UNITED CIRCLES

Guidebook for building a Hub 4 Circularity

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Table of Contents

Why do we need Hubs 4 Circularity?

Did you know that cities generate more than 2 billion tonnes of waste every year[1] — much of it material that could be feeding industry instead of filling landfill?

And the trend is heading the wrong way. By 2050, the world is expected to generate 3.40 billion tonnes of waste annually, rising sharply from today's 2.01 billion tonnes. The pressure on our cities, our landfills and our resources is not easing — it is accelerating.

Food waste, wastewater, and construction and demolition debris: urban areas produce a wide range of waste streams, and most of it is buried, burned, or simply mismanaged. It is an environmental burden and, just as importantly, a colossal waste of perfectly usable resources. At the same time, industry keeps reaching for virgin raw materials to make new things — at a pace the planet cannot sustain. Humanity already consumes natural resources around 1.8 times faster than the Earth can regenerate them — as if we had 1.8[2] planets to draw on. We don't. We have one, and we are already pushing it to its limit.

These two problems are usually treated separately: a waste problem for cities, a supply problem for industry. But look closer, and they are the same problem seen from two sides. What one discards, the other could use. A demolished building is a source of cement and aggregate. Treated wastewater holds water, nutrients and energy. Used cooking oil is a feedstock for bioplastics. The waste isn't the end of the story — it's the start of the next one.

This is the principle behind industrial–urban symbiosis (IUS): linking the outputs of one process to the inputs of another, so resources stay in productive use and loops close at the scale of a whole region.

The catch is that making this happen is rarely something any single actor can do alone. Collection, sorting and separation happen locally; the heavier processing usually runs through a few large plants; and turning a good idea into a working value chain means coordinating industries, municipalities, technology providers, investors and communities that don't normally work together. Someone has to connect them, align them, and keep them moving in the same direction. That is what a Hub for Circularity does — and it is why we need them.

1 Kaza, Silpa; Yao, Lisa Congyuan; Bhada Tata, Perinaz; Van Woerden, Frank; Martin, Thierry Michel Rene; Serrona, Kevin Roy B.; Thakur, Ritu; Pop, Flaviu; Hayashi, Shiko; Solorzano, Gustavo; Alencastro Larios, Nadya Selene; Poveda Maimoni, Renan Alberto; Ismail, Anis.What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050 (English). Urban Development Series Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/697271544470229584

2 Global Footprint Network, Earth Overshoot Day 2025. As of the 2025 edition of the National Footprint and Biocapacity Accounts, humanity's demand on nature equals roughly 1.8 Earths

What is a Hub 4 Circularity?

A Hub for Circularity (H4C) is a regional socio-technical ecosystem that enables large-scale industrial symbiosis, industrial–urban symbiosis (IUS), and circular economy solutions by closing energy, resource, and data loops at the territorial level. In practical terms, it is the coordinating platform that connects the actors who generate recoverable resources with those who can use them as industrial feedstock, so that materials which would otherwise reach landfill are kept in productive use.

What distinguishes an H4C from a one-off circular project is its role as an enabling structure rather than a single technology. It brings together governance, stakeholder collaboration, and data-driven decision support to organise dispersed waste streams, technologies, and partners into integrated, investable value chains.

The Hubs for Circularity concept has been recognised as a key element in the European Union's strategy to advance the circular economy, aligning with the European Green Deal, the Circular Economy Action Plan, and Horizon Europe's goals for climate neutrality and competitive sustainability. H4Cs are instrumental in accelerating the deployment of scalable and replicable circular economy solutions across European territories. An H4C focused on IUS creates synergies between industrial processes and urban services, such as energy, water, waste, mobility, and land use, to develop joint solutions that close resource loops at a territorial level, reduce environmental burdens, and enhance the efficiency and resilience of entire systems.

- **Accelerate the transition to a circular, climate-neutral economy**
- **Improved efficiency and sustainability of industrial and urban systems through collaboration**
- **Enable resource sharing, waste reduction, and value creation across sectors**
- **Strengthen regional innovation capacity and economic resilience**

Characteristics

H4Cs provide a structured platform for implementing circular-economy solutions, ensuring that industries and urban areas maximise resource efficiency and minimise environmental impact. An Industrial-Urban H4C should follow a structured approach based on three fundamental elements:

- Circular Economy and Industrial-Urban Symbiosis Activities.
- Continuous Stakeholder Engagement.
- Measurable Impact in Sustainability, Economics, and Social Development.

For detailed information regarding the fundamental elements, please see section 2.2 of Deliverable D2.2.

Vision and Mission

General Vision: The vision of an H4C within the framework of Industrial Urban Symbiosis (IUS) is an interconnected system in which resources are used efficiently, waste is minimised, and resilient, sustainable environments are created. This vision is rooted in the belief that the future of industrial activity must align with the ecological boundaries of our planet, driven by innovation, cross-sector collaboration, and systemic resource optimisation (Deliverable 2.2).

Specific Vision: Each H4C should develop and continuously adapt a specific vision tailored to its regional context, responding to local needs and opportunities.

