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Hub4Circularity

A First of a kind Hub for circularity demonstrator for Attica and peripheral regions

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Publishable summary

This document is an interim deliverable for Task 2.2: Participatory Approaches and Co-Creation of the Horizon Europe THESEUS Project, which runs from December 2024 to November 2029. Task 2.2 covers project months M1 to M36, and this document is submitted in Month 9 (M9).

As an early version of the final deliverable due in M36, the document presents initial reflections on participatory approaches within the Hubs for Circularity (H4C) framework. It includes background on participatory processes in H4C and industrial and urban symbiosis (I-US) cases, identifies challenges that have emerged or are anticipated, and outlines the methods planned for identifying appropriate participation strategies. Some sections currently contain only headings and will be developed in later versions. Their inclusion is intended to provide a preview of the expected content, facilitating early feedback and alignment with project goals.

Due to its preliminary nature, the content presented here is subject to change and may differ substantially, either in part or in whole from the final version. Additionally, some elements may be transferred to other deliverables, such as those related to Task 2.1.

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Abbreviations

Abbreviations	Full name
I-US	Industrial and Urban Symbiosis
H4C	Hubs for Circularity
PM	Project Management
PO	Project Officer
SC	Steering Committee
WP	Work Package

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1 Introduction

1.1 Background

Hubs for Circularity (H4Cs) in the European Union are regional industrial ecosystems designed to accelerate the shift toward a circular economy and promote industrial symbiosis. These hubs connect industrial and urban systems to reuse each other's waste or by-products, such as water, energy, or materials, or to share infrastructure, data, and knowledge. This integration aims to enhance resource efficiency and significantly reduce waste. Beyond these environmental benefits, H4Cs also aim to deliver regional economic advantages such as attracting new investments, reducing operational costs, and generating green jobs.

Although the technological and economic challenges facing H4Cs are significant, real-world experience shows that building and operating an H4C is not simply a matter of installing new technologies or issuing policy directives. The success of H4Cs depends fundamentally on the active collaboration and sustained engagement of a wide range of actors, including large and small enterprises, public authorities, research institutions, and the broader community. Yet this collaboration is far from straightforward. It is shaped by three interrelated but distinct challenges: sectoral fragmentation, institutional diversity, and spatial and hierarchical complexity.

The first challenge arises from the diversity of private sector actors that must collaborate within an H4C. This goes beyond coordination between different industries to include fundamentally distinct types of private actors, each playing different roles within value chains and urban systems. These may include waste management companies, wastewater treatment operators, chemical and cement manufacturers, food and beverage producers, energy utilities, logistics providers, and digital service firms involved in resource tracking or industrial IoT. For industrial symbiosis to take place, these actors must firstly be willing to exchange resources, such as heat, wastewater, carbon dioxide, or organic by-products, but often even go further to, for example, co-invest in shared infrastructure and new technologies. For example, a data centre generating large volumes of low-grade waste heat could partner with a greenhouse operator to produce food. Despite the potential mutual benefit, many of these actors have limited experience working together, and there are few established frameworks or market mechanisms that reward cross-sector cooperation. This sectoral fragmentation presents a structural barrier to the effective collaboration required within H4Cs.

The second challenge is rooted in the institutional diversity of actors involved. Collaboration must extend beyond the private sector to engage local and regional governments, research institutions, and increasingly, civil society. While industrial actors form the operational backbone of H4Cs, public authorities enable their development through facilitation, policy support, spatial and infrastructure planning, and sometimes direct participation, for example, integrating waste heat into municipally operated district heating systems. Research and educational institutions contribute essential knowledge, innovation, and training. Traditionally, this type of cross-sector innovation has been supported through the Triple Helix model (industry–government–academia). However, H4Cs increasingly rely on the participation of civil society and local communities, which brings a wider range of interests and expectations into play. Their involvement helps ensure public legitimacy, responsiveness to local needs, and inclusive development. Managing this level of institutional diversity, where actors have different mandates, values, and time horizons, requires careful design of participatory processes and governance mechanisms.

