Deploying circular systemic solutions through living labs in cities and regions

Topic: HORIZON-CL6-2027-01-CIRCBIO-01

Innovation Action (IA) – two stage

AI-DRIVEN SYMBIOSIS PLATFORM

AISYM

AI-DRIVEN SYMBIOSIS PLATFORM

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Background

Industrial parks across Europe are moving toward circular business models where companies share resources, exchange by-products and reduce waste. Several digital tools already support this transition, but they are either sector-specific, national, or limited in intelligence. Existing systems often work as simple matching directories or static databases, requiring companies to manually input information and search for possible symbiosis partners.

Kråkøya Biopark in Norway, which Prios is supporting with competence, is an emerging industrial cluster focused on aquaculture, bioenergy, shipping and green hydrogen. The park already plans integrated solutions such as biogas from fish sludge, zero-emission transport and shared energy systems. However, the level of digitalisation in the companies is still low (DMA score 22%), and there is no automated system that can map resource flows, simulate symbiosis opportunities or calculate environmental and financial benefits.

This creates a strong need for a next-generation AI-driven symbiosis platform that can support Kråkøya's development, and at the same time be scalable to other industrial parks in Europe.

The 2026-27 call seeks to implement and demonstrate circular systemic solutions in cities and regions, stimulating social innovation through new technologies and business models. It requires multi-sector involvement and engagement of all relevant stakeholders, including public authorities and civil society. AISYM will therefore serve as the digital backbone of a living-lab demonstration at Kråkøya while creating a blueprint for other regions.

Analysis

We have analysed the current available platform and those known under development, see table in annex.

Most digital tools for industrial symbiosis today are useful, but they are still too limited for the needs of modern industrial parks. Several platforms exist in Europe, yet most of them work mainly as static directories or simple matching systems where companies must register their waste and manually search for possible partners. They do not handle real-time data from sensors, and they cannot analyse energy, water, heat and biological flows together. Because of this, they cannot give a complete picture of how a whole industrial area works as one ecosystem.

Another challenge is that existing solutions rarely include simulation. They help identify possible exchanges, but they do not allow companies to test scenarios or evaluate future benefits before investing. For a new industrial park like Kråkøya, this is a real weakness. The companies need to understand how choices around biogas, heat reuse, sludge treatment or hydrogen systems will influence each other. None of the current tools offer a digital twin that can show this in a clear and practical way.

A further limitation is that most platforms do not use learning algorithms. They do not improve over time, and they do not learn from patterns in resource use, seasonal variations or cost–benefit results. As a result, the recommendations remain basic, and companies lose the opportunity to get better insights as the system collects more data.

Finally, many industrial parks consist of small companies with low digital maturity. Existing tools are often too technical, difficult to implement, and lack any form of built-in training or onboarding. This makes adoption slow, and many potential resource exchanges never happen simply because the companies do not get enough support to use the tools effectively.

For these reasons, there is a clear need for a new AI-driven platform that brings everything together: real-time data, simulation, learning algorithms and a user-friendly design that supports companies with limited digital experience. This would finally give industrial parks a practical and future-oriented tool that helps them unlock the full potential of industrial symbiosis.

Aim

The aim of AISYM is to develop, demonstrate and upscale a new AI-driven platform that enables circular systemic solutions in industrial parks acting as living labs. AISYM will be piloted at Kråkøya Biopark in collaboration with local authorities and multiple sectors, with clear plans for replication in other cities and region.

Project objectives

Objectives at this stage is mix of objective and activities to have in mind. The objectives must be reshaped as part of application process.

Objective 1 – Build an integrated data and resource-mapping system
Create a scalable data framework that collects, standardises and visualises resource flows across companies in an industrial park. This includes materials, water, energy, by-products, CO_2 and organic residues. The system will support both manual data entry and automated inputs from digital sensors and existing equipment.

