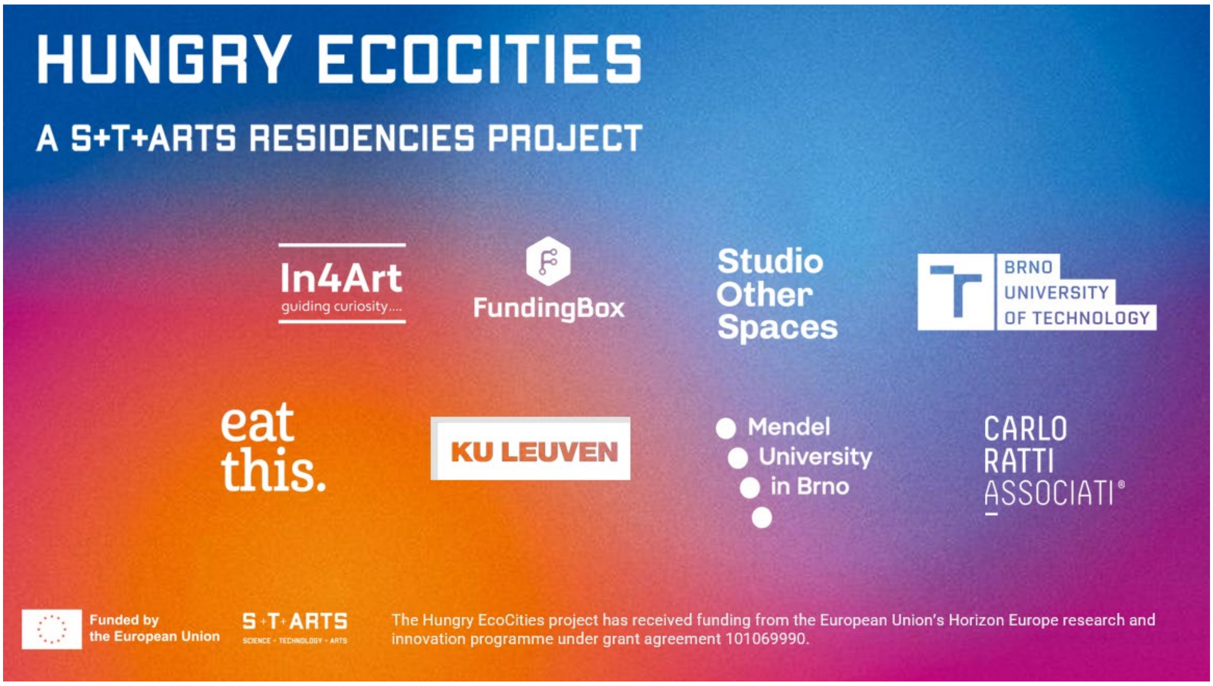


Deliverable 5.12 Experiments scale-up impact plan 2

Grant Agreement Number	101069990
Project title	Hungry EcoCities
Start date of the project	Sep 1st 2022
Duration of the project	42 months
Date of submission of the report	Dec 22nd 2025
Workpackage No.	5

Project coordinator: Brno University of Technology
WP leader: Lija Groenewoud van Vliet + In4Art
Lead author: Lija Groenewoud van Vliet + In4Art
Reviewers: Anca Marin + FundingBox

Objective of the deliverable

This deliverable is the second and final experiment scale-up impact plans. It presents the impact plans for the Paths-to-Progress experiments (PPEs), explaining the TRL reached, the relevance, and positioning the outcomes of the projects within their further development potential for the food sector and the ambitions of the Hungry EcoCities project.

History of changes

Date	Version	Author	Comment
20.06.24	0.1	Klara Kaluzikova	Setup of deliverables
11.12.25	0.2	Lija Groenewoud van Vliet	First draft deliverable
17.12.25	0.3	Anca Marin	First review
18.12.25	0.4	Rodolfo Groenewoud van Vliet	Second review
19.12.25	1	Lija Groenewoud van Vliet	Final deliverable

Table of Content

1. Abstract

This deliverable presents the scale-up impact plans for the ten Paths to Progress Experiments (PPEs)—the second cohort of experiments conducted within Hungry EcoCities from 2024 to 2025. Following the successful completion of the Humanizing Technology Experiments (reported in D5.11 and D4.9), the PPEs represent a transition toward practical, real-world application and sector integration.

Across the ten projects, a total of 16 distinct prototype outcomes emerged, with Technology Readiness Levels ranging from TRL 3 (early-stage research) to TRL 7 (ready for operational deployment). Collectively, these outcomes span product innovations, process improvements, and artistic innovations that contribute to food system sustainability and innovation. The diversity is intentional: the PPEs were designed to explore multiple pathways toward systemic food system transition, recognizing that innovation in food systems is not univocal but requires parallel exploration across production, consumption, governance, and cultural domains.

This deliverable provides the identified development options for each PPE. For each project, we explain the relevant outcome, current TRL levels and development pathways toward sustainable operation and impact.

The ten PPE projects have generated momentum beyond the residency period. Multiple projects have secured institutional validation (exhibitions, scientific publications, festival presentations), sparked genuine business interest (formal requests for deployment, new product lines, funding applications), and created foundations for sustained collaboration between artists, entrepreneurs and communities. These outcomes show that the Hungry EcoCities result help the needed ongoing innovation to achieve a healthier, more sustainable and resilient food system across Europe.

2. Development plans per PPE

The ten Paths to Progress Experiments have generated 16 distinct prototype outcomes across diverse domains of food system innovation. Rather than viewing these experiments as isolated initiatives ending with the residency period, the program has intentionally created infrastructure and documentation to enable sustained development and ecosystem integration. For each PPE, a comprehensive one-pager has been created documenting the project's effort and potential. They can all be found in the Annex section. These one-pagers serve as carriers for introduction and further development. Additionally, all prototypes have been added to the matchmaking tools—enabling potential funders, research institutions, and commercial partners to quickly understand each project's potential and identify collaboration opportunities. Simultaneously, all prototype outcomes have been integrated into the HEClab platform as dedicated prototype cards, creating searchable, discoverable entries within a broader ecosystem of agri-food innovation. In total, 14 new prototype cards have been added to HEClab, representing the cumulative innovation across the PPE portfolio. These experiments have not been isolated initiatives, but rather leave Hungry EcoCities with practical frameworks to make further development and uptake realistic.

PPE project	Projectcard on HECLab	TRL
Be(e)together	(Be)etogether Interface: transforms internal hive data into a sensory experience: light, sound, vibration, and airflow that allow you to "feel" the life of the bees from within.	6
	(Be)etogether set of sensors: the kit captures temperature, humidity, vibrations, sounds, bee movements, and air quality, along with periodic images of the hive environment. Thanks to this network of sensors and AI processing, behavioral patterns, hive health, and anticipated nectar flows can be monitored.	6
	Community Varroa Monitoring Tool: AI image recognition to automatically detect and count varroa mites from photos of monitoring boards — making hive health assessment faster, more accurate, and less invasive.	7
Compostable Altar	Compostable Altar: offering to the earth: recipes and process to transform agricultural waste into biodegradable, data-driven sculptures that enhance the soil quality. Combining biomaterial research, digital fabrication, and AI, it celebrates circularity and reimagines design as a living, regenerative process	7
Crafts | Meats | AI	Crafts | Meats | AI: combining scientific imaging, AI storytelling, and salt-based printing to reveal how salt, air, and patience transform raw meat into Prosciutto di Parma.	6
Open Source Harvesting Community	openCEM Spider: a coreXY tool plotter which can printed once and scaled to any dimension with standard profiles	6

	openCEM - controlled environment grow unit: a open source framework for growing plants in a controlled environment	4
Phygital Seasoning	Phygital Seasoning AR set-up redefines taste as a designed experience of perception, not ingredients.	5
Quiet Storm	Quiet Storm – Music for Insects a curated sound set-up to enhance the mating process of the Tenebrio Molitor beetle, population reproduction, and to cultivate empathy.	5
Re.Source-Society	Re-Source.Society prototypes: explores how materials can regulate climate using natural physics instead of energy-intensive machinery - Cooling Cactus: cools through evaporation inside its 3D-printed terracotta body — lowering temperatures without adding humidity to the air. - Living Lung: passively removes moisture through a textile membrane that lets vapor pass but not air, reducing the need for mechanical dehumidifiers. - Basic Brain: senses temperature and humidity to activate each system only when conditions are favorable.	5
	Fair-advantage.org : an AI-powered search tool that democratizes marketing and sales efforts of small, local, sustainable food producers	6
Sprouting Embryonic Futures	Sprouting Embryonic Futures Sprouter: a living system that combines sensor networks, a stroboscopic watering system, and an automated timelapse machine to grow and visualize sprouts in real time.	3
Straw Return	Straw Return: A process to turn wheat stem residues into high-value materials for design and interiors	6
Tomato Brain	Tomato Brain: A multi-agent AI system to support human collective intelligence	7

Table 1: overview of prototype outcomes

The prototype cards on HEClab are actively matched against emerging open call opportunities—enabling PPE outcomes to be positioned for further development, scaling, and institutional validation. This matching process creates a bridge between the exploratory work of the residencies and the funding and partnership ecosystems necessary for sustained impact. The HEClab dashboard allows project teams to identify relevant funding calls (EU Horizon Europe, national innovation programs, sectoral development initiatives) where their prototypes represent competitive applications. Below is an example from the HEClab dashboard showing how the Be(e)together Interface has been matched against potential open call opportunities where the prototype could be further developed as an innovative solution.

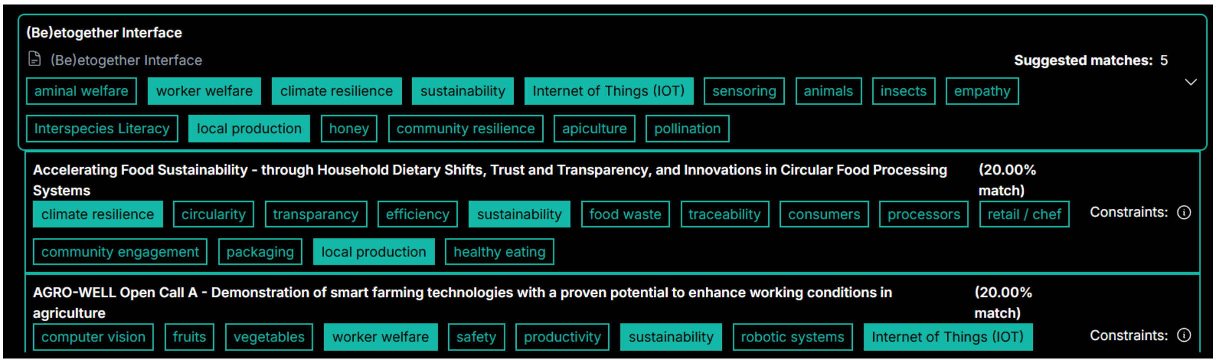


Figure 1: Overview opportunities matches for a specific PPE outcome

The following sections present the development plans for each of the ten PPEs, organized to provide a clear assessment of current status, near-term development priorities, and strategic pathways toward sustained collaboration and ecosystem integration. The scientific contributions are also jointly collected in Annex 11.

