

Hubs4Circularity
COMMUNITY OF PRACTICE



**UNITED
CIRCLES**

United Circles project Project Overview and Salamanca Hub

*Final Conference Hubs4Circularity
Community of Practice
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[CENTRO
TECNOLOGICO]

CARTIF



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UNITED CIRCLES. Networked industrial-urban symbiosis value chain demonstrators for biomaterials, C&DW, circular water loops & WWTPs, driven by Hubs 4 Circularity



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TECNOLOGICO] **CARTIF**

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UNITED CIRCLES

Implements a partnership of 44 partners across 16 countries & 1 United Nations body to connect to the **Hubs4Circularity** EU Community of Practice and to EU & global circularity, process industry & decarbonisation networks.



The plan?

To promote a circularity culture to tackle all generated waste across regions and industrial sectors through collaboration and innovation

The main **objective** of United Circles is to accelerate our progress to a fully **decarbonised future** without waste and with closed water loops.

By fostering a **problem-solving circularity culture**, we address urban waste at its source and across process industries.



Our goal?

United Circles is leading the change by showing how **cities and industries can work together** to upcycle **waste into value-added products**. By connecting urban and industrial systems with a set of **new technologies** and collaborative models (**Hubs4Circularity**).



Zero-waste cities and decarbonised industries that support sustainable growth and resilient communities

How?

Through 3 industrial-urban symbiosis value chains for the recycling of:



Urban food waste



Municipal solid waste from sewerage



Municipal construction and demolition waste

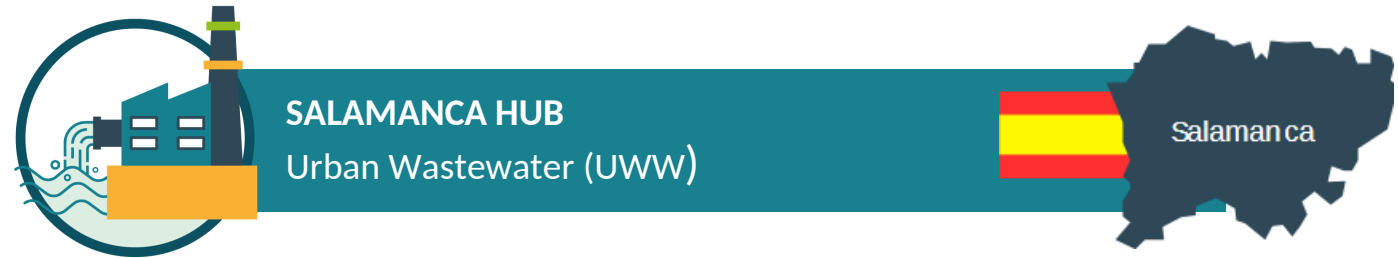
Through Hubs4Circularity

Each of the United Circles
Hub4Circularity will establish its
industrial and urban networks

- It will use advanced **governance** frameworks
- **Financial viability** methodologies
- **Digital tools**
- **Social and environmental innovations** and
- A **materials and products observatory**

Through 3 industrial-urban symbiosis value chains integrated into a Hub 4 Circularity

Hubs4Circularity
COMMUNITY OF PRACTICE



Mirroring Hubs

- **Replicates** the methods of an already established Hub
- **Learns** from **existing solutions** and avoids starting from scratch
- **Adapts circular models** to local needs
- **Accelerates implementation** and scaling
- Helps test the **transferability** of the Hub model **across Europe**

Each of the Demonstrator Hubs4Circularity will be followed by 4 Mirroring Hubs for replication



EASTERN MACEDONIA & THRACE HUB



Eastern Macedonia & Thrace



SOUTHERN TRANSDANUBIA HUB



Southern Transdanubia



GAUTENG HUB



Gauteng



KENT, EAST AND WEST SUSSEX AND BRIGHTON & HOVE HUB



Kent, East and West Sussex and Brighton & Hove

Seeds Hubs

- Builds a **Hub model** using United Circles **guidance**
- Tests how **the model can grow** in **new territories**
- With little to no grant funding, but instead **relying on local, regional** and **international investments**



VELENJE HUB



Velenje



BEIRUT



Beirut



NOUVELLE AQUITAINE HUB



Novelle
Aquitaine



GRAZ HUB



Graz

15 Technologies

15 advancing **innovative technologies** from **TRL5 to TRL7** in combined integrated value chains, to enable **zero-waste cities** and a **decarbonised Process Industry**



Urban Construction & Demolition Waste (C&DW)

- | | | |
|-----------------------------------|------------------------------|-----------------------------|
| 1 XRT-Driven Smart Sorting | 2 Attrition Scrubbing | 3 Carb-Upcycled HCP™ |
| 4 Alkali reactor | 5 Catalytic Pyrolysis | |



Urban Waste Water (UWW)

- | | | |
|--|---|-------------------------------------|
| 6 Coupled FO-CDI desalting | 7 RBF filter cellulose upcycling | 8 Coupled Anammox-FBR |
| 9 H2 & CO2 enhanced methanation for P2G | 10 Novel dNF membranes | 11 Hydrothermal liquefaction |



Urban Food Waste-Used Cooking Oil (UCO)

- | | | |
|--------------------------------------|--------------------------------------|-------------------------------|
| 12 MBT bioreactor | 13 Steam Drying and Pyrolysis | 14 Cellular Hydrolysis |
| 15 Steam Drying and Pyrolysis | | |

6 Digital Tools

An **evolutionary business intelligence ecosystem** for processing of waste, value chain, materials and products' data throughout their life cycle, with the purpose of **continuous expansion** of coverage, assessment, and enhanced **environmental performance**.