Objective 2 – Develop an AI-driven matchmaking and prediction engine
Design and train AI models that can identify potential symbiosis links, forecast resource availability and propose high-value exchanges. The engine will combine technical, economic and environmental data so companies can understand both the feasibility and the expected benefits of each recommendation.

Objective 3 – Create a digital twin to simulate circular scenarios
Build a digital twin of the industrial park that allows users to explore "what if" scenarios, such as shared heat use, biogas production, water reuse or CO_2-based value chains. The digital twin will estimate impacts on cost, emission reductions and resource efficiency to support better decision-making and strategic planning.

Objective 4 – Develop a user-friendly platform adapted to low digital maturity
Design the AISYM interface to meet the needs of SMEs with limited digital experience. The platform will include simple workflows, onboarding guidance, practical help functions and recommended actions tailored to each company's resource profile.

Objective 5 – Integrate training and competence development
Add a competence layer with micro-learning modules and onboarding materials that help companies understand industrial symbiosis, digital resource management and circular practices. This will support adoption, create new skills and make the platform more useful for local industry.

Objective 6 – Validate AISYM through a real-world pilot and prepare EU-wide replication
Demonstrate AISYM in a living-lab setting at Kråkøya, involving multiple sectors (aquaculture, bioenergy, shipping, manufacturing etc.) and local/regional authorities. Test the platform with real data, evaluate socio-economic and environmental impacts and define a replication roadmap for other cities and regions.

Objective 7 – Develop and validate novel circular business models enabled by AISYM
Design, test and evaluate new circular business models that arise from the use of AI-driven resource insights. This includes identifying value chains, assessing economic

feasibility, defining incentives for collaboration and preparing replicable business model templates that industrial parks can adopt across Europe. Ensure that the business models support multi-stakeholder circular value chains and can be integrated into regional circular economy strategies, aligning with the call's requirement to involve at least two sectors and multiple actors.

Objective 8 – Promote inclusive multi-actor participation and knowledge transfer
Actively involve public authorities, industry partners, SMEs, civil society and research organisations in the living-lab demonstration at Kråkøya. Document lessons learned, barriers and enablers for adoption, and ensure that knowledge and good practices can be transferred and replicated in other cities and regions across Europe.

Outcomes

Outcome 1: A validated AI-driven platform that enables industrial symbiosis in real settings
AISYM delivers a fully functional platform that has been tested and proven useful by companies in an operating industrial park. The pilot demonstrates that SMEs with low digital maturity can easily work with circular resource flows through simple digital tools.

Outcome 2: Increased number of resource exchanges between companies
Several new symbiosis connections are established in the pilot (e.g. water reuse, sludge-to-biogas, heat sharing, CO_2 utilisation). Companies show measurable reductions in waste, cost and emissions as a direct result of using AISYM.

Outcome 3: A digital twin that supports real-world decision-making
Park operators and companies can use the AISYM simulation tool to evaluate the impact of planned circular investments. This helps them make better decisions, reduce risk and design circular infrastructure based on evidence.

Outcome 4: Reduced environmental footprint of the industrial park
Through improved resource sharing, companies reduce emissions, waste and use of virgin materials. Environmental benefits are documented through pilot indicators such as CO_2 savings, reduced waste handling and increased resource efficiency.

Outcome 5: Improved skills and higher digital readiness among SMEs
Thanks to integrated micro-learning and onboarding modules, companies gain better understanding of resource flows, basic data skills and circular business models. This leads to higher digital maturity and increased willingness to adopt new technologies.

Outcome 6: A scalable and replicable model for other industrial parks
AISYM produces a complete replication package including the platform architecture, APIs, governance model, training modules and business model. This makes it possible for other regions in Europe to implement AISYM after the project.

Outcome 7: Stronger cooperation and governance for circular ecosystems
The pilot shows how an industrial park can use a shared digital platform to plan collective circular solutions. Stakeholders build trust, establish new routines for data sharing and become more coordinated in how they develop their local circular economy.