Social and Economic Benefits

- Deliver **visible and meaningful** outcomes for local communities
- Generate employment and stimulate **inclusive economic growth**
- Enhance **well-being** and address **social inequality**
- Ensure **broad participation** essential for long-term success

Innovation in Circular Business Models

- Support **regenerative practices**
- Promote **alternative ownership schemes**
- Advance **circular design** and **resource valorisation**
- **Maximise value** whilst **reducing dependency on virgin materials**

Inclusive Stakeholder Engagement

- **Active involvement** of all relevant stakeholders
- Establish **participatory governance structures**
- Create **inclusive dialogue mechanisms**
- Develop **shared goals** through co-creation of solutions

Mission: The mission of a H4C is to define and pursue clear medium- and long-term goals that contribute to systemic circularity and address regional challenges and opportunities. In the medium term, the H4C should define a set of circularity implementations that demonstrate the benefits of industrial-urban collaboration. In the long term, H4C envisions a just and regenerative transformation of European regions, where industrial, urban, and community systems work in symbiosis to foster circular and climate-neutral societies. Rooted in place-based action, H4Cs serve as inclusive innovation ecosystems that not only close loops of material, water, and energy flows, but also provide economic benefits and cultivate trust and shared purpose across sectors and communities.

More information about medium-term goals and long-term mission can be found in **section 3.2 of Deliverable D2.2.**

GUIDE BOOK I What is a Hub 4 Circularity?

Principles

The fundamental principles and values of a H4C are:

- Collaboration and Cooperation
- Innovation and Adaptability
- Sustainability and Environmental Stewardship
- Transparency and Accountability
- Inclusion and Social Justice
- Systems Thinking and Integration
- Economic Viability and Value Creation
- Bioeconomy Integration

A detailed explanation with regards to the fundamental principles and values of a H4C is provided in **section 3.2 of Deliverable D2.2.**

Types

H4Cs progress through five conceptual stages, ranging from early awareness and networking to advanced systems with fully integrated symbiotic exchanges of energy, materials, and services. These stages provide a roadmap for transformation, applicable across diverse territorial and industrial contexts, and are measured against the Symbiosis Readiness Level (SRL) framework, which evaluates and guides the maturity of symbiotic cooperation within a hub — looking at aspects such as stakeholder engagement, infrastructure readiness, operational coordination, and value-chain integration.

Within the United Circles project, and based on these conceptual stages and the SRLs, three kinds of H4C have been defined:

Demonstrator H4C	a fully operational ecosystem where circular economy solutions are tested and validated at a regional level.
Mirroring H4C	an ecosystem that seeks to replicate successful industrial symbiosis value chains from established demonstrators.
Seed H4C	a nascent initiative that starts with a small number of committed organisations aiming to evolve into a fully functional H4C.

Five levels of maturity have been defined for the H4C:

Seed H4C

Starting from scratch with 1-3 organisations to setup a starting hub

Approx. €50k/year investment available, seeking €500k+ funding for 2 years of starting hub stage

Starting H4C

Governance structure + business plan for setting up FOAK value chains

Commit partners to develop initial B2T strategy.

Seeking €1.5+ million invest/year to establish IUS demonstrators

Intermediate H4C

At least 1 FOAK value chain demonstrator (TRL7)

Focus on advancing B2T strategy, FOAK value chain demonstration.

Seeking €10+ million invest/year for scaling to TRL8

Advanced H4C

At least 1 FOAK operational value chain (TRL8)

Actively implementing B2T plan to accelerate IUS network and implementing their TRL8 FOAK value chains

Seeking €30+ million invest/year for scaling to TRL9.

Mature H4C

Multiple FOAK commercial value chains (TRL9).

Continuous IUS network improvement, lighthouse for export replication to other regions.

Seeking €100+ million invest/year for expansion + export

For more information concerning the levels of maturity of H4Cs and Symbiosis Readiness Level (SRL) framework, and the conceptual stages for H4C, please see **section 2.3 of Deliverable D2.2.**

Who can participate in a Hub 4 Circularity?

An H4C is a collaborative ecosystem: a wide range of actors — public institutions, semi-public companies, large industries, SMEs, start-ups, investors and research organisations — working toward a shared vision of sustainable regional development. A hub succeeds only when these actors collaborate actively, contributing not just resources and expertise but also shaping its governance, decisions and daily operations.

To make sense of such a broad network, it helps to group participants by the role they play. Some drive and use the circular value chains; others enable them. Both are essential.

The actors who drive and use the value chains (primary stakeholders)

These are the actors whose materials, sites and know-how make a circular value chain physically possible:

Industries and industrial clusters	supply the waste streams and feedstocks, and the technical data on materials that a value chain runs on. In Veneto, for example, food-industry actors supply used cooking oil as feedstock for biomaterials.
Municipalities and local governments	open up access to municipal waste streams, public infrastructure and land, and support permitting and policy alignment.
Technology providers and innovators	deliver and integrate the technologies that actually close the loops, from sorting and recycling to processing.
Research institutions and academia	contribute specialised expertise such as life cycle assessment and process know-how.