1

Regenerate Explorer (RECY)
The www.regeneratehub.org tool

2

Advanced as an AI assistant for IUS design, (**AI Recommender, UoJ**)

3

IUS Designer (EKOD), redevelop the FISSAC Platform to implement IUS design capabilities & create process-flow links with technology innovation evaluation

4

GRETA (SUPSI) for performing integrated Life Cycle Assessment (LCA) for process flow networks on-top of Material Flow Analysis (MFA)

5

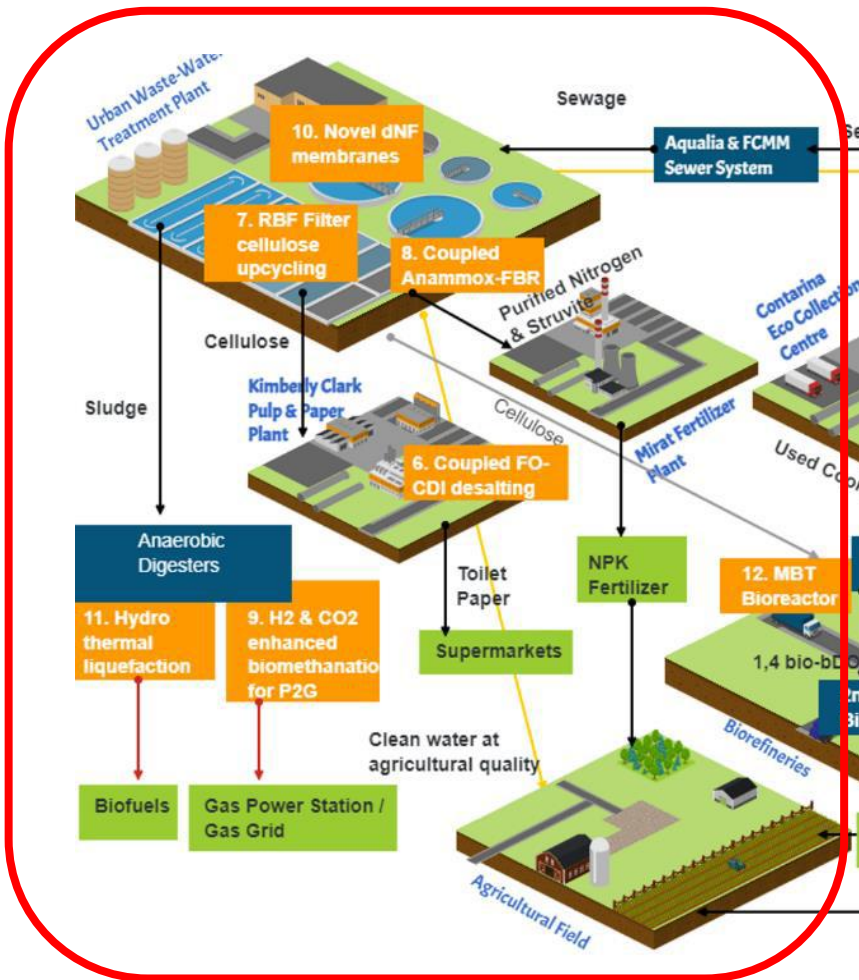
TRACID (ECOW), www.tracid.net, the Digital Product Passport system for life-cycle events. For material passports of batch shipments, considering unique identification & traceability

6

IUS flow catalogue (CARTIF), a centralised repository that will gather exchange flow critical documents and lab & engineering material-process specifications related to IUS flows

HUB 4 CIRCULARITY SALAMANCA


Water/Nutrients/Energy. WWTP to Resource Recovery Center with closed water loops



United Circles Demonstrator Value Chains of focus for the Hub



6	Coupled FO-CDI desalting for 100% circular water use in Pulp & Paper industry	Waste-water
7	RBF filter cellulose upcycling to obtain purified cellulose from Urban Waste-Water (UWW)	
8	Coupled Anammox-FBR to extract nitrogen & phosphorus from UWW into NPK fertilizer	
9	H2 & CO2 enhanced methanation for P2G for UWW sludge to AD to syngas for P2G grid load balancing	
10	Novel dNF membranes for tertiary UWW purification incl. PFAS removal for agricultural water reuse	
11	Hydrothermal liquefaction of bio stabilized waste to obtain value-added biofuels	



AQUALIA

Drinking water


- CDI
- Use of membranes to drinking water
- Activated carbon recovery

Wastewater regeneration and resource recovery

- FO optimization and coupling with CDI
- Use of membranes to wastewater regeneration
 - N and P recovery
 - Cellulose recovery

Sludge and energy valorization


- Codigestion



ELECTROCHAEA

Sludge and energy valorization


- Biological methanation. Upgrading $CH_4 > 95\%$



CARTIF

Wastewater regeneration and resource recovery

- FO optimization and coupling with CDI




KIMBERLY-CLARKE

Water regeneration and resource recovery

- Pulp & paper water regeneration with FO-CapDi coupling.
- Use of recovered cellulose.

