[Saint-Germé School](#) (FR); [BlueFactory](#) (CH)

[Block 6](#) (DE), [Sneek](#) (NL); [Ile de France Master Plan](#) (FR)

[Braunschweig](#) (DE); [Ringsend](#) (IE); [Limassol](#) (CY); [P2Green Pilot](#) (ES)

[Nieuwe Dokken](#) (BE); [Helsingborg](#) (SE)



## Support

### Provide financial and non-financial resources for circular sanitation through:

- ★ **Research and innovation funds** to develop alternative treatment technologies and recycled fertiliser production, and explore possibilities to address regulatory gaps
- ★ **Subsidies and grants** for construction and agriculture, e.g. through resource efficiency, decarbonisation and drought prevention funds
- ★ **Taxes and tariffing schemes** incentivising water reuse, decentralised wastewater treatment and pollution reduction
- ★ **Equipment, infrastructure and land** to meet the logistical needs related to the production transport, storing of recycled fertilisers

### Examples

[ZirkulierBAR](#) (DE); [La Fumainerie](#) (FR); [Circularise](#) (DE)

[Andalusia](#) (ES); [Berlin WFB 2023](#) (DE); [FRL KrW/2024](#) (DE)

[Murcia](#) (ES); [Geneva](#) (CH)

[KOLOS](#) (FR)

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Funded by  
the European Union

European Union's Horizon Europe research and innovation programme under grant agreement No° 101081883. Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.