Outcome 8: New circular business models demonstrated and validated
The project documents how digital tools and AI make circular collaboration financially attractive for SMEs. At the end of the project, at least 2–3 new business models are proven in practice (e.g. waste-as-a-service, shared energy, CO_2-to-biomass chains).

Outcome 9: A successful living-lab demonstration showing circular systemic solutions across multiple sectors, with documented lessons learned, barriers, enablers and a replication guide for other regions

Project structure

WP No. & Name	Linked Objectives	Expected Outcomes (each outcome only used once)
WP1 – Project Management & Coordination	O1, O2, O3, O4, O5, O6	
WP2 – Data Architecture, Interoperability & System Integration	O1, O2, O4	Outcome 1: A validated AI-driven platform that enables industrial symbiosis in real settings.
WP3 – AI Engine Development & Digital Twin Modelling	O1, O2, O3, O5	Outcome 2: Increased number of resource exchanges between companies. Outcome 3: A digital twin that supports real-world decision-making
WP4 – User Interface, Experience & Decision-Support Tools	O1, O3, O5	Outcome 5: Improved skills and higher digital readiness among SMEs.
WP5 – Environmental, Social & Economic Impact Assessment	O3, O4, O6, O8	Outcome 4: Reduced environmental footprint of the industrial park.
WP6 – Circular Business Models & Systemic Solution Design	O1, O2, O3, O7, O8	Outcome 7: Stronger cooperation and governance for circular ecosystems. Outcome 8: New circular business models demonstrated and validated.
WP7 – Living-Lab Demonstration, Evaluation & Replication Model	O1, O2, O3, O4, O5, O6, O8,	Outcome 6: A scalable and replicable model for other industrial parks. Outcome 9: A living-lab demonstration delivering circular systemic solutions across multiple sectors

About the WPs

The big picture

- WP2 → technical foundations
- WP3 → AI + digital twin
- WP4 → user tools
- WP5 → impact assessment
- WP6 → systemic circular solutions & business models
- WP7 → living-lab demonstration & replication

WP2 – Data Architecture, Interoperability & System Integration

WP2 develops the technical foundations of AISYM, including the unified data architecture, interoperability framework and integration of data streams from multiple sectors (energy, water, waste, logistics, biomass). The work includes establishing secure data governance, defining APIs, ensuring compliance with European data spaces, and preparing the platform for real-time operations in the living lab. WP2 ensures that AISYM is robust, scalable, and capable of supporting cross-sector circular systemic solutions.

WP3 – AI Engine Development & Digital Twin Modelling

WP3 develops the AI-based symbiosis engine and the digital-twin environment powering AISYM. This includes algorithms for resource-flow matching, predictive modelling, optimisation of circular solutions, and automated identification of symbiosis opportunities. A multi-layer digital twin replicates the industrial park's material, energy, water and waste flows to enable scenario simulations and impact forecasting. WP3 delivers the intelligence core that allows AISYM to support evidence-based decision-making for circular systemic transformations.

WP4 – User Interface, Experience & Decision-Support Tools
WP4 creates all user-facing components of AISYM, including dashboards, visualisations, decision-support tools and role-specific interfaces for companies, public authorities, waste/energy operators and regional planners. The work emphasises usability, transparency and co-design with stakeholders engaged in the living lab. WP4 ensures that complex data and AI outputs are translated into intuitive, actionable insights that support circular business decisions and regional planning processes.

WP5 – Environmental, Social & Economic Impact Assessment
WP5 establishes the full impact-assessment framework for environmental, social and economic performance. This includes lifecycle analysis (LCA), carbon and resource-efficiency modelling, socio-economic indicators, and monitoring of behavioural and organisational change within the living lab. WP5 measures the effectiveness of AISYM-enabled systemic solutions, provides continuous feedback loops to WPs 3 and 7, and ensures that the Kråkøya demonstration generates robust evidence for scaling and replication in other European regions.