Sludge and energy valorization


- Use renewable gas produced from recovered organic waste.
- Support theoretical studies for the recovery of CO_2 .
- Explore and develop methods to separate unsorted domestic waste streams and recover organic biomass to produce biomethane



MIRAT

Water regeneration and resource recovery


- Use struvite for fertilizers formulation.
- Agronomic trials with different conditions



FCC MA

Sludge and energy valorization

- HTL optimization using FORSU (5 kg/h)
- Biostabilized leachate AD
- Biological methanation testing



H4B SALAMANCA

Design → M3-30
Deployment → M30-48

Salamanca Hub: the opportunity

Territorial starting point

A real wastewater treatment and resource recovery environment, connected to regional industry and agriculture

Core value proposition

Move from waste treatment to recovery of water, nutrients, cellulose and renewable energy carriers

H4C ambition

Use the demonstrator as a platform for collaboration, evidence, investment preparation and replication

Salamanca Hub: the opportunity

The hub is not only a technical pilot. It is a regional coordination mechanism that helps utilities, technology providers, industry, agriculture, public actors and researchers work on a shared circular water-loop agenda

- Urban wastewater solids and side streams become feedstocks rather than liabilities
- The WWTP becomes a node for water resilience, fertiliser recovery and industrial symbiosis
- CARTIF contributes coordination, technology integration and stakeholder facilitation

Salamanca Hub: Incentives for establishing the activity

Economic drivers

Recovered products can reduce dependence on virgin inputs and open new local value chains for water, fertilisers, cellulose and energy

Policy and regulatory drivers

Circular economy, water reuse, nutrient recovery, climate neutrality and industrial decarbonisation are converging priorities. Castilla y León Circular Economy Strategy and Urban Waste Water Treatment Directive

Resilience drivers

Drought pressure and resource-security concerns make closed water loops and local recovery solutions more strategic

Salamanca Hub: Regional enablers

A hub works when the region recognises the WWTP as infrastructure for circular value creation, not only as an environmental compliance facility

- Castilla y León is a CCRI Demo Region, giving the Salamanca Hub a recognised European framework for circular transition
- CCRI helps position the hub beyond a single pilot, connecting it to wider European circular cities and regions initiatives.
- The Castilla y León Circular Economy Strategy reinforces this framework by promoting biomass, residual stream valorisation and circular value chains.
- United Circles turns this regional framework into a real H4C demonstrator focused on wastewater solids upcycling, nutrient recovery and circular water loops.
- Industry champions such as Aqualia, Kimberly-Clark and MIRAT and CARTIF as RTD provide real infrastructure, industrial demand and market connection.

Salamanca Hub: Success factors

Real site conditions

Testing in a WWTP environment reveals integration issues early and creates stronger evidence for replication

Integrated value chain

The objective is not one isolated unit process, but a circular pathway linking recovery, reuse, products and users

Clear governance layer

The H4C approach provides a structure for roles, stakeholder engagement, decision-making and learning

Cross-hub learning

Salamanca can learn from Ankara and Veneto, while mirroring and seed hubs can learn from Salamanca

KPI-driven narrative

Technical results should be translated into environmental, social, economic and territorial indicators

Trusted facilitator

CARTIF can act as a neutral technical and coordination partner connecting policy, industry and research

Salamanca Hub: Ongoing challenges

Technology integration

Combining nutrient recovery, cellulose recovery, water reuse and energy valorisation under real wastewater variability

Operational robustness

Managing ammonium-rich streams, membrane fouling, draw-solution management, solids variability and maintenance needs

Market uptake

Recovered products must meet quality expectations, regulatory requirements and user confidence in agriculture and industry

Financing and scale-up

Moving from demonstration to deployment requires credible business-to-territory plans and investment alignment.

Stakeholder continuity

Maintaining engagement beyond project events and reporting cycles is essential for durable hub activity

Replication without copy-paste

Each region should adapt the model to its own flows, actors policies and market conditions

Governance layer: useful for other H4Cs

A simple metaphor for clustering: hubs are at different life stages, so they need different kinds of support



The older siblings

Demo hubs

The older siblings

Already walking the path: testing real solutions, facing implementation issues and showing what others can learn from



The younger siblings

Mirroring hubs

The younger siblings

They look at the older sibling as a model: learn from existing approaches, adapt them locally and test transferability



The newborns

Seed hubs

The newborns

They are learning to walk: building vision, governance, working groups, roadmaps and first financing pathways

THANK YOU

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