The actors who enable them (supporting stakeholders)

These actors don't operate the value chain directly, but it cannot develop or endure without them:

Investors and financial institutions	provide the grants, co-financing and blended or private capital that move projects from plan to reality.
Policymakers and regulatory bodies	set the rules, incentives and permits that determine whether a value chain is viable.
NGOs, citizens and local communities	provide social legitimacy, local knowledge and public acceptance; cooperatives, in particular, can connect industrial processes to communities and broaden participation.

Working together under a shared vision, these two groups build durable links between industrial and urban systems — spreading good practice and generating long-term economic, social and environmental benefits.

How the hub is coordinated: the Circular Hub Organisation (CHO) and the facilitator

Two coordinating roles hold the ecosystem together and operate at different levels.

The Circular Hub Organisation (CHO) is the hub's central orchestrating body — a neutral, trusted entity responsible for the hub's overall coordination, strategy and implementation. It connects actors, aligns their initiatives, and enables co-investment in shared infrastructure, knowledge and innovation. The CHO is what gives a hub continuity and a single point of accountability over time. (The CHO's role is developed further in Circular Hub Organisation (CHO), below.)

The H4C facilitator works at the level of individual value chains. Facilitators initiate, develop and guide specific circular value chains, acting as embedded advisors — bringing the right stakeholders together, integrating technical expertise, and steering a project forward in a structured way. Rather than running projects themselves, they keep the strategic, technical and financial elements aligned so a project stays investment-ready. The role matters most in demonstrator and mirroring hubs, where real-world delivery and replication are the priority, and it is especially valuable for drawing in technical specialists — in waste-stream mapping, bioprocessing or water reuse, say — whose expertise might otherwise sit outside the hub's governance and planning.

In short: the CHO coordinates the hub; the facilitator coordinates the projects within it.

The Executive Board

Steering the whole ecosystem is the Executive Board — the hub's strategic decision-making body. It keeps the H4C aligned with its mission, vision and objectives; sets long-term strategy; oversees governance; approves major initiatives; and guides key policies. It is typically made up of 7 to 9 senior representatives drawn from across the stakeholder groups — industry leaders, public-sector representatives, research and innovation experts, civil-society and community advocates, and the CHO.

Detailed information about the role, composition, key responsibilities, structure and operations of the Executive Board can be found in section 6.1 of Deliverable D2.2. Moreover, members' requirements, benefits, commitments and expectations are described in section 6.2 of Deliverable D2.2.

What activities do the Hub 4 Circularity partners carry out together?

Everything a hub does serves a few strategic objectives: advancing industrial–urban symbiosis, closing resource loops, reducing freshwater consumption, and fostering energy co-generation. The activities that pursue them fall into three categories:

Technical activities

- Mapping the current state
- Design and Connect
- Implement andTest
- Enabling Measures and Supporting Infraestructure
- Capacity Building andTraining
- Communication of Results and Cross-Fertilisation

Stakeholders' engagement activities

- Multi-Stakeholder Collaboration
- Policy and Regulatory Alignment
- Fundraising
- Scaling and Replication

Communication, dissemination and training activities

- Awareness and Knowledge Sharing
- Digital and Media Outreach
- Capacity Building and Training

Most of a hub's joint work is organised around the Feasibility to Finance (F2F) process (Deliverable 2.3)— eight steps that take a circular idea from first concept to an investment-ready proposal. Partners contribute to each step according to their roles, and the work moves through three phases, with each step closing at a shared decision gate that holds the collaboration accountable before it commits more effort or money.

GUIDE BOOK I What activities do the Hub 4 Circularity partners carry out together?

Phase 1 — Exploration

1. Waste challenge framing and opportunity identification — partners jointly define the overarching waste challenge, identify circular opportunities, and clarify the territorial and policy context, building early consensus on which problem is worth solving.
2. Waste mapping and technology screening — they map local waste flows and existing infrastructure and screen candidate technologies, identifying the input/output collaboration that makes a viable technical configuration.
3. Stakeholder engagement and partnerships — partners are identified, their interests assessed, and formal collaborations established across industrial, urban and public domains, so the right actors are committed before further effort is invested.