2.1 Tomato Brain: Collective intelligence platform

Tomato Brain is a practical, human-centered AI workflow created by artist Jo Kroese to support Axia Seeds in translating organizational complexity into accessible decision-making infrastructures. Rather than automating human judgment, the system amplifies collective intelligence by redesigning the information layer of work—how teams gather, synthesize, and act on knowledge. The prototype comprises three interconnected AI agents (Sales Sage, Seed Sommelier, and Cultivation Coach) deployed on Axia Seeds' private cloud environment. It tackles the challenges the organization has with organizational knowledge sharing, first internally. The organizational knowledge is scattered across sales records, cultivation knowledge, customer feedback, and institutional experience, yet rarely synthesized in real time. This fragmentation creates inefficiencies – and hence, leads to wrong decisions and food loss throughout the value chain. Decision-making becomes reactive rather than anticipatory. Organizational learning is hindered by information silos. Tomato Brain addresses this gap by creating a system that continuously synthesizes diverse data streams into actionable intelligence, enabling faster sense-making, reduced waste through better decision alignment, and hands-on AI literacy across the organization.

Current Technology Readiness Level: 7. The system is validated in relevant and operational environment with field testing at Axia; ready for deployment in comparable contexts.The current prototype operates as a modular, privacy-preserving workflow within Axia's existing digital infrastructure. Open-source documentation is created that allows other organizations to adapt and implement similar workflows.

The relevance

The design philosophy underlying Tomato Brain reflects emerging practices in responsible AI and human-centered innovation. Rather than deploying AI to replace expertise, the project treats human judgment as irreplaceable and AI as a tool for augmenting awareness and decision quality. The system ingests pre-meeting inputs—notes, CRM data, trial results, and accumulated organizational knowledge—and produces structured synthesis: patterns detected across datasets, tensions or trade-offs surfaced, alternative options proposed with rationale, post-meetings insights and draft actions for consideration. During meetings, teams pose live questions ("Which varieties suit this customer's conditions?") and receive cross-checks that integrate sales knowledge, seed traits, and cultivation expertise. Post-meeting, decisions and their rationale are captured, creating an ongoing learning archive that strengthens future decision-making. Tomato Brain hence creates an infrastructure for collective learning to benefit the food system challenges.

Next steps:

To advance Tomato Brain toward broader application and impact, a few directions can be explored: software development, social impact and broader knowledge sharing.

Related to software development, the meeting workflow could be expanded to support more granular decision capture and sophisticated pre-meeting brief generation. Current prototypes focus on pattern detection and option proposal; future iterations could also support scenario modeling ("If we prioritize this customer segment, what happens to our sustainability metrics?"), which was brought forward as a feasible direction from validation conversations. Additionally, there is a request to implement a low-connectivity mode (SMS and lightweight text interfaces) to extend usability beyond high-bandwidth environments, potentially supporting smallholder and cooperative contexts with limited digital infrastructure.

Related to the social impact and awareness, the artist already actively designs and deploys live, participatory demonstrations in public settings (theatre, design festivals, food conferences, academic venues) that make collective intelligence tangible and demystify AI for broader audiences.

Tomato Brain has the potential to be developed into curricula as a case study in how organizations can redesign their information layer to become more responsive, thoughtful, and aligned with sustainability goals. At sector level, Tomato Brain offers a replicable model for how knowledge-intensive organizations in agriculture, food systems, and environmental management can use AI as infrastructure for collective learning rather than for automation or cost reduction interesting angle would be through a tech-for-democracy to position Tomato Brain within broader conversations about responsible AI, digital rights, and technology serving public goods.

The artist wants to advance the Tomato Brain from an initiative to an organizational infrastructure, positioning AI as a tool for amplified collective intelligence rather than automation. Its development path emphasizes ecosystem integration—connecting with civic tech and democracy initiatives, while supporting sector-wide adoption through open documentation and public engagement.

2.2 (Be)etogether

Be(e)together is a collaborative research and artistic prototype led by artists María Castellanos and Alberto Valverde in partnership with Olaya Miel (ecological beekeeping initiative, Northern Spain) and with the contribution of BeeSage (IoT-enabled apiculture monitoring startup). The project developed three interconnected outcomes, each addressing different dimensions of human-bee relationship: (1) an Open Sensoring Kit for comprehensive hive monitoring; (2) the Interface, a physical device that makes invisible hive activity visible through light, vibration, and tactile feedback; and (3) a Community Varroa Monitoring Tool for collaborative pest management across beekeeping networks.

Be(e)together operates at the intersection of three disciplines and value systems: ecological beekeeping practice (as embodied by Olaya Miel), technological innovation (technical expertise of one of the artists), and artistic research (the artists' practice of translation and meaning-making). The project started with a previous monitoring sensor kit- the Open Environmental kit - which was specifically adjusted and adapted to fit in open field outdoor monitoring and extended with sensors to record and make visible the relation with bees. The new kit prioritizes sensors that reveal hive health and well-being—internal temperature and humidity, vibration frequency and weight fluctuations.

Current Technology Readiness Levels: TRL 6 -7 .
The Open Sensoring Kit was validated in real beekeeping environments, the artistic interface is ready for public deployment and exhibition and the Varroa tool is in the MVP phase, with an operational online dashboard and ready for operational testing.

The Relevance
Bees face converging crises: disease pressure (Varroa destructor mite, nosema), climate volatility triggering brood loss and hive absconding, and loss of habitat and forage diversity. These challenges are particularly acute in Spain, which hosts the largest professional beekeeping sector in the European Union, yet faces "pain points" that existing monitoring technologies inadequately address. Current solutions are often expensive, proprietary, or require high technical literacy—barriers for small-scale and subsistence beekeepers.

Beyond productivity metrics, there is a growing recognition that how humans monitor and manage hives reflects and shapes our relationship with bees. Industrial monitoring often reduces bees to production units. Be(e)together asks a different question: How might monitoring become a practice of care? How might transparency about hive condition deepen rather than exploit the human-bee relationship?

The Open Sensoring Kit for Beehive Monitoring has the potential to contribute to actionable intelligence for beekeepers—early warning of swarming, disease pressure, or starvation risk—while creating an archive of hive behaviour across seasons and years. The kit's modular design allows beekeepers to adapt it to their specific needs and contexts, and its open-source nature enables community contribution and refinement.

The Interface takes this translation work further. By rendering invisible hive dynamics (temperature shifts, vibration intensities, population stress) into perceptible form (light gradients, vibrational rhythms), the Interface makes bees' experience accessible to human sensibility.

Lastly, The Community Varroa Monitoring Tool addresses a collective action problem. Varroa spread is not a problem individual beekeepers can solve in isolation; it requires coordinated monitoring and early response across regional networks. The tool creates infrastructure for collaboration, allowing beekeepers to share data, detect regional patterns, and coordinate responses—turning individual surveillance into collective stewardship.

Next steps
The interface prototype has been fully developed and documented; a next phase will involve real-time data integration (currently uses pre-recorded seasonal data) and testing in both operational and public-facing settings.

The artistic outcomes have been selected for a major institutional exhibition (CAB Burgos, February–May 2026, titled "Syntopies: Shared Ecologies Between Humans, Bees, and Machines"). This institutional validation signals the prototype's maturity and artistic significance, while opening pathways for future exhibitions and public engagement. Related to public engagement it has the potential to develop a public education curriculum around Be(e)together that addresses beekeeper audiences (training in sensor deployment and data interpretation) and broader publics (understanding hive ecology, human-bee relationships, technology for care). Consider partnerships with environmental education organizations, design schools, and food system initiatives.

The Community Varroa Monitoring Tool can be developed into an integrated web platform enabling collaborative pest monitoring across beekeeping networks. Using computer vision to analyze hive monitoring boards, the system automatically detects and counts Varroa mites with high accuracy, eliminating manual counting error and labor. Data is visualized in real-time on a dashboard accessible to individual beekeepers and (with appropriate permissions) to regional coordinators. The platform as such could generate community-level insights—mapping Varroa spread patterns, triggering alerts when infestation thresholds are crossed, enabling coordinated regional response. Currently the tool has demonstrated technical feasibility and user acceptance among test users. Advancement to full production requires development resources (backend optimization, UX refinement, regulatory compliance for data handling) and a pathway to sustainable operation (service model, support infrastructure).

For both the sensor kit as the varroa tool business interest has emerged from the Spanish beekeeping community, with a formal request from a beekeeping collective in León to establish a Be(e)together trajectory at their site.

As for the PPE SME BeeSage this project was a learning experience and the discussions resulted in a deeper understanding and appreciation of organic beekeeping as a management system. It led to the ambition to establish and validate an integrated, harmonised methodology to assess the environmental and economic outcomes of organic apiculture and its interactions with other pollinators across Europe, enabling comparable evidence, practice optimisation and pollinator-inclusive stewardship. With this, BeeSage has successfully been selected for the EIT Food Bilbao Campus Experience in Spain as one of the 10 startups to take part in this entrepreneurship programme designed for startups as post-accelerator to serve as your gateway to the Basque Entrepreneurship Ecosystem.

Be(e)together has generated considerable momentum and multiple stakeholder interests. The choice to use open-source hardware and software reflects a commitment to accessibility and collective learning, supporting the emergence of a community of practice rather than locked-in dependence on proprietary systems. This outcome is simultaneously artistic practice (creating meaning through aesthetic form), scientific communication (translating data into comprehensible pattern), and an ethical act (inviting empathy through perceivable presence).

With this, the project exemplifies how art-driven innovation can address systemic challenges in food production and ecological stewardship. The outcomes—Sensor Kit, Interface, Varroa Tool—are not isolated products but elements of a coherent vision: technology deployed in service of care, transparency enabling collaboration, data supporting ecological stewardship. As these outcomes mature and scale, they contribute to the emerging infrastructure for regenerative agriculture, particularly in the pollinator-dependent domains of European farming.

2.3 Quiet Storm

Quiet Storm is a collaborative artistic and scientific project led by sound artist Samuel Van Ransbeeck in partnership with Protiberia, a Spanish insect farming startup focused on Tenebrio molitor (darkling beetle) production. The project explored whether specific audio environments can enhance beetle mating behavior, population reproduction, and cultivation efficiency. The prototype encompasses a curated sonic environment played continuously in the rearing facility, a livestream setup allowing public observation of beetle conditions, and an ongoing data collection system documenting behavioral and physiological responses.

Current Technology Readiness Level: TRL 5.
Initial testing has revealed promise in density optimization, particularly with a 60

female to 40 male ratio yielding the highest egg-laying rates. The current prototype comprises three interconnected elements. A carefully composed soundscape developed through experimentation is played continuously in the facility, with the hypothesis that acoustic stimulation influences mating behavior, fertility, and population growth rates. Multiple data collection streams capture beetle responses: movement patterns, mating frequency, egg-laying rates, larval development metrics for which the Brno University of Technology team provided machine vision analysis of behavioral responses. A live digital interface allows remote audiences to observe beetle rearing conditions while hearing the sonic environment, creating simultaneous functions of research, education, and artistic expression. The set-up is validated in a relevant environment, namely the production facilities of Protiberia.

The Relevance:

Insect farming represents a critical pathway toward sustainable protein production, since insects require minimal resources compared to conventional livestock, efficiently convert organic waste into biomass, and generate minimal greenhouse gas emissions. Yet adoption barriers remain substantial, particularly around public acceptance and production optimization and animal well-being should be taken into account. Protiberia recognized that beetle reproduction and population growth rates constrain production capacity, a challenge that conventional agronomic optimization alone may not resolve. Quiet Storm emerged from a deceptively simple question: Could artistic experimentation—specifically, sound design—offer insight into insect behaviour? This bridges multiple domains: neurobiology, animal welfare, public perception, and innovation culture itself.