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The third challenge concerns spatial complexity and the need to coordinate across multiple geographic and governance levels. H4Cs are inherently regional because many circular economy activities such as waste collection, sorting, and heat recovery are only viable at the local scale. At the same time, other processes, like the treatment and reprocessing of secondary materials, require coordination across regions to ensure sufficient material throughput and economies of scale. This spatial mismatch creates a governance challenge because actors, particularly public institutions, tend to operate within administrative boundaries that do not align with the physical flow of materials and resources. These limitations are compounded by a lack of precedent and institutional tools for inter-jurisdictional collaboration. As a result, H4Cs must establish new forms of multi-level governance that function effectively both within and across jurisdictions.

Together, these challenges mean that many of the actors involved in H4C initiatives may lack the institutional experience, coordination mechanisms, or incentives to collaborate effectively. Organizational roles and mandates may even restrict participation. For example, a regional government may hesitate to engage with industries outside its jurisdiction, or a company may not have staff assigned to build partnerships beyond its own supply chain. These constraints risk fragmenting efforts and undermining the synergies that H4Cs are intended to create.

Participation is not a peripheral concern in the development of H4Cs, it is central to their mission, functionality, and long-term viability. The success of industrial symbiosis depends on sustained participation from a wide range of actors across sectors and governance levels. Whether aligning industrial processes, co-developing shared infrastructure, building public trust, or advancing workforce development, each of these activities requires participation that is meaningful, inclusive, and continuous. However, despite growing recognition of its importance, there is still a lack of practical guidance on how to structure and sustain participation in real-world H4C and I-US settings. Ensuring participation also requires appropriate incentives e.g. financial, regulatory, or reputational especially for actors who may not see immediate or direct benefits. Moreover, power imbalances can hinder inclusive participation, as smaller firms and community groups may lack the capacity or institutional footing to engage on equal terms. Critical questions remain unanswered: How can relevant actors be systematically identified and invited to participate? What are the expectations from their participation? At which stages of H4C development is their participation most impactful? What mechanisms can ensure their continued participation in the face of changing political, institutional, or market conditions? Without clear answers to these questions, participation risks becoming fragmented, symbolic, or short-lived undermining the systemic collaboration that H4Cs require.

These questions are particularly relevant for the Attica region, where the THESUS project supports the development of an H4C in a setting that includes a complex and diverse landscape of actors, infrastructures, and institutions. In this context, the present research task will explore participatory and co-creation approaches that can inform and strengthen actor collaboration, not only for the Attica H4C, but also for similar hubs in other European regions.

1.2 Purpose of the deliverable

This document is an interim deliverable submitted in M9 for Task 2.2: Participatory Approaches and Co-Creation (M1-M36) of the Horizon Europe THESEUS Project. The purpose of final deliverable from this task is to provide conceptual and practical input on actor participation and co-creation processes within Hubs for Circularity (H4Cs), with a specific focus on the Attica H4C supported by the THESEUS project. As an interim report this document is an early version of the final report.

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When exploring participatory approaches for H4C five core dimensions central to enabling effective and sustained participation will be considered:

1. Who participates?
   Identification and mapping of relevant actors across industrial, public, research, and civil society sectors.
2. What is the expected/desired outcome?
   Identification of the expected/desirable outcomes from participation.
3. When do they participate?
   Analysis of participation across different lifecycle stages of H4C development.
4. How do they participate?
   Exploration of participation methods and formats (e.g., workshops, co-design sessions, governance boards).
5. Why do they participate?
   Examination of actor motivations, such as economic, regulatory, social, and reputational incentives.
6. How is participation sustained?
   Investigation of the governance structures, institutional practices, and learning mechanisms that support continuous engagement over time.

These six dimensions will be examined with attention to the specific characteristics of different material flows, such as energy, water, textiles, or packaging because we hypothesize that participation is not uniform across them. Each material flow involves distinct actor constellations, regulatory environments, public visibility, and infrastructure dependencies, which shape not only who participates, but also how, when, and why. For example, participation in water reuse may be driven by public utilities and strict health regulations, while engagement around textiles may involve SMEs, informal economies, and consumer-facing co-creation formats. Accordingly, this research will seek to analyse participation strategies based on the socio-technical and institutional specificities of each material ecosystem.

This research serves a dual purpose. First, it will provide direct input to the THESEUS project to support the planning and implementation of the Attica H4C. Second, it is designed to be transferable and useful for other emerging H4Cs across Europe, offering guidance that reflects shared challenges while being adaptable to the material-specific and regional contexts in which different hubs operate.