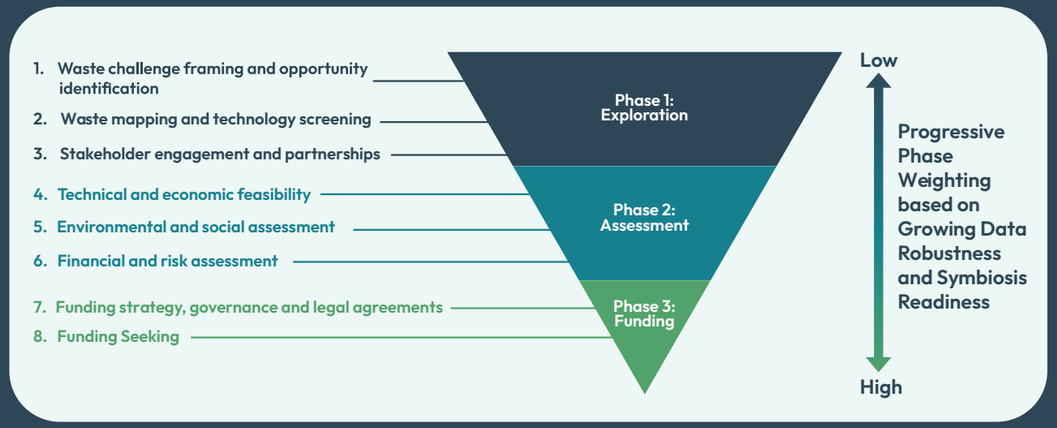
Phase 2 — Assessment

4. Technical and economic feasibility — the group validates the chosen technology, plans the deployment site, and works through permitting and regulatory compliance to produce a credible technical–economic case.
5. Environmental and social assessment — partners conduct life cycle (LCA) and social life cycle (S-LCA) assessments and translate the findings into concrete design and operational decisions.
6. Financial and risk assessment — financial models are refined and stress-tested, and shared strategies are developed to mitigate technological, market, regulatory and operational risks.

Phase 3 — Funding

7. Funding strategy, governance and legal agreements — partners agree a funding strategy, ownership and governance models, and the legal agreements that set out roles and responsibilities.
8. Funding-seeking package — finally, they assemble a complete, investor-ready package: business case, technical and impact data, legal documentation, and an implementation roadmap.

Throughout, collaboration is organised around a clear shared purpose — whether that's a market, a technology, data, policy and infrastructure, investment, or a cooperative partnership — so every partner understands both what it contributes and why.



Waste mapping (step 2 above) deserves particular attention, because it is the evidence base everything else builds on: you cannot design a value chain around a resource you haven't reliably quantified. Yet in many regions, dependable waste statistics — especially for end-of-life and residual streams — simply don't exist. Available data is often fragmented, underestimates real quantities, or can't be tied to specific sites, which makes symbiosis opportunities almost impossible to spot from statistics alone. The answer is to combine several data sources with on-site collection and validation.

The United Circles waste mapping methodology (Deliverable D2.6) does exactly this, combining top-down and bottom-up assessment to quantify and characterise waste at the level of a site, city, region or country — giving both strategic oversight and the operational accuracy that investment decisions require. It is modular and interoperable, so it can be complemented by geographical mapping and spatial screening (proximity, clustering, logistics), visual inspection (rapid assessment of types and volumes), laboratory testing (composition and suitability for recovery), and sensor-based assessment (continuous monitoring).

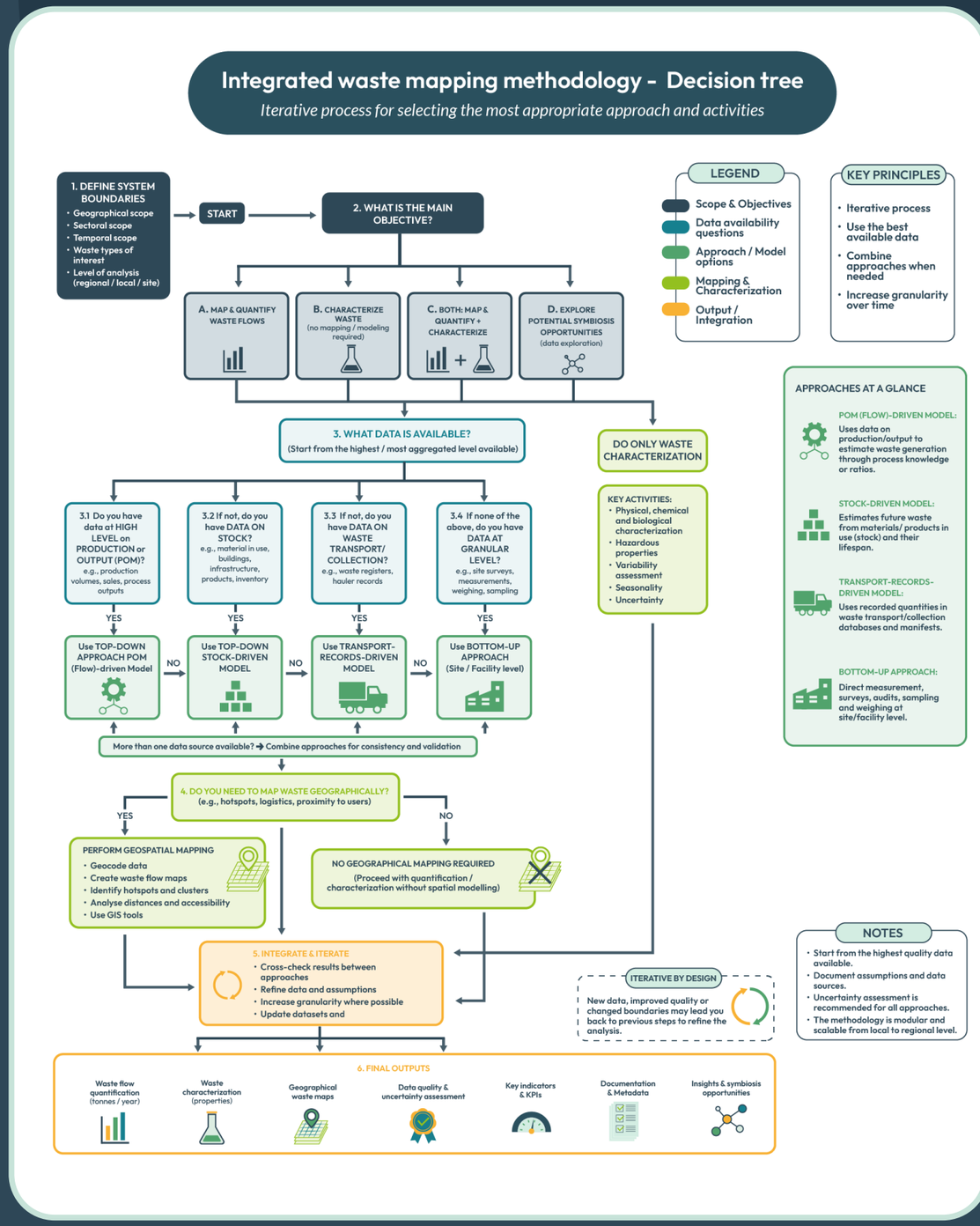
The methodology runs through four actions — best treated not as a fixed sequence but as steps practitioners move between to refine the assessment over time:

1. Define what to map and set the system boundary — establish what waste is generated, how it's transported, and how it's currently handled (landfill, incineration, recycling, purification), documenting the boundary clearly so studies can be compared across sectors and regions.
2. Top-down / desk-based accounting — estimate waste generation and recovery potential from existing datasets, using one of three models: stock-driven (from assets currently in use), flow-driven (from products placed on the market), or waste-transport record (from legally recorded transport data). Ideal early on, when data is scarce, fragmented or unharmonised.
3. Bottom-up mapping — collect granular data directly from waste producers and processors through surveys, audits and facility records, then aggregate it to reveal detailed quantities, composition and material flows for a specific sector or area.
4. Waste quality characterisation — determine whether a waste stream can actually support a given use. The key principle: characterise a waste stream against a specific route, never in the abstract. Work backwards from the intended use — material substitution, construction, nutrient recovery, bio-based intermediates, energy or chemical recovery, water reuse — identify the quality attributes and control parameters that route demands, and test only for those. This keeps the work proportionate, reproducible and decision-focused.

To help practitioners choose the right combination of methods, D2.6 provides a decision tree: starting from the system boundary, it guides users through a series of questions based on their objective and the data available — whether they need to estimate future waste availability, locate geographical hotspots and symbiosis opportunities, or characterise waste quality for reuse. Like the four actions, it is iterative by design; in practice, robust mapping usually blends top-down estimation, bottom-up validation, geographical analysis and quality characterisation in a single assessment.

A step-by-step guide and a practitioner checklist are included in D2.6.

GUIDE BOOK I What activities do the Hub 4 Circularity partners carry out together?



What tools and frameworks are available for the Hub 4 Circularity activities?

The Feasibility-to-Finance (F2F) process is more than a sequence of steps — it comes with a practical set of tools and frameworks that equip partners to carry each one out. Tools are the individual instruments a hub uses to map, measure, model and document; frameworks are the structured methodologies that tie those instruments together into a repeatable way of working. None is mandatory: a hub draws on whichever suits the task at hand and the project's maturity. The tools group naturally into the three phases of the F2F process — Exploration, Assessment and Funding.

Tools for exploration

In the early phase, the challenge is to work out what is worth pursuing — which resources are available, which technologies could use them, and who needs to be involved.

Readiness and progress tools help a hub judge how mature an opportunity is and whether it's ready to move forward. The Symbiosis and Technology Readiness Levels (SRL/TRL) provide common maturity scales — the SRL gauging how developed the symbiotic cooperation is, the TRL how proven the technology is — while a phase-weighting system and adaptable stage-gate templates (with KPIs and built-in decision logic) turn each F2F decision gate into a structured, evidence-based checkpoint rather than a judgement call.

Mapping and screening tools build the factual picture on which the whole value chain rests. Waste and resource mapping — using GIS and material- and substance-flow analysis — establishes what materials exist, in what quantities, and where; technology screening, scoring matrices and acceptance tables then narrow the field to the configurations that are technically viable.

Stakeholder tools make sure the right partners are identified and engaged before significant effort is committed. A Theory of Change framework clarifies how the hub's activities are expected to lead to impact; stakeholder mapping and the power–interest matrix reveal who matters and how to engage them; and stakeholder registers, role matrices and partner due diligence and risk-profiling templates keep roles, expectations and partner reliability transparent from the outset.

GUIDE BOOK I What tools and frameworks are available for the Hub 4 Circularity activities?

Tools for assessment

Once a promising opportunity is defined, it has to be rigorously tested — environmentally, socially, financially, and against the risks that could derail it.