By treating the insect farming environment not as a sterile production facility but as a rich sensorium where multiple stimuli interact, the project asks whether creative design might optimize conditions in ways that pure technical approaches miss. Samuel worked closely with Protiberia to understand beetle biology before exploring what artistic methods might matter. The livestream setup simultaneously serves research (documenting behavioural responses through observation) and public engagement (making insect farming accessible and emotionally resonant to broader audiences).

The next steps:

Before we could look at the next steps, we have to await the growth cycle data collection of the beetles. This will provide quantitative evidence of the sonic environment's impact on beetle reproduction, fertility, and larval development. Depending on the outcome, the data can be prepared for publication in entomology and applied zoology journals, with a research collaboration formalized with the Shmir research team at Lusíada University of Lisbon establishing an ongoing partnership for future behavioural studies.

The Brno University team's machine learning expertise offers potential for refining digital sex determination of beetles, which would enable real-time population sex ratio optimization. Temperature variation, light cycles, and airflow patterns represent additional stimulus modalities beyond sound that deserve systematic exploration.

Future work should pursue synthesized pheromone compounds to test their effects on mating behaviour.

The livestream setup offers real-time monitoring that can benefit both research and public education. Educational curricula and workshops introducing insect farming to schools, food festivals, and design/innovation conferences could be interested in positioning Quiet Storm as a case study in how artistic methods humanize food production. The strong reception at public demonstration events in Villamaela suggests appetite for accessible, engaging insect farming education that could expand to additional venues.

2.4 CRAFTS I MEATS I AI

This project explored how artistic practice, scientific analysis, and AI-assisted documentation can translate the invisible craftsmanship of cured meat production into accessible, compelling narratives. The prototype outcomes include a documentary video capturing the production process, an artist book using salt-based printing techniques and AI-assisted writing, and initial scientific direction of ham chemistry and sensory properties.

Current Technology Readiness Level: TRL 6.
The project took a strong point on responsibly using AI-tools to amplify human expertise rather than replace it. The artist engaged directly with Capanna's production spaces, workers, and knowledge keepers throughout the residency, allowing embedded research to inform both the visual language of the documentary and the conceptual framework of the artist's book. Scientific partners provided initial evidence of chemical and sensory properties, grounding artistic interpretation in measurable data.

This resulted in a three-part dissemination toolkit, consisting of a documentary, an artist book, and scientific documentation. The documentary video combines visual documentation of production spaces and worker portraits with scientific visualization of chemical transformations, communicating the temporal dimension of curing.

The artist's book creates multiple reading paths through the production process, using salt-based printing (referencing the material foundation of curing) alongside photography and conceptual depth. Scientific documentation provides starting points for further chemical and sensory analysis that serve simultaneously as a research contribution and as a communication tool for quality claims and producer education. Together, these elements demonstrate how heritage knowledge can be preserved and celebrated even as production scales.

The Relevance
Parma ham (Prosciutto di Parma) is a protected designation of origin product whose value derives from centuries of accumulated knowledge: specific pig breeds, regional salt sources, climate conditions, and slow-curing techniques that transform raw ingredients into products of exceptional quality. Yet this knowledge is increasingly invisible to consumers and even to producers in larger consortiums. Industrial

competition and commodity-market pressures incentivize cost reduction and efficiency gains that risk eroding the artisanal foundations of the product.

This project tackled the challenge on how to communicate authenticity and craftsmanship in a market saturated with products claiming similar virtues? Rather than treating AI and digital technology it explored how these tools help make invisible craft visible and emotionally resonant.

The creation of multiple entry points enables communication with diverse audiences: consumers, designers, food professionals, and cultural institutions can all engage with the complexity of cured meat craftsmanship through formats suited to their interests and literacy.

Next Steps:
Both artist and SME are committed to advancing the collaboration. A digital version of the artist book will extend its reach to broader audiences and facilitate distribution beyond physical venues. The video is being positioned for use at company events and international food fairs, while the book serves as a premium communication tool for high-value buyers and partners. Capanna's physical "Ham Room" is being transformed into a multisensory space where visitors experience the complete production narrative: combining video, printed materials, and direct sensory engagement with the product itself.

A "salt, air, time" communications brand is being developed spanning video, printed book, and sensory experience, capable of differentiating Capanna in competitive markets while authentically reflecting its production values. Food museums, design schools, and regional cultural institutions represent important venues for expanding reach and could be interested in talks or installations that demonstrate how heritage knowledge becomes accessible and compelling to new generations. The artist book and video are exhibition-ready works that can circulate through galleries, design fairs, and cultural venues, generating visibility and cultural legitimacy.

A particularly promising development involves deepening investigation of correlations between chemical properties and consumer perception (sensory and emotional responses). This could evolve into a larger research project with institutional support, offering substantial value to PDO producers seeking to understand and authentically communicate their product's distinctiveness. Initial conversations are started with the Parma Ham Consortium itself to create a shared platform for knowledge sharing and producer education across the 100+ member companies, positioning this not as a single company initiative but as a sector-wide contribution.

Another branch that can also be developed is the extension of this methodology to other PDO and geographically regulated products, such as Parmigiano Reggiano, regional wines, or other EU-certified foods whose identity is tied to place and process. The prototype and storytelling framework developed through Crafts | Meats | AI can be easily adapted to communicate the invisible dimensions of these products, scaling the approach from a single producer to a broader cultural and educational platform that highlights the intelligence of time, matter, and tradition.

2.5 Harvesting Community

The project developed two interconnected technical systems: the Spider, a modular plant monitoring and imaging system, and openCEM, an open-source control framework for controlled environment modules. Together, they address a central challenge in urban agriculture—how to make advanced growing systems accessible, transparent, and adaptable to diverse contexts rather than locked into proprietary architectures. This vision reflects both technical opportunity and philosophical commitment. Logiqs recognized that their expertise in logistics and modular systems could be redirected toward crop science and urban growing. The artist brought artistic practice attuned to accessibility, experimentation, and community participation. The collaboration produced systems designed for transparency: hardware that can be sourced and built locally, software that is open-source and community-modifiable, workflows documented for adaptation and replication.

Current Technology Readiness Level: TRL 4
The focus was to increase the speed of learning on what is the perfect environment to grow plants in a sustainable way. The team discovered that they need many more experiments to grow the knowledge on plant behaviour in a CEM. For this, they need to measure more precisely, so one experiment gives more data, but also do smaller experiments, so the cost per experiment is reduced. The spider helps in the more precise measurement and the mini-CEM, or openCEm module- helps reduce the cost per experiment. Each build iteration revealed new ideas and opportunities for improvement.

The Spider is integrated in the current testing CEM at Logiqs. OpenCEM, as inspiration also for a miniCEM but open-source, has a first modular prototype, that provides standardized command language (DD:HH:MM /command) allowing farmers to specify watering, lighting, sensor operations, and data collection. A Raspberry Pi hosts the control system, sending commands to WiFi-enabled microcontrollers. A GitHub repository enables community contribution, modification, and version control. Inspired by G-code, the framework creates a familiar mental model: standardized markup language for cultivation where hardware and software integrate seamlessly. The extensive command set includes water management, LED control, imaging, notifications, and email reporting.

The relevance
Vertical farming and controlled environment agriculture (CEA) represent promising approaches to urban food production: reduced resource use, year-round production, shorter supply chains. Yet current solutions are dominated by large-scale, capital-intensive systems operated by industrial players. Individual farmers, small communities, and researchers are excluded by cost and technical complexity. The project asks a fundamental question: How might advanced agricultural technology be democratized? How can growing systems be designed as open platforms where users innovate, adapt, and contribute rather than as locked-in, proprietary services?

The project embodies principles of open innovation and participatory design, prioritizing accessibility and community participation over commercial capture. The Spider's modular design allows researchers to adapt monitoring to specific questions, while the openCEM control framework uses a human-readable "grow playlist" format inspired by G-code (the standard for 3D printing)—commands that any farmer can read, modify, and share.

This approach is particularly relevant for food system innovation in urban contexts. Cities face complex constraints: limited space, diverse environmental conditions, multiple stakeholder interests. Agricultural systems designed for one specific context do not adapt well. Open-source, modular approaches allow each community to innovate within local ecological and social contexts while contributing to a larger common of shared knowledge. The Spider combines X- and Y-axis modularity, hardware sourced from standard aluminum profiles and 3D-printed parts for accessibility, battery-powered operation, integrated imaging and environmental sensors, and an extensible design allowing additional attachments. This enables precise, non-invasive plant monitoring without disturbing optimal growth conditions.

Next Steps
Multiple cultivation cycles across different crops and seasonal conditions are required to enable protocol optimization and validation of the system. Universities and research institutions are being engaged as users of Spider and openCEM for agricultural research, creating network effects and community investment. Technical specifications, grow protocols, and design files will be documented and published, enabling replication by the global agricultural community. Educational content and training resources will enable farmers to design custom protocols

Logiqs will present the Spider at Messe Essen (IPM Exhibition, January 2026)—a major horticultural trade fair representing commercial validation and market entry opportunity. Logiqs' will explore how to integrate it in its product line, exploring hybrid commercial and open-source models. Simplified, lighter versions are planned as a result from the field testing.

Partnerships with agricultural universities and research institutions will ensure the Spider and openCEM serve genuine research needs. The work positions open-source, modular design not as a limitation but as a business model offering Logiqs differentiation in competitive markets while advancing public good objectives.
As urban agriculture scales and diversifies, approaches like openCEM may become foundational infrastructure for distributed, adaptive, community-responsive food systems. Although the open CEM is more a proof of concept, it brings together so many smart ideas and takes on engineering that it lays the foundation for different directions of development - from artists and societal to technological and scientific.

2.6 Compostable Altar

The project explored the intersection of 3D printing, biomaterial development, soil science, and artistic practice by creating compostable sculptures that serve simultaneously as aesthetic interventions and soil amendment (educational) objects. Large-scale 3D-printed objects created from agricultural by-products are planted in soil; embedded sensors measure changes in pH, nutrient content, and microbial activity as the biomaterial decomposes. The prototype outcomes include multiple compostable sculptures deployed at the farm, documented sensor data, and a methodological framework for biomaterial design and testing.

Current Technology Readiness Level: TRL 7.
The artist worked directly with waste from the local orchards, tested materials in field conditions, and collaborated with the farm to understand soil chemistry and health indicators. Therefore, the system reached the level of being demonstrated in an operational environment. The installation includes embedded sensors measuring soil conditions (pH, nutrients, microbial activity) as the biomaterial decomposes. Data is collected in real time and visualized on a digital platform, creating transparency about soil processes usually invisible to human perception. The entire process, consisting of material selection and processing (recipes), printing parameters, installation and the decomposition trajectory, is documented through photography, video, open-source code and written analysis, creating a methodological foundation for replication and adaptation. The availability of sensing data online ensured transparency and enabled continuous monitoring and productive discussion of ongoing results. The willingness to share and give back to the open source community, which also supported the development of various parts in the project, is carried on through enclosing all on Github and actively seeking platforms to present the project insights, like during the the *1st European Symposium on Cultivated Biodiversity and Local Food Policies* and *International Symposium Bio-Design For Living Futures (2025).*

The Relevance
Industrial agriculture generates enormous quantities of organic waste, like crop residues, processing by-products, spent biomass. Most is burned, left in fields, or disposed of at cost. Meanwhile, soil degradation is a critical challenge across European agriculture. Compostable Altar emerges from a straightforward insight: what if agricultural waste could be transformed into materials that simultaneously address aesthetic, educational, and soil health objectives? This reflects growing recognition that the linear agricultural model (inputs → production → waste) is failing ecologically and economically. Regenerative agriculture demands closed-loop systems where all biomass has value, requiring not just technical innovation but also new imaginaries about waste as resource and design's role in making these transitions visible.

