Development of Hubs for Circularity inspired by Urban-Rural-Industrial Symbiosis Concept

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Hubs for Circularity (H4C) are expected to play a critical role in sustainable regional development across Europe. Grounded in the industrial symbiosis (IS) concept, H4C offer opportunities for companies located in industrial zones with high carbon emissions as well as for their surrounding urban and/or rural ecosystems, enabling resource and energy savings, decarbonization, and reduced health impacts.

The project "From Industrial Symbiosis to Hubs for Circularity" (IS2H4C, https://is2h4c-project.eu/) scales circular technologies including carbon capture and utilization (CCU), electrolysis for green hydrogen production, and e-fuels production, from Technology Readiness Levels (TRL) 3-6 to TRL 7-9 to facilitate implementation of IS in the establishment of near-commercial-scale H4C. The project develops four first-of-a-kind H4C in the Netherlands, Germany, Türkiye, and the Basque Country, integrating new and existing infrastructure to connect process-industry-dominated industrial zones with surrounding urban and rural ecosystems. Aligned with the European Green Deal and the Circular Economy Action Plan, IS2H4C introduces new financial schemes and social innovation approaches to facilitate market uptake, with green investment from both public and private institutions serving as key enablers.

This talk reflects on the first two years of the IS2H4C project, summarizing achievements, key findings, and challenges encountered across all work packages, while also looking ahead to the remaining months. Specifically, we cover technological advancements in circular technologies (WP2); drivers, barriers, and enablers for H4C implementation based on stakeholder interviews (WP3); hub optimization models combining descriptive, predictive, and prescriptive analytics for operational decision-support (WP4); innovative circular business models and financial strategies (WP5); field implementation at the four demonstration hubs covering both technology deployment and infrastructure development (WP6); and the alpha version of DigitalH4C, a digital collaboration platform enabling cyber-safe management of physical H4C operations (WP7). Together, these contributions support the development of a standardized, replicable H4C design methodology that can serve as a blueprint for regional circular development beyond the project's lifetime.