Impact assessment tools measure whether a project delivers genuine environmental and social value. Life Cycle Assessment (LCA) quantifies environmental impacts across a product or process's entire life cycle, and Social Life Cycle Assessment (S-LCA) does the same for social impacts on workers and communities. These are supported by established indicator sets and databases — such as the Global Reporting Initiative (GRI) and the Social Hotspots Database (SHDB) — and by dedicated tools such as GRETA, the project's own life-cycle sustainability assessment tool, which brings environmental, economic and social analysis into a single workflow.

Financial and risk tools assess whether a project is commercially viable and what might go wrong. Financial modelling — net present value (NPV), internal rate of return (IRR) and debt-service coverage ratio (DSCR) — establishes whether the numbers work; sensitivity and scenario analysis stress-test them against changing assumptions; multi-criteria decision analysis (MCDA) weighs options that can't be reduced to money alone; and structured risk methods such as HAZOP (a hazard and operability study) systematically surface technological, operational and safety risks before they become costly.

Tools for funding

The final phase converts a validated project into one an investor can actually back.

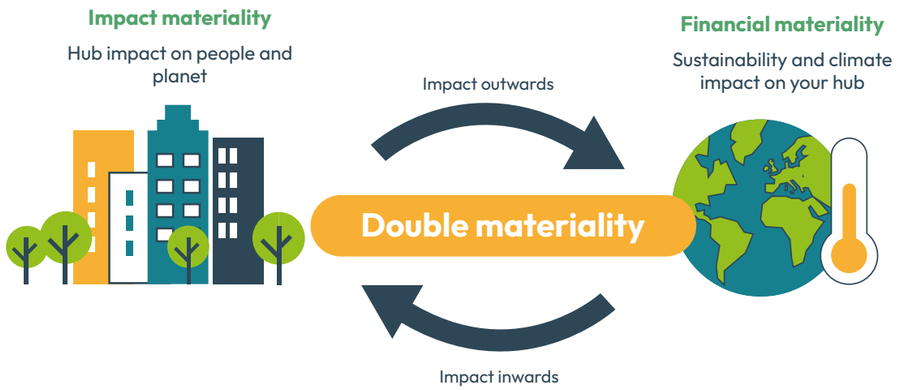
Funding and legal tool's structure the deal and bring partners and financiers together on firm terms. Funding-source mapping matches the project to the right mix of public and private finance; ownership and governance models set out how the venture will be run and how value will be shared; legal instruments — Memoranda of Understanding (MoUs), Letters of Intent (LoIs), Non-Disclosure Agreements (NDAs) and data-sharing agreements — formalise cooperation as it deepens; and investment documentation such as the Private Placement Memorandum (PPM) and financial prospectus packages the opportunity for funders in the form they expect.

Frameworks: assessing the social dimension

Tools tell you what to measure; a framework tells you how to measure it consistently. The clearest example is the Social Impact Assessment (SIA) Framework (Deliverable 2.4), which provides hubs with a structured method for the social side of the impact assessment above — the dimension that circular economy work most often overlooks.

Circular projects are usually judged in technical and environmental terms: tonnes diverted, emissions avoided, loops closed. But whether a project creates good jobs, shares its benefits fairly, and earns the trust of the surrounding community frequently decides whether it succeeds at all. The SIA Framework — developed with all eleven United Circles hubs and designed for use by non-specialists — closes that gap.

It rests on the principle of double materiality: a hub needs to understand both how its activities affect people and communities and how social factors, in turn, affect the hub's own resilience and legitimacy. Assessing both directions is what moves social impact from an afterthought into a factor in real decisions.



In practice, the Framework concentrates on three mandatory dimensions:

Employment

Examines job quality, creation patterns, and skills transition pathways. Quantifies job creation in circular sectors, assesses working conditions, and measures demographic distribution of employment benefits.

Equitability

Addresses fair access to benefits, services, and decision-making processes. Evaluates how environmental improvements benefit different groups and identifies potential unintended consequences.

Equality

Focuses on representation of disadvantaged groups and environmental justice. Ensures less vocal communities are empowered within IUS networks and examines fair distribution ofbenefits and burdens.

It is organised around two interlocking sub-frameworks, one for engaging citizens and community actors (moving beyond consultation to genuine partnership) and one for measuring social impact (with SMART indicators, baseline protocols, and a ‘traffic-light’ system that makes results legible at a glance), both running through a continuous five-phase cycle adapted from the Design Council’s Double Diamond method. It aligns with the EU’s sustainability-reporting landscape (ESRS/CSRD and the European Green Deal) and the UN Sustainable Development Goals.

The Framework comes with a ready-to-use Operational Toolkit and three plain-language booklets — for leaders and funders, for citizens, and for the technical staff and replicating hubs who apply the method.

For more details, see the booklets: Social Impact Assessment Analysis Framework, Understanfing Industrial-Urban Sybiosis (IUS), Social Impact Assessment for Circular Industrial Processess.

How can we structure the activities to work together in a Hub 4 Circularity?

A Hub for Circularity brings together public and private partners with very different resources, objectives and risk appetites. For them to act as one, the way they work together has to be made explicit — through governance (who coordinates, who decides, and how) and through formal agreements (how commitments and contributions are protected). Both share a defining feature: they are not fixed at the outset but mature as the hub does, tightening from loose cooperation into firm structure as a project moves toward investment (Deliverable 2.5).