Combining material research with advanced technologies is nothing new, yet also collecting evidence that this combination leads to soil enhancements is. The power of the outcome in this project lies in the bringing together of circularity, community, technology and data. Going forward, the innovation holds promise as a total concept as well as in individual parts. For the SME, the focus on community and circularity could be a differentiator as a regenerative farm as well as an agri turismo. For the artist, the focus on data in combination with circularity could lead to new directions of research and application.

Compostable Altar demonstrates how creative practice can translate complex scientific and ecological knowledge into forms that invite care and participation. By treating agricultural waste as valuable material and soil health as an aesthetic and ethical concern. This project opened valuable pathways for ecological design, horticultural applications, and market-aligned circular products.

Next Steps:
The ambition is to continue expanding Compostable Altar as both a research platform and a replicable methodology. Building on the insights of the PPE, the next step would be to allow the project to be adapted to other geographical and climatic contexts.

The project would serve as a case study in the academic work that the artist undertakes as an educator and will result in publications, lectures, and workshops: fostering dialogue between art, science, and regenerative design. These activities will help empower a new generation of designers and artists to work with living systems and circular materials.

Le Terre di Zoé's Compostable Altar installation can serve as an educational experience where visitors learn about soil health, regenerative agriculture, and circular design. Workshop programming combining hands-on biomaterial making, soil testing, and artistic practice can integrate ecological knowledge with creative experience. Schools and educational institutions will be engaged to bring Compostable Altar methodology into curricula around sustainability and circular economy.

A scale installation is scheduled for Disseny Hub Barcelona, and additional exhibitions are in discussion for 2026. A curatorial framework is being developed positioning Compostable Altar within broader conversations about regenerative design, circular economy, and art's role in environmental transformation.

2.7 Straw Return

The project transforms agricultural residues (wheat stems, processing by-products) into high-performance biomaterials suitable for interior design, acoustic applications, and sustainable construction. Through intensive residency involving material experimentation, 3D printing, and AI-supported prototyping, the team developed a fully natural composite material with proven acoustic and structural properties, resulting in finished products (acoustic panels, bricks) exhibited at Dutch Design Week 2025.

Current Technology Readiness Level: TRL 6
The material leverages multiple waste streams within Staramaki's operations: disqualified wheat stems, rejected straw, processing residues. Using wheat stems and starch-based binders created from flour derived from wheat plants, the team developed a fully natural composite material. Production processes utilize by-product starch and residual heat from existing equipment, minimizing additional infrastructure and energy requirements. The material was formed into multiple product types: acoustic panels (45×45 cm, suitable for interior design and sound treatment), bricks (for construction and design applications), and bar elements. All products were designed for aesthetic appeal and functional performance. Multiple designs and samples were exhibited at Dutch Design Week 2025, generating significant professional and commercial interest. The exhibition provided public validation, demonstrated market potential, and attracted attention from designers, architects, and sustainable business investors. The aesthetic quality of finished products

demonstrates that sustainable materials need not sacrifice beauty or design sophistication.

The Relevance
Agricultural production generates enormous waste streams: wheat stems, crop residues, processing by-products. In most regions these are burned, left in fields, or disposed of at minimal value, representing massive inefficiency. Meanwhile, construction and interior design sectors face pressure to adopt sustainable, low-carbon materials. Conventional options rely on fossil fuels and generate end-of-life waste challenges.

By converting wheat stem residues into useful materials, Straw Return reveals hidden potential within the food system. Agriculture, beyond producing food and feed, can provide bio-based raw materials for design, construction, and interiors. In this way, the project advances a circular and regenerative food system, where value is extracted from every part of the crop. With this, Straw Return demonstrates how waste can become a resource, reducing dependence on virgin materials and inspiring systemic change. The project shows how byproducts can be creatively reintegrated into the economy. The collaboration not only delivers practical alternatives but also raises awareness of inefficiencies in food production. By treating secondary waste streams as resources, it redefines value and supports the transition to a more sustainable future.

Next Steps:
The process has been promising and demonstrates strong potential for future applications of the developed material, which effectively raises awareness of circularity and sustainable design.

Controlled production batches will be run within Staramaki's existing facilities to confirm process compatibility, cost efficiency, and quality consistency. Forming and drying techniques will be refined using modified existing infrastructure, leveraging excess capacity rather than requiring new capital investment. Internal teams and initial product testers will provide feedback to identify refinements.

Market entry is being pursued through two phases.
Phase 1 involves launching small-scale production of select panel and bar products. For this a third-party certifications (acoustic properties, fire resistance, structural strength) through ISO-accredited testing labs has to be pursued. Modest production equipment (pressing/molding systems, improved drying racks) will be invested in to enhance quality and throughput. Full lifecycle assessment documenting environmental benefits compared to conventional alternatives will provide credible evidence for sustainability claims.Targeted marketing and sales outreach will focus on early adopter segments: boutique hotels, sustainable architects, design-conscious cafés and cultural venues. Market research will validate pricing, positioning, and key application areas.
Phase 2 would be based on the success of phase one and could then approximately in 12- 24 months focus on the marketing, scaled production and expanded distribution.

To support the investments in phase one, EU programs (Horizon Europe, LIFE Programme) aligned with circular economy and sustainable materials themes are being scouted for funding as well as national and regional innovation grants (Greece, Netherlands) that focus on supporting material innovation and circular production. Additionally, first talks are planned with private investment channels through Staramaki's investor network and impact-focused venture capital.
The Dutch Design Week also led to contact with potential distribution and manufacturing partners for scaling production beyond Staramaki's facility.

Closing material loops within agricultural production systems advances circular economy principles while creating new value streams for farming communities.

2.8 Phygital Seasoning

The project explored how immersive technologies can alter human taste perception by manipulating sensory context through light, color, spatial presence, rather than by changing food composition. It offers a glance on how personalized digital flavouring of monoproducts could change the full food system: from production to consumer behaviour. Using Apple Vision Pro mixed-reality headsets, participants engage in guided tasting experiences where MR (Mixed Reality) overlays and environmental design influence the taste perception. Additionally, a speculative movie was created to support the narrative and show the potential of this concept in the long term, since it is a highly visionary and innovative concept, but would still require both technological, material as cultural acceptance of new eating habits before it would reach the market.

Current Technology Readiness Level: TRL 5.
The prototype demonstrates proof of concept: taste perception is substantially shaped by sensory context and can be influenced through designed MR environments. It has been validated in several relevant environments, both in Spain as in the Netherlands.

Using Apple Vision Pro headsets, participants experience carefully designed visual and spatial environments while tasting. Environments are calibrated to evoke specific taste perceptions, in this project sweet and sour. Color gradients, spatial compositions and subtle visual cues combine to influence perceived taste. Testing with hundreds of participants provides statistical evidence that MR sensory design reliably influences taste perception. Participants show consistent associations between specific visual/spatial designs and taste perceptions: warm colors and soft spatial designs associated with sweetness; cool colors and sharp geometries associated with sourness.

The Relevance
Global food systems face converging sustainability challenges: overproduction of product variants (leading to waste), excessive packaging, heavy reliance on additives and flavorings, unhealthy consumer behavior. Industrial food design typically addresses taste variation through reformulation by adding sugar, salt, or flavoring

compounds to create "different" products from identical base ingredients. This approach is inherently wasteful and unsustainable. Phygital Seasoning emerges from a radical alternative vision: what if a single, nutritionally optimized food product could be perceived as having different tastes through manipulation of sensory context rather than ingredient reformulation? This is not merely an interesting research question; it has profound implications for sustainability (one production line instead of ten variants), health (reduced additives, simplified nutrition), and consumer experience (perception as a designed dimension).

The core insight is that a single food product, like a plain, unsweetened yogurt, can be perceived as having different tastes through MR-mediated sensory manipulation. Rather than producing ten variants with different sugar content and flavorings (waste, packaging, complexity), one base product becomes adaptable to different preferences. This functions simultaneously as research platform, artistic experience, and public education tool. Participants engage directly in the experiment, learning through embodied experience how perception works and how technology shapes sensory experience.

The project enhances neurogastronomy research demonstrating that taste is not merely a tongue phenomenon but a multisensory, context-dependent experience involving vision, smell and sound. By systematically designing these contextual dimensions, it becomes possible to create distinct taste experiences from identical foods. By demonstrating that taste is designable through context, the project opens new possibilities for more sustainable, healthier food systems and positions food design and sensory science as central to food system transformation.

Next steps:
To offer a true monoproduct in the future, firstly, sensory testing will need to be expanded to additional taste dimensions (bitter, umami, salty) and complex multi-taste combinations. Further testing will also need to be broadened to include diverse populations to understand how age, culture, and individual sensory sensitivity influence effects. Any further insights on this can be valuable to enhance this knowledge base and could serve as input for articles in sensory science journals to establish scientific credibility.

Related to the selected technology, it is good to keep an eye on the developments and acceptance of wearing as MR devices, versus more accessible visual perception manipulations (e.g. AR versions (lower technical barrier than Vision Pro) or more towards multimodal integration combining visual cues with spatial audio, olfactory cues (scent technology), and haptic feedback to increasingly enhance the immersive experiences. Physiological measurement integration has also been identified as a potential research direction. Electroencephalography (EEG) will measure neural correlates, facial expression recognition will assess emotional response, and electrodermal activity will measure autonomic response. Correlational models linking VR design parameters to physiological responses will create predictive capabilities. This data will refine AR designs, optimizing for measured perceptual and emotional effects.

However, on the short term, the visionary story and concept can already be promoted and marketed. For this a dedicated installation at Mediamatic Amsterdam is planned (starting with sweet installation, expanding to other tastes), creating a permanent public engagement platform combining research and education. Hence, the first development direction is to position Phygital Seasoning in food design, sensory science, and food system sustainability education.

2.9 Re-source.Society

Controlled environment agriculture is often promoted as a sustainability solution: local production, minimal pesticide use, year-round supply. Yet current CEA systems are frequently energy-intensive, relying on complex HVAC (heating, ventilation, air conditioning) technology to maintain precise temperature and humidity conditions. This energy demand undermines sustainability claims, particularly in regions reliant on fossil fuel electricity. Re-Source.Society emerges from a critical question: Must CEA require high-tech, energy-intensive solutions? Or can simpler, more elegant approaches achieve adequate climate control using substantially less energy?
Current Technology Readiness Level: TRL 5.
The project investigates whether low-tech, low-energy climate control solutions can effectively support indoor crop production, challenging the assumption that controlled environment agriculture requires high-technology, energy-intensive HVAC systems. Through experimentation with passive and semi-passive cooling and dehumidification strategies, the team developed three prototype systems: the Cooling Cactus and Living Lung, both controlled by the Basic Brain, a simple Arduino-based intelligence system. Field testing has demonstrated 20% energy savings compared to conventional HVAC approaches.

The Cooling Cactus is a passively cooled bio-inspired structure using principles of evaporative cooling. Water circulation and strategic material placement create cooling effects without active refrigeration. Controlled by the Basic Brain the system responds to temperature and humidity sensors, adjusting water flow to optimize cooling efficiency. The Living Lung is a dehumidification system using bio-inspired principles of moisture absorption and release, leveraging natural material properties and passive airflow to manage humidity within acceptable ranges. The Basic Brain provides simple Arduino-based control logic coordinating sensor inputs and system operation—unlike complex HVAC systems requiring specialist technicians, the Basic Brain is comprehensible, maintainable, and modifiable by farmers with basic technical literacy.