WP6 – Circular Business Models & Systemic Solution Design
WP6 focuses on co-creating and designing circular systemic solutions across multiple sectors in the Kråkøya living lab. The work includes developing and validating innovative circular business models supported by AISYM, involving companies, public authorities, and civil-society stakeholders. Special emphasis is placed on identifying economic feasibility, collaboration incentives, governance models, and value-chain integration relevant for scaling circular practices across regions.

WP7 – Living-Lab Demonstration, Evaluation & Replication Model
WP7 leads the implementation of AISYM in a real-world **living-lab environment** at Kråkøya, designed to demonstrate circular systemic solutions involving multiple sectors (aquaculture, energy, transport, waste, logistics). The work package coordinates stakeholder engagement, data collection, platform piloting, and socio-economic and environmental evaluation. WP7 documents lessons learned, success factors, barriers and enablers, and prepares a **replication package** enabling other European cities and regions to adopt AISYM and integrate it into the Circular Cities and Regions Initiative (CCRI).

Excisting platforms

Plattform	Functionality
SYMBA (Horizon Europe)	A new *AI-driven industrial symbiosis database* for the bio-based sector. SYMBA develops a digital tool that automatically matches companies' by-product streams (e.g. organic waste, biomass residues) to suggest zero-waste value chains. It uses artificial intelligence and big-data analytics to recommend waste-to-resource exchanges locally, circulareconomy.europa.eu. The project (Jan 2024–'26) involves 50 R&I sub-projects across Italy, Spain, Belgium, the Netherlands and Denmark, testing the platform's matching in real bio-industrial clusters
SymbioTech AI Collaboration Platform (Erasmus+)	A *digital matchmaking and simulation platform* under development by the SymbioTech alliance. It provides SMEs with an "AI-assisted collaboration platform" that simulates waste, energy and material flows between firms. The tool uses artificial intelligence and predictive analytics to map resource exchanges (waste heat, byproducts, etc.) and design efficient symbiotic processes, symbiotech-project.eu. SymbioTech (a 2024–27 Erasmus+ project) is creating curricula and digital tools (the SymbioTech platform and SymbioEnergy tool) to train "SymbioTech Managers" and help industrial parks adopt data-driven symbiosis practices.
LIAISE IS Stakeholder Directory (COST Action)	A *Europe-wide digital directory* launched by the LIAISE COST Action. It serves as an online networking hub where companies, researchers and policymakers list their inputs (required materials/energy) and outputs (by-products) to find symbiotic partners. The platform functions like a specialized search engine for industrial symbiosis: users can filter by material type, geographic region or sector to discover matches, cost.eucost.eu. Covering 92 countries, the directory enables companies to connect directly and turn a firm's waste stream into another's feedstock.
be@t Industrial Symbiosis Platform (Portugal)	A data-driven marketplace for agro-industrial residues in Portugal's textile and agrifood sectors. Part of the national "Bioeconomy at Textiles (be@t)" initiative, this digital platform lets textile companies and agro-processors register their waste streams (e.g. cotton scraps, agricultural by-products) and matches supply with demand in real time Link. By facilitating exchanges of bio-residues between the textile industry and local farms or food processors, the platform promotes circular value chains, reduces disposal costs and keeps materials in the regional economy
ENEA Italy Industrial Symbiosis Platform	A *national online matching portal* developed by ENEA (Italy's National Agency for New Technologies). Italian enterprises register surplus resources (materials, energy, water, by-products, etc.) and the platform algorithmically finds matching needs among other firms, circulareconomy.europa.eu. It also analyzes each company's resource management to suggest both internal optimizations and external symbiotic exchanges. Deployed across Italy, the platform has created a network of enterprises exchanging wastes and byproducts in line with IS principles
Material Match Making Platform (LIFE M3P)	A *LIFE-funded waste-matching tool* for circular value chains. M3P is an online database of materials, technologies and patents that uses open data and semantic **"smart-tag"** matching to reconnect industrial outputs with new uses. Users enter details of a waste stream (composition, properties, volume) and the platform applies keyword and semantic analysis to suggest high-value reuse options, lifem3p.eu. It is piloted by research and industry partners in Italy, Greece, Belgium and beyond, effectively acting as a circular-economy search engine for secondary raw materials.
Excess Materials Exchange (Netherlands	A *B2B digital marketplace* (EUR Cosme/STARS) headquartered in Amsterdam. Companies tag their excess materials or waste products with digital IDs (QR/RFID/barcodes) containing data on composition, origin, toxicity, etc. The platform's matching engine then identifies reuse opportunities based on economic, environmental and social value, starseurope.eu. In practice, an industrial cluster can barcode a by-product stream and immediately see which nearby factories can use it. This IoT-enabled platform has been deployed in Dutch industry clusters to turn one company's waste into another's feedstock.
CircLean Network Platform (EU)	A *digital marketplace* being built by the EU-sponsored CircLean initiative. It will let companies in the CircLean industrial symbiosis network list, buy or sell secondary raw materials and by-products across Europe. According to project literature, the platform is designed as an online trading venue for circular supplies, complemented by tools for self-assessment and impact tracking, technopolis-group.com. (CircLean is a DG GROW/EU Parliament-funded network led by Technopolis, aiming to create an EU-wide symbiosis marketplace to overcome information gaps.