Governance is a journey, not a fixed structure

Most hubs don’t begin with formal governance — they begin as a Community of Practice (CoP): an informal network for mapping stakeholders, exchanging knowledge, and building the first connections among industry, public authorities, research organisations, and civil society. Governance work is the deliberate process of turning that loose network into a coordinated ecosystem, shifting stakeholders from being mapped to taking part — through advisory boards, steering committees, thematic working groups and structured decision-making. A hub’s governance is therefore best understood as something that matures progressively, from network formation, through collaborative planning, to formal structures backed by advisory bodies and clear decision rules.

This is why hubs at different stages look different. Among the United Circles hubs, the demonstrators show the most advanced governance: Ankara runs a structured, technically steered model built around waste mapping and harmonised performance indicators; Veneto uses a flexible, cluster-based structure spanning its entire value chain; Salamanca builds on established institutional partnerships. Mirroring hubs sit at an intermediate stage, adapting these models to local conditions, while seed hubs are still at the foundational stage — defining mission and vision, mobilising stakeholders, and designing the governance they will grow into.

The coordinating core: the CHO

Whatever the stage, effective governance depends on a clear coordinating function. That role belongs to the Circular Hub Organisation (CHO) — the neutral, trusted body, introduced above, that holds the ecosystem together by ensuring alignment, continuity and collective ownership. Many hubs reinforce the CHO with systemic approaches such as Communities of Practice, which map interdependencies and turn fragmented expertise into shared, co-owned action plans.

There is no single right governance model. The H4C Community of Practice study identified six recurring models, but these are neither mutually exclusive nor exhaustive — as hubs mature, hybrid and evolving models are expected to emerge. What matters is not which model a hub adopts but that it has identifiable coordination, transparent decision-making, and inclusive stakeholder representation.

Agreements that grow with the project

As cooperation deepens, it has to be formalised — and, like governance, the formal commitments harden in step with the project's maturity.

In the early phases, collaboration can be governed by lightweight, flexible instruments — Memoranda of Understanding (MoUs), Letters of Intent (LoIs), Non-Disclosure Agreements (NDAs) and data-sharing agreements. These build trust and define roles without locking partners into binding commitments before the case is proven, so that uncertainty over roles doesn't slow progress or deter risk-averse partners.

As a project advances toward investment, these mature into binding, investment-grade contracts that give funders confidence and ensure operational continuity:

- **Shareholders' or partnership agreements** — ownership percentages, voting rights, profit distribution, strategic decision-making, and exit and dispute-resolution terms.
- **Joint venture (JV) agreements** — pooling resources and sharing risk for a defined scope, with capital contributions, governance, and profit and liability allocation.
- **Operations and maintenance (O&M) contracts** — service levels, maintenance obligations, and performance-linked penalties or incentives.
- **Supply and off-take agreements** — securing stable feedstock inputs and reliable sales of recovered materials or energy, with agreed quantities, quality, pricing and risk allocation.

GUIDE BOOK I How can we structure the activities to work together in a Hub 4 Circularity?

Protecting ideas: intellectual property

Because innovation in industrial–urban symbiosis usually emerges from collaboration — shared technology, co-designed processes, jointly optimised resource flows — ownership and commercialisation must be settled early. A clear IP strategy separates background IP (what partners bring in) from foreground IP (what the project generates), and assigns it through sole ownership, joint ownership or licensing, drawing on standard frameworks such as the WIPO model clauses. Proprietary knowledge is protected through NDAs, confidentiality clauses, IP liaisons and secure data rooms; contributions are formally attributed in patents and publications; and dispute-resolution mechanisms — including a neutral steering committee — are agreed in advance. Agreements must also satisfy funder requirements, such as the Data Management Plan (DMP) that Horizon Europe projects use to balance confidentiality with open-access obligations.

Fairness as a structuring principle

Finally, durable collaboration depends on fairness being built in rather than assumed. Agreements should include explicit fairness and inclusiveness clauses that prevent better-resourced actors from imposing unbalanced terms and safeguard the interests of SMEs, cooperatives and public entities. It is this clarity and equity from the outset that gives partners the confidence to co-invest, share knowledge, and scale the value chain over the long term.

What helps — and what holds hubs back

Across the United Circles hubs, one lesson stands out: success depends less on technology than on the quality of governance, stakeholder engagement, and collaborative capacity. The same factors recur as either barriers or enablers.

The most common barriers are limited long-term financing; fragmentation among stakeholders with divergent interests; regulatory and administrative complexity across sectoral boundaries; gaps in data and information-sharing; difficulty sustaining commitment once initial enthusiasm fades; and limited institutional capacity to coordinate.

The strongest enablers mirror them: strong leadership and a dedicated coordinating body (the CHO); active stakeholder participation and trust-building; established collaboration networks to build on; alignment with regional policy priorities; access to research and innovation expertise; and available funding and investment-support mechanisms. Hubs that secure these are far better placed to move from planning into implementation.

How do we build the skills to run a Hub for Circularity?