The project is grounded in real challenges at Instagreen: cooling and humidity management in semi-controlled environments in Mediterranean climates. This embeddedness means solutions are tested in actual conditions with genuine production pressures.

The Relevance
The project reflects a philosophical stance emerging across sustainability and regenerative agriculture: that technology should serve life and ecology, not dominate them, and that simplicity and elegance can outperform complexity. The collaboration between Nicolas (an artist with interests in material intelligence and low-tech systems) and Instagreen (committed to accessibility and low-tech agriculture) created ideal conditions for exploration. Rather than assuming that more technology is better, they asked what minimal, elegant solutions might work. This exemplifies responsible

innovation in technology development: using sophisticated tools to design deliberately simple, low-tech solutions accessible to small-scale farmers.

The process has been a true intersection of science and art, characterized by a non-linear and experimental approach. The artist began working with clay, testing the initial concept in various conditions before recognizing its limitations and shifting the research toward textile materials as well. This transition, though momentarily disorienting, was managed with resilience and curiosity, leading to meaningful and innovative outcomes. The project demonstrates how the program fosters experimentation, iteration, and moments of re-evaluation as essential parts of the journey toward genuine innovation and empowered collaboration and trust building between the SME and artist, showing that through dedication and persistence, relevant outcomes can be achieved.

The Next Steps

Based on the initial validations and demonstration in a relevant environment at the InstaGreen farm, the test results of the latest prototypes give good indications that potentially interesting energy savings can be reached for small to medium sized local indoor farms, both inside buildings and in greenhouses. However, multi-season and multi-context testing is essential before scaling. Testing across all four seasons and in different buildings (greenhouses, obsolete urban spaces, garages) will reveal how performance varies with climate conditions; winter dehumidification challenges and summer cooling demands likely show different effectiveness profiles. Multiple geographic contexts, like Mediterranean (hot/dry summers, mild winters) versus Northern Europe (cool/damp conditions) must be tested. Energy consumption, crop performance (yield, quality), and operating costs will be measured across diverse contexts to build evidence base for scaling.

Sensor configurations, material choices, and control logic will be refined based on field data. System designs, construction protocols, and operational procedures will be documented in open-source format, enabling replication and adaptation. Simulation models for different climate conditions and greenhouse configurations will be developed, allowing farmers to predict performance before installation. Partnerships with software and hardware developers interested in open-source agricultural technology can be explored.

Additionally, also the Fair Advantage tool was as an AI-powered search tool that democratizes marketing and sales efforts of small, local, sustainable food producers. This is an Open Source solution, developed in such a way that anybody who would like to build further upon this AI tool can do so, in 2026 and beyond.

2.10 Sprouting Embryonic Futures

Sprouts represent an underexplored dimension of food systems innovation. As foods, they are nutrient-dense, rapidly produced, and suitable for decentralized production. As biological processes, sprouting exemplifies an elegant a possible efficiency by maximizing nutritional value in minimal time and space. Yet sprouting is rarely centered in food system conversations and a lot is still unknown. Therefore, this project recognized this gap and focused on creating imaginaries and research directions that might deepen understanding and reveal new possibilities rather than commercial prototyping: exploring the sprouting process as both biological phenomenon and speculative design opportunity. Through workshops, installations, media (video, written documentation, digital visualizations), and creative collaborations, the project created new imaginaries around sprouts and their potential role in food systems,

Current Technology Readiness Level: TRL 3.
he Sprouter installation is an example of a experimental proof of concept, and therefore reached TRL 3. This project needed to take a step back in development, to first work on structured research and exploration and contribute as an early-stage innovation imagination and perspective-shifting. This approach embraced the hand-in-hand development of cultural work and technical development.

The Relevance
This project created space for questions that might not emerge in conventional product development: What does sprouting teach us about life, time, and transformation? How might sprout cultivation reshape urban food spaces? What imaginaries do sprouts enable?

Close attention was paid to sprouting processes, growing conditions, and variability. While not at the level of controlled scientific research, the project documented sprouting dynamics, created records, and generated insights about conditions supporting optimal growth. The collected data can support both scientific analysis and public understanding of how small environmental changes affect food quality. The artistic interventions through video, photography, spatial installations, and multimedia works created a new aesthetic and conceptual engagement with the sprouts.

The developed participatory public engagement event invited broader audiences to engage with sprouts as food, biology, and design inspiration, combining hands-on sprouting, tasting, and creative exploration. Scenarios, visualizations, and narrative frameworks explored how sprouting and sprouter technology might reshape urban food systems, domestic spaces, and relationships with food.

Through this experiment, the SME Sprout Dynamics learned how digital tools can bridge biotechnology, education, and design, creating a new form of interaction between people and living systems to help see and understand the invisible intelligence of nature.

The project may catalyze future innovations not yet visible. By creating new imaginaries and research foundations, the project contributes to the cultural and intellectual infrastructure necessary for understanding role of sprouts have in food system transformation.

Next Steps
Insights from the project are documented and published in accessible, academic formats and already included in the conference presentations and research reports the artist undertakes. Mendel University will be conducting further research on sprouting biology, optimization of growing conditions. These materials will be valuable for schools, universities, and informal learning contexts.

Artist Haseeb Ahmed will refine the Sprouter prototype with enhanced sensors, visualization tools, and a more responsive watering system. A presentation in Toronto is planned, introducing the project to new academic and artistic audiences. The studio will continue its collaboration with Chef Brian Kaderavek to develop public events that merge food, art, and technology through participatory dining experiences. Further partnerships with universities and research institutions will focus on co-authoring publications and advancing the scientific and cultural understanding of sprouting as a sustainable and aesthetic practice.

Sprout Dynamics' continued development will benefit from the cultural and conceptual foundations created by the project. They will organize a public demonstration event in Sofia Tech Park, Social enterprise and community development pathways deserve exploration. Partnerships with educators, nutritionists, and public health actors interested in accessible, nutritious food production will be investigated.

3. Responsible AI and Digital Literacy

An important objective of the Hungry EcoCites project was to stimulate the uptake of AI usability prototype in the food industry and, with that, also contribute to the trust in and acceptance of digital technologies in society. Together with the HTE outcomes, we have seen diverse applications of AI and digital technology in food systems. This section reflects on the governance, ethics, and implications of AI deployment in food innovation as part of the development plans. It is bundled here together, since the insights and considerations are relevant for all AI-related projects and not on an individual basis. The main implications are:

1) Nurture the human and ecological embeddedness by assuring that AI serves as an amplifier rather than a replacement. Technology should be used to strengthen rather than replace human relationships, ecological embeddedness and community knowledge. By assuring that local communities can adapt the systems to specific ecological and social contexts, it empowers instead of pushes for size-fits-all solutions.

2) Ensuring that the used technology serves explicit values: Rather than deploying technology first and asking about values afterward, responsible approaches identify desired outcomes (regeneration, transparency, local resilience) and design technology in service of those values.

3) Systems should be designed so that decisions and logic are comprehensible and can be questioned. This means avoiding "black box" and resulted in sharing knowledge through GitHub repositories to ensure traceability and reusability.

4) Algorithms in food governance contexts where stakes are high.

These principles are not constraints on innovation; rather, they enable more robust, sustainable, equitable innovation that is a responsible path to achieve lasting positive impact. Let’s look at some examples of how the principles were used in practice.

An important decision it that the AI-tools are deployed to amplify human expertise rather than to replace it. In Tomato Brain, AI synthesizes data to enhance decision-making, but humans retain judgment and authority. In Compostable Altar and Re-Source.Society, simulation algorithms and machine learning are used to understand complex systems and design simpler solutions. This design pattern an standpoint of “amplification rather than replacement” reflects a particular philosophy of responsible AI: technology should honor and strengthen human expertise and judgment, not subordinate it. For food systems this matters as it remains dependent on human knowledge, embodied skill, and ecological alignment is possible to design AI systems that serve distributed, ecological, human-centered food practices. The projects clearly wanted to deploy AI-tools in service of farmer autonomy, community stewardship, and ecological regeneration. This were explicit values embedded through the artistic research in the project development.

Multiple PPE projects involve data collection: environmental sensors in Be(e)together and Compostable Altar, sensor networks in Re-Source.Society and Harvesting Community. Each raises questions about data ownership, privacy, and use. Across the projects, the principle employed is transparency and community control. In Be(e)together, sensor data is made visible in real time to beekeepers and (where appropriate) to broader communities, supporting collective stewardship rather than asymmetric surveillance. In Compostable Altar, soil health data is documented and shared. In Phygital Seasoning, participants are fully informed about the research and how data will be used. Establishing norms of transparent, community-controlled data governance is essential. The projects in Hungry EcoCities showed various data architectures that serve community knowledge and decision-making rather than external control.

Many of the projects explicitly aim to demystify technology and build digital literacy. Quiet Storm's livestream makes insect farming transparent and invites public engagement. Tomato Brain is designed so non-technical users can engage with AI systems directly. Open Source Harvesting Community's openCEM uses human-readable command formats inspired by 3D printing standards, making the system comprehensible without specialized training. This emphasis on accessibility and literacy reflects recognition that technology-driven prototypes cannot remain the domain of specialists. Various stakeholder (farmers, food workers, consumers, and communities) must develop understanding and agency with digital tools. Through various workshops that stimulate participation they are empowered to inform and interact.

4. Reflections and learnings

The ten Paths-to-Progress Experiments have generated substantial learning about art-driven innovation, food system transformation, and collaborative practice that have an influence also on the scale-up and further development of the outcomes.

The first and most notable is the quality and character of collaboration. In projects characterized by genuine partnership, both artist and SME brought essential expertise and shared decision-making authority, resulting in outcomes that reflected integrated thinking rather than one party's agenda imposed on another. In some projects, the partnership was imbalanced, where one party (typically the artist) carried disproportionate responsibility for both conceptualization and execution. Early identification of imbalance enables intervention before it becomes destructive. This was done through supportive rebalancing of effort, additional mentorship, or restructuring of partnership roles. This requires dedicating mentor and coordinator time to partnership dynamics, not just technical progress, and establishing clear communication protocols where teams feel comfortable naming challenges as they emerge. Nonetheless the collaboration dynamics, these projects also achieved strong outcomes through the artist's excellence and the trust and support they received from the mentors, though with reduced potential for sustained collaboration and ecosystem impact.

It does lead to the observation that it is worth considering for future programs to reassess the prescribed budget allocation. In this project, it was determined upfront, assuming relatively equal work distribution, for all projects. In practice, in certain cases, effort and responsibility are distributed unevenly. Some artists and SMEs invested substantially more than anticipated; some partnerships evolved into genuinely collaborative relationships while others remained appropriately artist-led. The fixed budget allocation, designed for consistency, did not easily accommodate this reality. Partners investing disproportionate effort received no additional recognition or compensation, while partners investing minimum effort to reach the threshold received equal support. More importantly, there was a limited mechanism to reward projects where one or both partners exceeded expectations or to adjust resource allocation to reflect actual partnership contribution.

For future programs, a more equitable approach might strengthen outcomes. Rather than determining budget allocation entirely upfront, consortiums could be invited to adjust their internal budget distribution at mid-project review to reflect actual effort and partnership evolution. This small change creates fairness, partners know that significant additional effort will be recognized, while also creating genuine incentive for all parties to invest substantively in collaboration. Similarly, establishing mechanisms to identify and support projects where one or both partners exceed expectations would enable concentration of support on genuinely innovative work. Rather than treating all projects uniformly and rewarding compliance, programs could provide additional resources, accelerated development pathways, or priority access to ecosystem opportunities for work that shows exceptional promise. This concentrates effort and investment where potential is highest while also sending signal to partners that excellence matters and will be rewarded.