1.3 Overview

This document serves as an early version of the final deliverable due in Month 36 for Task 2.2. It presents initial reflections on the role and importance of participatory approaches within the H4C framework, as well as several overarching challenges associated with implementing such approaches (Section 1).

Section 2 offers a section of the literature review, focusing on participatory approaches more broadly, both within and beyond the context of industrial symbiosis. This several section will be expanded upon.

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Section 3 outlines the proposed approach for participatory strategy development, which is already underway. While data collection activities, including the literature review and actor mapping have begun, they are not yet reported on in detail here, as the analysis is still in progress.

Throughout the report, the main structure and proposed section headings of the final deliverable are presented. However, several sections currently remain empty or include only titles. Their inclusion is intentional as it serves to give reviewers a clear sense of the planned content and to enable early feedback that can help ensure alignment with project objectives and expectations.

Given the document's preliminary nature, its content is expected to evolve significantly over time. Elements may be expanded, revised, or shifted to other deliverables (e.g., those under Task 2.1) as the project progresses.

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2 Participatory approaches

2.1 Participatory approaches and cocreation across multiple disciplines

Participation has become a central theme across diverse domains of human activity. From user involvement in product design, to stakeholder engagement in corporate strategy (Freeman, 2010), to citizen participation in building sustainable neighbourhoods (Wesselow et al., 2025), and women's inclusion in global health decision-making (Banchoff et al., 2025), there is a widespread and growing commitment to include a broader range of voices in the processes of designing, deciding, and interacting. This is reflected in the variety and quantity of academic articles dealing with participation. These efforts build on democratic ideals, particularly the principle of inclusion, to enhance the legitimacy of decisions by incorporating a wider set of perspectives of those affected (Renn, 2006). In academic literature and practical initiatives alike, participation is increasingly recognized as a critical component of effective governance and sustainable development (Andriof et al., 2017; Cornwall, 2008). In the business context, engaging actors through participatory processes forms the foundation of transparency and accountability (Andriof et al., 2017).

Participation is often envisioned as a collaborative process where individuals and groups come together to exchange ideas in a flexible, inclusive, and democratic manner unconstrained by hierarchy or bias. The aim is to foster mutual understanding and establish shared goals. However, reality imposes limitations. They are shaped and often constrained by institutional, economic, temporal, and political factors (Fung, 2006). Each participant enters the process with their own agendas, priorities and capacities. Power dynamics, competing interests, and practical limitations frequently complicate the promise of open and balanced engagement

Challenges arise at every stage of the participatory process: identifying the appropriate actors, persuading them to engage, ensuring they have the time, knowledge, and resources to participate meaningfully, and managing expectations around the scope and impact of their contributions (Cornwall, 2008). There are also nuances to quality of participation and moving to higher levels, such as co-creation and co-production, can be particularly challenging (Voorberg et al., 2015). In some contexts, such as technological innovation (Wesselow et al., 2025) or medical policy (Eldh et al., 2006) actors may lack the technical expertise required to make fully informed decisions. Additionally, issues such as "participation fatigue," have been reported (Wesselow et al., 2025). Furthermore, some conflicts of interest are so fundamental that they cannot easily be reconciled. These challenges highlight that effective participation demands far more than scheduling a meeting, sending invitations, and drafting an agenda. It requires careful design, thoughtful facilitation, and a sustained commitment to inclusivity and responsiveness (Cornwall, 2008).

Among the various strands of participatory research, three stand out as particularly relevant for informing the development of H4C.

First, the strand focusing on planning and the development of geographic contexts, such as regional development and urban planning is especially important. This is because Hubs for Circularity are inherently place-based, addressing not just a single material flow but multiple interconnected flows within a specific region.

Second, stakeholder participation from an organizational perspective is crucial. A hub can be viewed as a central organizational entity that must engage a wide range of stakeholders. Even at the level of individual

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material flows (e.g., water), there is often a lead organization responsible for coordination, which must collaborate with others to ensure effective participation and implementation.

Finally, since Hubs for Circularity are envisioned as socio-technical ecosystems enabling full-scale industrial symbiosis, the participatory approaches developed within the industrial symbiosis (IS) literature are particularly relevant.