A Hub for Circularity asks a lot of the people who run it. Coordinating industries, public authorities, investors and communities — and steering circular value chains from idea to investment — calls for a blend of technical, regulatory, financial and collaborative skills that few organisations have all at once. Building that capacity is itself a core hub activity, and the United Circles H4C Skills Training Programme (Deliverable 2.7) was designed to do exactly that, for project partners and the external stakeholders working alongside them.

The programme was built from the ground up around real needs. Rather than assuming what hubs should learn, the team ran a structured needs assessment — interviews, co-creation workshops and an online survey across the hubs — to identify where the skills gaps actually were. The answers spanned both the technical (energy and material flow analysis, waste mapping, circular business models, financial planning, ESG reporting, regulatory compliance, risk analysis, KPIs) and the human (stakeholder engagement, communication, collaboration, trust-building). The programme was then shaped and refined to match and mirror hubs, so the content fit real regional and sector contexts.

A blended approach

The programme deliberately split its content between two formats, matched to how each is best learned.

Online modules carried the technical, regulatory and business content — the material that works well through expert presentations, case studies and self-paced study. Across sixteen sessions they covered four broad areas: identifying symbiosis opportunities (drawing on Scandinavian case studies and a library of 30+ real examples); analysis and digital tools (energy and material flow mapping, Sankey diagrams, screening platforms); business, finance and compliance (circular business models and the H4C Business Model Canvas, financial planning and the “valley of death,” ESG reporting, risk analysis, KPIs); and circular technologies in practice, including dedicated peer exchanges between hubs on each demonstrator’s specialism — wastewater (Salamanca), food waste (Veneto–Gauteng) and construction and demolition waste (Ankara–Greece).

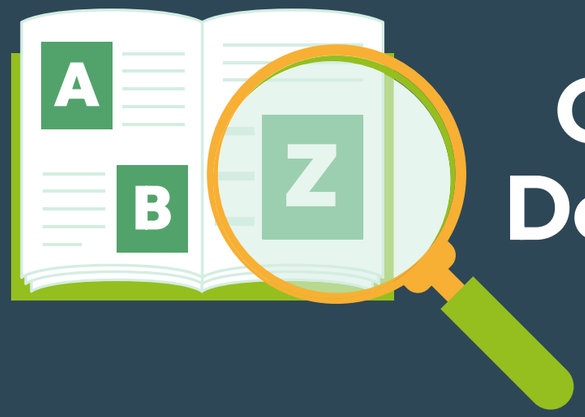
In-person training in Pécs concentrated on the collaborative competencies that are hard to build online — the ones that depend on doing rather than watching. Three themes ran through it: systems thinking, stakeholder engagement and communication, taught through group exercises, stakeholder mapping, role-play, and hands-on value-chain and waste-mapping work, supported by causal-loop diagramming and the Vensim modelling tool.

Systems thinking: the unifying skill

The single most important finding of the co-design process was that systems thinking is the competence that ties all the others together — and it became the backbone of the in-person training. At its core, it means seeing a hub not as a set of separate problems but as one interconnected system, where resource flows, technologies, stakeholder relationships and decisions all affect one another. That perspective is what lets a hub coordinator anticipate trade-offs, spot leverage points, and make decisions that hold up across the technical, environmental, economic and social dimensions at once. Participants applied it directly — mapping their own hubs as systems, tracing feedback loops, and working through real decisions such as the TEPE Betopan industrial case.

What it achieved, and what comes next

Evaluation showed high participant satisfaction and confirmed the value of the blended, exchange-driven approach. The clearest lessons for future rounds: allow enough coordination time, build in peer exchange between hubs as a core feature rather than an add-on, and provide additional support for topics that demand hands-on implementation. Together, the programme provides a foundation for strengthening hub capacity and supporting the long-term scaling of circular economy approaches across regions.



Glossary/ Definitions

Hubs for Circularity (H4C): industrial clusters that realise lighthouse projects in industrial and industrial-urban symbiosis and circularity of materials and resources.

Seed H4C: a nascent initiative that starts with a small number of committed organisations aiming to evolve into a fully functional H4C.

Mirroring H4C: an ecosystem that seeks to replicate successful industrial symbiosis value chains from established demonstrators.

Demonstrator H4C: a fully operational ecosystem where circular economy solutions are tested and validated at a regional level.

Symbiosis Readiness Level: provides a structured approach to evaluating and guiding the maturity of symbiotic cooperation within a hub, with a focus on stakeholder engagement, infrastructure readiness, operational coordination, and value chain integration.

Vision of an H4C: The vision of an H4C within the framework of IUS is an interconnected system where resources are used efficiently, waste is minimised, and resilient, sustainable environments are created.

Mission of a H4C: The mission of a H4C is to define and pursue clear medium- and long-term goals that contribute to systemic circularity and address regional challenges and opportunities.

CHO: the key orchestrator responsible for managing the H4C's coordination, strategy, and implementation efforts. As a neutral and trusted facilitator, it connects actors, aligns initiatives, and enables co-investment in shared infrastructures, knowledge, and innovation.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