In general, the artist excellence and drive was essential to the outcomes, which are reflected in the visual quality of Damian Alexandru's artistic work on Crafts | Meats | AI, Isaac Monté's material innovation in Straw Return, Betiana Pavón's aesthetic and conceptual vision in Compostable Altar, and Laila Snevele's sensory design in Phygital Seasoning. These projects elevated far beyond what conventional product or service development alone would achieve. The artistic dimension attracted professional attention, generated public engagement, and created beauty and meaning alongside function. Yet artist excellence cannot be presumed or demanded; it emerges from creating conditions where artists can do their best work. This requires resources, time, respect, and freedom to follow creative experimentation, as well as partners willing to be surprised and challenged by artistic perspectives.

Another insight related to scaling and uptake has to do with the geographic proximity and local embeddedness of projects. Those with geographic proximity, where the artist and SME were in the same region, enabled frequent informal exchange and on-site collaboration. This demonstrated stronger momentum and deeper innovation, as witnessed at Re-Source.Society (Barcelona-based artist and company and Be(e)together (artists in Spain with Spanish beekeeping partner). This doesn't mean that the other projects weren't able to have iterative co-learning and rapid feedback loops in online exchange and during the 3 mandatory on-site collaboration days, but the integration of local context and connection to stakeholders was more difficult. This suggests that future programs could consider prioritizing geographic clustering: inviting artists and SMEs from the same regions to collaborate, reducing transaction, language barrier and travel costs. Another benefit from a safe work organization perspective it would also reduce dependencies of being out of one ones place within the operation environment of another, and no third parties are involved, which could lead to unbalanced risk. It also highlights the importance of active support for ecosystem integration in final project phases, connecting projects with relevant institutions, funding opportunities, commercial partners, and research networks. For this, the push for the local demonstration (see D5.8) was an important step, where the mentors from Hungry EcoCities required and supported integration with the local food system actors.

We witnessed that the reached Technology Readiness Levels across the projects differed from TRL 3 (Sprouting Embryonic Futures, due to its research nature and need to adjust and change needed to adjust the orginal prototype to fit with the objectives of the SME) to TRL 6–7 (Tomato Brain, Be(e)together Interface, Straw Return, which are tested in a relevant environment and are ready for system demonstrations in an operational environment). This range occurred through the space we created for both advanced prototyping and exploratory research to fit to the actual challenge at hand.

Although in some situations, first benefits are recorded, more evidence is needed to deploy at a larger scale. For example, some projects are still pending insights from growth parameters: whether plant behaviour - Harvesting Community and Re-Source.Society, soil adoption, Compostable Altar or Beetle reproduction. This is also a lesson for the timing of the project and the aftercare. Where in the HTE experiments (and as reported in D4.9) there was a period of 18 months after the project for continuous research and development, these projects finished just before the winter and those depending on natural seasons need to wait for the next year for test results.

Additionally, we should acknowledge that not all food system innovation will target commercial deployment and that our 10-month prototype projects are too short to understand the further deployment, for which at least another 12–24 months is needed. Some innovations require longer incubation, cultural work, and imaginative exploration. Sprouting Embryonic Futures' value lies in creating research foundations and imaginaries that may inform future development. Phygital Seasoning contributes to advancing understanding of sensory perception and what becomes possible when technology serves human experience rather than replacing it. Including the art-driven approach showed that we can reach different types and maturity of outcomes.

Several PPE projects made deliberate commitments to open-source approaches: Tomato Brain's documentation for sector-wide adoption, Open Source Harvesting Community's GitHub repository, Be(e)together's open-source sensor kit, Compostable Altar's methodology documentation. These reflect commitment to public good and to generating value beyond individual project outcomes. Yet open-source commitments are not automatic; they require intentional design (creating comprehensive documentation, building accessibility) and sometimes tension with commercial interests; however, within Hungry EcoCities we recognize this as a valuable food system innovation direction as part of the public goods rather than proprietary products.

In general, the projects identified clear development paths, secured stakeholder interest, and generated artifacts (platforms, installations, documentation) that will persist beyond the residency period. The work will continue in exhibitions, research partnerships, commercial development, and the imagination of multiple actors now connected through shared engagement with food system futures. Some of the successful PPEs have already generated ecosystem integration: secured institutional exhibitions (Be(e)together at CAB Burgos, Compostable Altar at Disseny Hub Barcelona and Ars Electronica 2026), attracted community interest (Be(e)together interest from León beekeeping collective, Straw Return conversations with investors, and established research partnerships (Quiet Storm with Lusíada University, Open Source Harvesting Community at IPM exhibition). These institutional validations and partnerships create foundations for sustained development beyond the residency period.

Annex 1 – Tomato Brain

Tomato Brain is a practical, human-first AI workflow co-created by artist Jo Kroese and Axia Seeds.

It comprises three connected agents—Sales Sage, Seed Sommelier, and Cultivation Coach—running on Axia's private cloud. Rather than replace people, the system facilitates collective intelligence, especially around meetings and decisions.

What we built: a modular, privacy-preserving setup that ingests pre-meeting inputs (notes, CRM, trial results) and produces a one-page brief: patterns spotted, tensions surfaced, options proposed, and draft actions. During meetings, teams ask live questions (clients, varieties, cultivation conditions) and see cross-checks between sales data, seed traits, and growing knowledge. Afterward, decisions and rationale are captured and shared.

What it does: turns round-robin updates into Parallelise → Synthesise → Decide. In pilots this yielded shorter meetings, clearer priorities, and better shared understanding—without centralising sensitive data.

Why it matters: by redesigning the information layer of work, Tomato Brain helps organisations match the complexity of the food system, reduce waste through faster sense-making, and build hands-on AI literacy.

Annex 2 – (Be)etogether

(BE)ETOGETHER – the Interface

"Experiencing the inner life of the beehive through art and technology"

Info and contact
https://uh513.com/
uh@uh513.com

(Be)etogether –the Interface

What if we could experience the inner life of a beehive through art and technology, fostering empathy and care for non-human species?

(Be)etogether – The Interface translates the complex data collected from active hives into multi-sensory experiences of light, sound, vibration, and airflow. Using the (Be)etogether set of sensors installed in Felechosa, Asturias (Northern Spain), the project gathers continuous environmental data—temperature, humidity, sound, bee movements, air quality, and more. Artificial intelligence and custom algorithms created by the artist process this data, revealing patterns of hive behavior and transforming them into perceivable human experiences.

This innovative interface invites users to feel the rhythms of the colony, shifting technology's role from measurement to empathy. It proposes a new, non-invasive model of human–bee interaction—one inspired by the organic architecture of wild hives and oriented toward listening, care, and interspecies coexistence.

Developed by María Castellanos & Alberto Valverde,in collaboration with Olaya Miel – a family-run ecological beekeeping initiative in Felechosa, Asturias (Spain) and BeeSage – a technology company specializing in precision beekeeping tools.

Applications

EDUCATIONAL & AWARENESS TOOLS
Enables students and the public to sense hive dynamics firsthand, fostering ecological literacy and empathy.

SUPPORT FOR BEEKEEPERS
Provides an alternative way to monitor hive health and seasonal patterns while promoting a caring, non-extractive approach to apiculture.

ARTISTIC EXPERIENCES
Serves as a mode of inquiry and reflection, using sensory translation of hive data to explore alternative ways of knowing and imagining possible futures. The interface transforms complex ecological and behavioral information into experiences that provoke thought, question human-nonhuman relationships, and stimulate critical engagement in exhibitions, installations, and public programs.

Next Steps

In the upcoming season, the team will test the interface in real-time with live hive data, refining its application in both beekeeping and artistic contexts.Future plans include expanding the system to additional hives and environments, scaling its impact in education, sustainability, and interspecies literacy.

HUNGRY ECOCITIES
A S+T+ARTS RESIDENCIES PROJECT

Funded by the European Union

S+T+ARTS
SCIENCE + TECHNOLOGY + ARTS

The HungryEcoCities project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement 101069990.

Annex 3 – Quiet Storm

QUIET STORM: MUSIC FOR INSECTS

SAMUEL VAN RANSBEECK & PROTIBERIA

THE PROJECT

Quiet Storm: Music for Insects is a project for the Tenebrio Molitor (darkling beetle) to listen to music: A music track is played every hour for 12 hours and the beetles feel it through a vibration speaker.

The goal is to make them mate more and lay more eggs but also to expose them to arts and treat them as sensitive beings that have a right to nice things in life. A contact microphone allows us to listen to beetles' wandering around the rest of the time.

We can watch the beetles through a livestream. Thirdly, it brings the world of these sustainable insects (used for protein production) closer to humans.

BENEFITS

If you are rearing darling beetles, this setup can enhance the mating process and have a higher yield, We are running a longterm study to evaluate these benefits.

If you are an arts organisation or venue, Quiet Storm gives a rare look at these small insects. You can stream it to your venue and let people enjoy the music and the sounds the beetles make.

If you are an organization that works around sustainability, the environment and agriculture, you can show this installation to show a sustainable future and coexistence with insects.

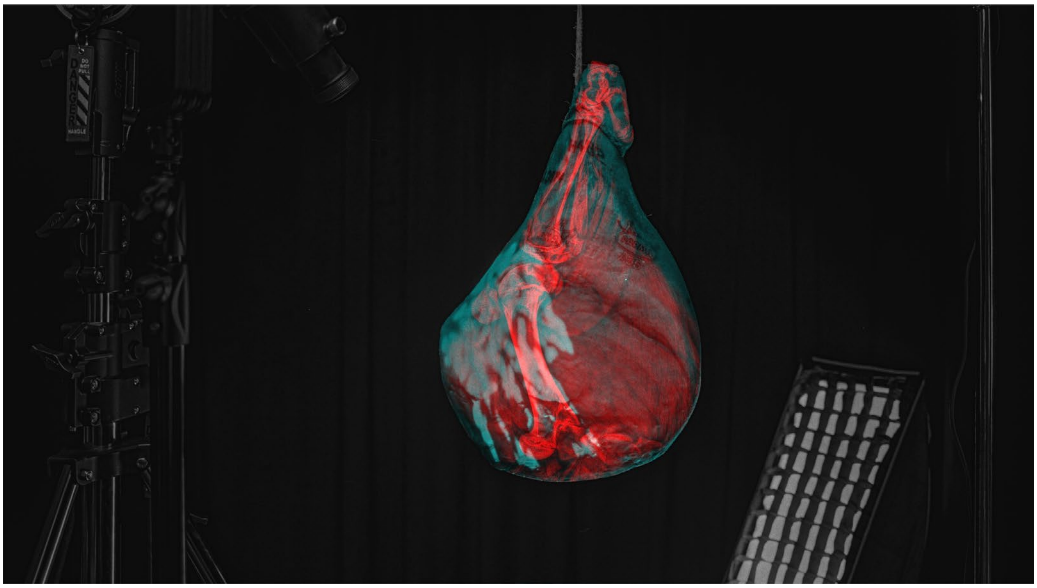
Watch the livestream

GET IN TOUCH

Samuel Van Ransbeeck and ProTiberia
samuelvanransbeeck.be
contact@samuelvanransbeeck.be
protiberia.com
hola@protiberia.com

Annex 4- CRAFTS I MEATS I AI

CRAFTS MEATS AI I Crafted by Tradition, Enhanced by AI



WHAT IS CRAFTS MEATS AI?