Data needed

This table is just a preliminary brainstorming. Each factor in the table needs to be reviewed as part of application development and consider if some factors should be added or deleted.

Type of data needed	How to collect the data	Purpose for platform development
Material inputs (raw materials used by each company)	Short survey form; manual registration in AISYM; upload of purchase lists; interviews	To understand resource flows, detect potential symbiosis matches and build the baseline for the digital twin.
Material outputs (waste, residues, by-products)	Waste handling reports; sensor data; manual entry; interviews	Essential for AI matchmaking: identifies which outputs from one company can become inputs for another.
Energy use (electricity, heat, cooling)	Energy bills; smart meters; IoT sensors; data export from existing systems	To model heat and power flows, enable energy symbiosis and provide realistic scenarios in the digital twin.
Energy outputs (waste heat, biogas potential, hydrogen use)	Temperature sensors; process logs; operator interviews	Helps simulate heat recovery, shared energy systems and alternative energy chains in the park.
Water use (intake, discharge, quality)	Water consumption meters; wastewater reports; manual upload	Supports modelling of water reuse loops and optimising water-related circular business models.
CO_2 streams (emissions, captured CO_2, flue gases)	Emission reports; CO_2 meter systems; production process logs	Key for identifying CO_2-to-biomass, CO_2-to-fertiliser or other carbon circular value chains.
Transport data (material movement, distances, frequency)	Logistics reports; GPS export; manual mapping of routes	Needed to calculate circularity score, transport impacts and feasibility of symbiosis flows.
Production volumes (monthly/annual outputs)	Company reporting; internal dashboards; interviews	Allows AI to forecast future resource availability and seasonal patterns.
Operational constraints (temperature needs, timing, quality requirements)	Interviews with technical staff; process descriptions	Ensures the AI only suggests realistic and technically possible symbiosis matches.
Cost data (waste fees, energy prices, transport costs)	Confidential submission; anonymised data sheets; one-to-one sessions	Required for economic calculations and showing financial benefits of circular business models.
Environmental data (CO_2 emissions, waste volumes, water footprint)	CSR reporting; environmental audits; LCA screening	Used to estimate environmental impact, reduction potential and EU Green Deal alignment.
Company metadata (size, sector, location, digital maturity)	Registration forms; DMA self-assessment	Helps tailor platform features, guidance and training for SMEs with low digital readiness.
Organisational willingness and goals	Short survey; digital maturity interviews	Needed to align business model development and determine which synergies have highest adoption potential.