Each of these participatory traditions is explored in the following sections.

2.2 Participatory approaches in organisational stakeholder literature

To be developed in next version.

2.3 Participatory approaches in regional development

RIC framework to be developed in next version.

2.4 Participatory approaches in I-US and H4C literature

To be developed: a framework that includes digital enablers, communication and interaction structures, as well as softer aspects such as trust, power dynamics, and balance of influence.

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3 Methodology

3.1 Approach and scope

This deliverable aims to address the central question:

“How can participation of diverse actors be designed, implemented, and sustained in the context of Hubs for Circularity (H4Cs)?”

The report is structured around six analytical dimensions of participation:

1. Who participates?
2. What are the expected/desired outcomes?
3. When do they participate?
4. How do they participate?
5. Why do they participate?
6. How is participation sustained?

These dimensions are applied both generically and in relation to specific material flows, in order to reflect sectoral differences in actor constellations, regulatory frameworks, infrastructure dependencies, and participation dynamics.

The Attica H4C currently includes the following value streams: water, ecosystem, textiles, municipal solid waste to packaging, biobased and plastics, construction and demolition and industrial waste to bricks, metals, glass and marble. However, not all will necessarily be mapped separately, several may be grouped together or further separated depending on stakeholder overlap or functional similarities.

3.2 Research process

Step 1: Conduct Literature Review

Conduct a targeted review of academic and grey literature on participation and co-creation in regional development, stakeholder theory, and H4C/I-US contexts. This includes participatory methods, actor roles, engagement formats, and material-specific challenges.

Step 2: Map Actor Participation per Material Ecosystem in Attica H4C

Using the quadruple helix model (industry – government – academia – civil society), identify and map key actors across Attica’s major resource streams (e.g., energy, water, waste, construction materials, etc.). Interviews, workshops, and document analysis will be used to determine who participates, how, and where opportunities for stronger engagement exist. A participation table (similar to Table 1) will be developed for each stream or group of related flows.

Step 3: Identify Participation Challenges Within and Across Material Ecosystems

Based on Step 2, identify gaps, mismatches, and challenges in participation. This will involve both direct input from interviews/workshops and comparative analysis across different resource ecosystems to highlight underrepresented actors, inconsistent engagement stages, or ineffective participation formats.

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Step 4: Review Literature and Case Studies for Responses to Participation Challenges

Drawing on findings from Steps 1–3, conduct an integrated review of both academic literature and 2–3 relevant case studies. Focus will be placed on identifying how participation challenges were addressed, which formats or strategies proved effective, and what lessons could be relevant or adaptable to the Attica H4C context.

Step 5: Develop Tailored Recommendations for the Attica H4C

Synthesize insights from the previous steps into actionable, context-sensitive recommendations to improve participation and co-creation in Attica. These recommendations will specify suitable engagement formats, timing, and methods across different material streams. As part of this step, findings will be validated through a feedback session or stakeholder workshop to assess feasibility, gather input, and refine the proposals.

Step 6: Formulate General Recommendations for Other H4Cs

Translate the learnings from Attica into generalized participation strategies and formats that can support other H4Cs across Europe. These will be designed to accommodate differences in material flows, development stages, and regional settings while remaining adaptable and implementation-ready.

Table 1 Example of actor-participation map

	Industry	Academia	Government	Civil Society
Who participates?				
When do they participate?				
How do they a participate?				
Why do they participate?				
How to ensure continued participation?				

4 Actor-participation maps in Attica H4C

This section is indicative and subject to change in the final deliverable.

4.1 Actor-participation map for water ecosystem

To be developed in next version.

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4.2 Actor-participation map for energy ecosystem

To be developed in next version.

4.3 Actor-participation map for textiles ecosystem

To be developed in next version.

4.4 Actor-participation map municipal solid waste to packaging biobased and plastics ecosystem

To be developed in next version.

4.5 Actor-participation map for construction and demolition and industrial waste to metals, glass and marble

To be developed in next version.

5 Participation challenges and solutions

To be developed in next version.

6 Recommendations on participatory approaches for the Attica H4C

To be developed in next version.

7 Guidance on actor participation for H4Cs

To be developed in next version.

8 Conclusions and next steps

To be developed in next version.

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