Crafts | Meats | AI is a research project exploring how time, material intelligence, and artificial intelligence can work together to make invisible craftsmanship visible. Developed with Capanna Prosciutti in Parma, it combines scientific imaging, AI storytelling, and salt-based printing to reveal how salt, air, and patience transform raw meat into Prosciutto di Parma. The project culminates with a book prototype that merges data, poetry, and sensory experience, where pages cure in light and a digital glossary opens through touch, connecting tradition, technology, and time.

WHERE IT CAN BE USED?

The outcomes of *Crafts* | *Meats* | *AI*—the video, the salt-printed artist book, and the sensory room concept—can be used in multiple contexts: commercially, at trade fairs and buyer events to communicate craftsmanship and authenticity; educationally, in food museums, design schools, and cultural institutions to illustrate the intersection of tradition, science, and technology; and publicly, in exhibitions or art festivals exploring the future of food and AI.

WHAT ARE THE BENEFITS?

- Focus on experience and authenticity rather than product functionality
- Bridge between consumer and producer perspectives
- Low start-up costs — development and learning curve already covered
- Ideal for luxury and niche food products seeking innovative communication tools

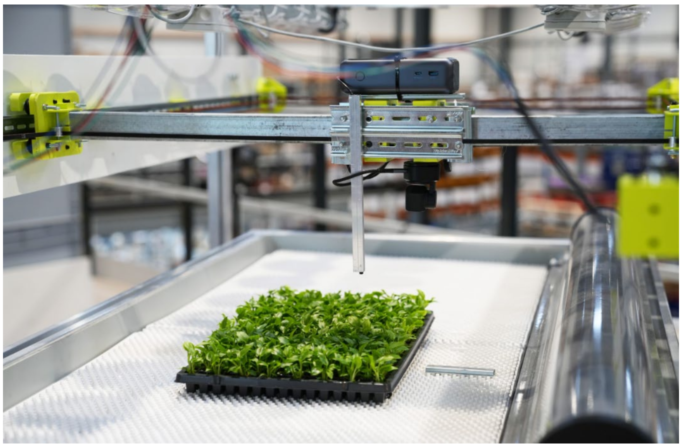
MORE INFO AND CONTACTS

Collaboration between artist Damian Alexandru and SME Capanna Alberto SpA.

This Hungry Eco Cities project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement 101069990. It is part of the S+T+ARTS programme. S+T+ARTS is an initiative of the European Commission to bring out new forms of innovation at the nexus of arts, science and technology.

Annex 5 - openCEM & Spider Monitoring System

OpenCEM is an innovative framework for automated plant cultivation and monitoring in Controlled Environment grow units (CEMs). The system consists of two integrated components: the Spider monitoring platform and the openCEM control framework.
The Spider is a modular monitoring platform designed to track plant growth inside Logiqs CEMs without opening the unit, maintaining consistent research conditions and preserving the internal climate.



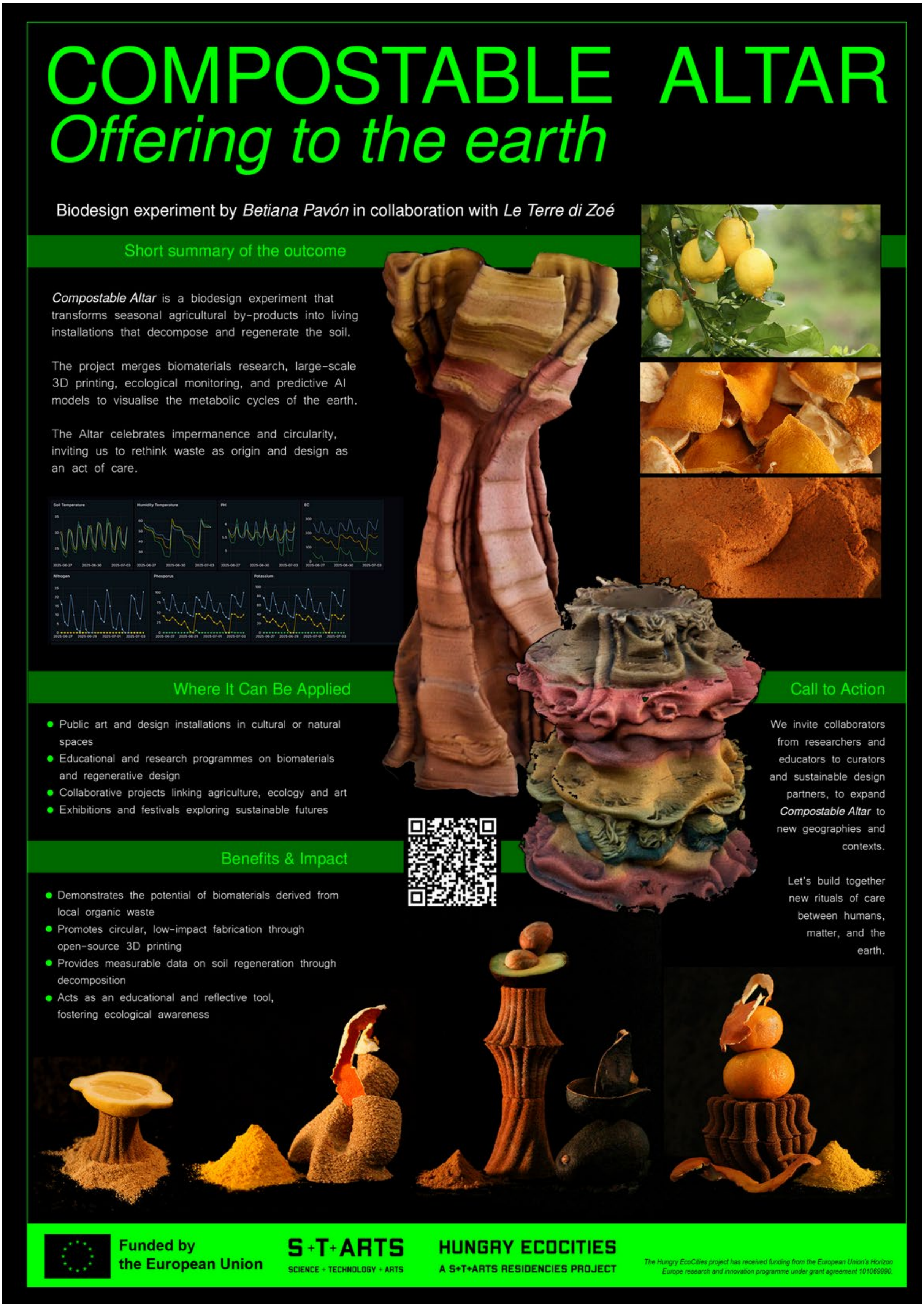
Key Features:
● **Modular Design**: Adaptable x- and y-axes accommodate CEM sizes from 60×40 cm to 400×200 cm
● **Minimal Footprint**: All components are either 3D printed or off-the-shelf aluminum profiles
● **Battery-Powered**: 5 hours of continuous, cable-free monitoring before recharging
● **Flexible Tooling**: Current attachments include 4K and thermal cameras, plus airflow, temperature, and humidity sensors
● **Future Development**: Leaf punchers for probe sampling and crop pickers are in development
● **Easy Maintenance**: Stepper motors positioned on one side for accessible servicing

The openCEM Control Framework

openCEM is an open-source grow module that anyone can build anywhere. Parts are either 3D printed or purchased at any store, enabling anyone to grow food in their basements, empty rooms, or parking garages. This accessibility democratizes controlled environment agriculture, making professional-grade growing technology available to everyone, including an easy innovative commands structure following the format: DD:HH:MM /command (e.g., 01:00:01 /waterplants)

Project: Hungry Ecocities | **Artist**: Georg Kettele | **SME Partner**: Logiqs BV | **Date**: October 2025

Annex 6- Compostable Altar



Annex 7 – Straw Return

Straw Return:

From Wheat Waste to Premium Materials

What if agricultural leftovers could replace plastics, reduce waste, and create new value for rural economies?

The Challenge

Agriculture yields food and feed but leaves plant matter unused. Staramaki turns wheat stems into biodegradable straws, yet this sustainable process still produces residues like cut-offs and rejected stems.

With Straw Return, we asked: Can this "waste of waste" be transformed into high-value materials for design and interiors?

The Breakthrough

Through over 100 material experiments—from dyeing and weaving to shredding and pressing—Straw Return explores how wheat stem residues can be transformed into new, high-performance materials. Using the starch of wheat, we developed a 100% natural biobinder. Combined with the rejected stems, this creates a biodegradable composite material with unique qualities.

Key Qualities

- ***Acoustic absorption***
- ***Fire retardancy***
- ***Structural strength***
- ***Full circularity***

Applications

Bar Tools & Displays

Coasters, straw stands, and bar elements that elevate the coffee experience while telling a sustainability story.

Acoustic Panels & Bricks

Modular interior pieces that combine sound absorption with design while acting as visible carbon storage.

Why It Matters

Agriculture is more than food—it can supply bio-based raw materials for design, construction, and interiors. By unlocking the hidden potential of wheat stems, Straw Return shows how waste can fuel innovation, reduce reliance on virgin resources, and inspire systemic change.

Straw Return is the result of the collaboration between social company staramaki and material designer Isaac Monté in the S+T+ARTS Hungry EcoCities project, which has received funding from the Horizon Europe research and innovation programme

What's Next

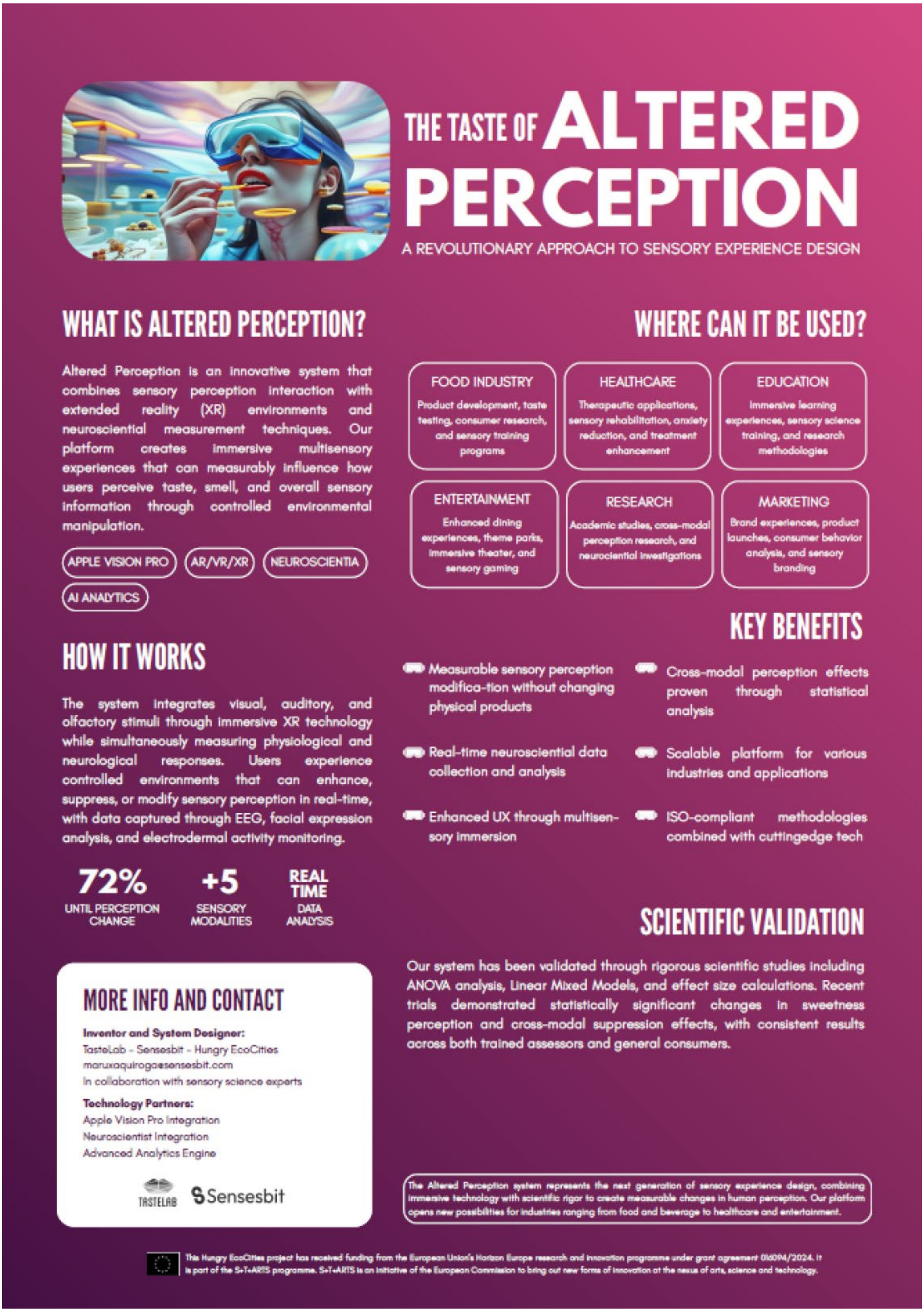
From prototype to scaling; we seek partners in design, interiors, and sustainable manufacturing to bring Straw Return materials to market.

Contact Us

info@isaacmonte.nl

eleni@staramaki.gr

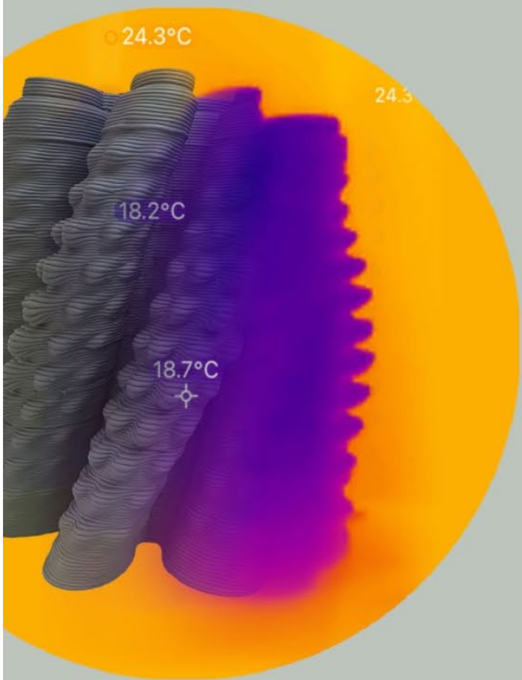
Annex 8 – Phygital Seasoning



Annex 9- Re-Soucre.Society

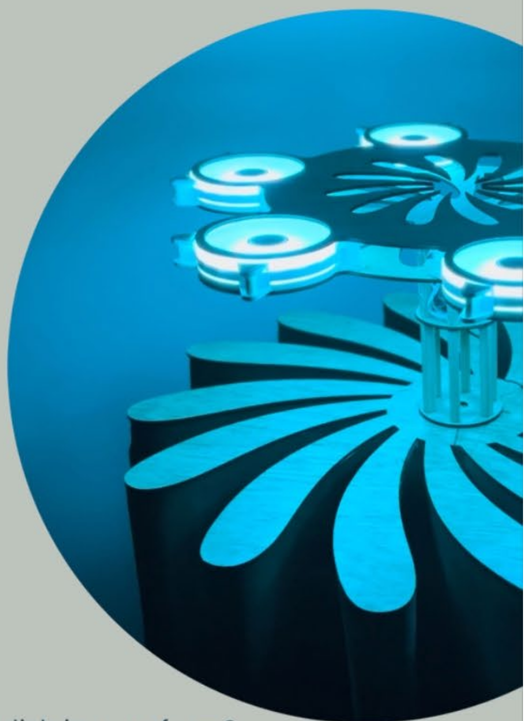
Re-Source.Society

Energy waste in indoor farming
Controlled environment agriculture can ease the environmental pressure of agriculture. Using less water, less land and no chemicals. But, controlling indoor environments comes at a cost: heating, cooling and dehumidifying demand large amounts of energy, leaving heavy environmental footprints and expenses.



Resource efficiency by nature!
Re-Source.Society created a collection of resource efficient systems that work together to regulate indoor climates:

- The **Cooling Cactus** uses outdoor air to lower the temperature, without altering the humidity levels
- The **Living Lung** in its turn uses outdoor air to remove humidity from the indoor air, without changing the temperature
- The **Basic Brain** measures and compares the indoor climate with the outdoor climate and decides whether or not it is opportune to make use of the outdoor temperature, humidity or both.



Maximise energy saving
By de-coupling the temperature and the humidity we can now benefit much more, and much more often, from what the natural outdoor climate has to offer. This way, the climatisation of indoor spaces depends much less on energy consuming air conditioners and dehumidifiers.

Customised designs
Our digital twin makes it possible to simulate real situations and customise the designs of the Cooling Cactus and the Living Lung to different types of farms in different types of climates around the globe.

Do you want to know what energy savings you can accomplish in your farm?
Feel free to reach out: **info@instagreen.eu**

InstaGreen Nicolas Rotta HUNGRY ECOCITIES A S+T+ARTS RESIDENCIES PROJECT Funded by the European Union S+T+ARTS SCIENCE + TECHNOLOGY + ARTS

Annex 10 – Sprouting Embryonic Futures

Sprout Dynamics

SPROUTER

A NEW APPROACH TO URBAN FOOD GROWING AND ARTISTIC EXPLORATION

WHAT IS THE SPROUTER?

The Sprouter is a small-scale, site-specific test bed designed for cultivating edible sprouts.
It turns the simple act of growing sprouts into a transparent, poetic exploration of embryonic food life.
The device integrates sensors and automated systems to monitor light, humidity, air flow, temperature, while a smart fountain circulates water to sustain the sprouts.
A built-in camera captures timelapse videos, transforming each growth cycle into a living artwork.

WHERE CAN IT BE USED?

- The Sprouter can be applied across various contexts:
- Urban agriculture and community kitchens: Encouraging local, visible food production.
- Educational institutions: Demonstrating biological processes and sustainability principles.
- Art and science exhibitions: Serving as an interactive installation on the interface of living systems, design, and data.
- Culinary innovation: Connecting chefs and consumers to the origin of their ingredients through real-time observation of growth.

WHAT ARE THE BENEFITS?

- Reconnecting with food origins: Makes the invisible process of germination visible and experiential.
- Sustainability: Encourages local and small-scale food production with minimal resource use.
- Cross-disciplinary innovation: Integrates art, design, and science to promote new models of food understanding.
- Digital engagement: Data from the Sprouter's sensor network can be displayed via an app, linking physical growth with virtual observation.

APPLICATION AREAS

- Public installations and exhibitions
- Urban farms and educational spaces
- Restaurants and food-tech innovation hubs
- Research on sustainable and circular food systems

MORE INFO AND CONTACT

Creators:
Sprout Dynamics (Copenhagen, Denmark)
in collaboration with artist Haseeb Ahmed

Supported by:
EU Science, Technology and Arts Initiative (S+T+ARTS), HEC-Lab, and IN4Art
Project: Hungry EcoCities – Sprouting Embryonic Futures
Duration: September 2024 – October 2025

Annex 11- Scientific contributions

This overview reports on the scientific contributions to the specific projects. In D3.7 on the matching for PPEs between the SMEs and scientists, we created the following overview (colum research match in below table). In this table, we added what actually happened. The participation was mostly as a context-specific advisor or access to student research; therefore, from the data collection and research perspective, resulting in a few identified further development plans.

The level of needs between the involved parties differed a lot, not always matching the preset knowledge and skills within the scientific pool of the consortium, which influences the further development and potential of the project. We noticed that in this stage, the scientific contributions to the specific were mostly as context-specific advisors or access to student research; however, the table below shows the different actions and interactions that took place and support the future knowledge development and development of the themes addressed in the specific PPEs

SME	**Research match**	**Outcome**
AXIA	KUL on developing a multi modal conversational agent tool	KUL advised the team, however the project moved away from the original idea. Methodologies from KU Leuven (augment) 'Living Corpora' project are being applied to frame Generative AI as an 'intellectual sparring partner' for creative teams. Instead of replacing human marketers, the focus is on developing workflows where the AI supports divergent thinking (concept generation) while human experts handle synthesis, directly addressing the consistency issues AXIA faced. Additionally, research from 'Explanations in AI for Learning Analytics' provides a framework for 'opening the black box' of these generative models, helping the SME understand why certain visual artifacts appear."
BeeSage	MNDL on in-hive sound post processing from high sensitivity microphones	MNDL advised the team, however, The application of high-sensitivity microphones was abandoned due to cost. It changed to the use of low-fi microphones as those are sufficient for beehive monitoring.
	BUOT on in-hive queen-related issues detection through computer vision	As a part of a successfully defended Bachelor's thesis (Katarina Chovancova, FIT BUoT, 2025), a queen detection dataset was collected and shared with the Be{e)together/BeeSage team. There is also a new dataset of close camera recordings of

		bees leaving and entering the hive, collected by the student. Two new Bachelor's students are currently involved in the thesis topics related to the BeeSage business. We will also scale-up the initial experiments through new academic-industry cooperation with local SMEs – Apiarist - https://www.apivcelar.cz/ and BeeHeart - https://www.ivcelarstvi.cz/ulovy-snimac-bee-heart--ei6811/ The impact will be also realized through the new university-wide initiative of BUoT's rectorate garden apiary - https://www.vut.cz/en/but/news-f19528/technology-and-nature-go-hand-in-hand-but-has-opened-a-university-apiary-d305361
Capanna	BUOT on warehouse traceability through RFID	The company Outsourced to external available partner Sirmium ERP
Instagreen	KUL on last mile logistics for urban vertical farms	Dedicated postgraduate Master's students in Management at Vlerick Business School course. Outcomes reported in the following article: What's the right supply chain for urban food? ○ Reflection article – HUNGRY ECOCITIES – S+T+ARTS Additioanlly , a master graduation project is planned
	BUOT on machine learning applied to small scale urban microgreen farming	A Master's student (and a potential new Doctoral student) began collaborating with Sensorie - https://sensorie.cz/ - by applying the concepts of ML-based prediction models to small-scale urban microgreen farming. To realise the scale-up plan, we will interlink the current work with the results of the LoLiPoP-IoT project and offer licensing of the existing prediction models to Cognitechna Ltd.
Terre di Zoe	MNDL on optimizing natural resources in orchard farming through acoustics and mycorrhizae	The topic was exploited in collaboration with Institute of Botany, AS CS, Department of Mycorrhizal Symbioses. Optimization steps were applied in Terre di Zoe orchards, however effects of the measures will have to be evaluated in longer time-scale. MNDL explores a dual approach combining targeted acoustic stimulation and mycorrhizal inoculation technologies to optimize natural resource utilization in fruit orchards. Acoustic stimuli in specific frequency bands may modulate physiological activity in plants, potentially improving nutrient uptake, photosynthetic

		performance, and stress tolerance. Further investigation will be needed to bring the topic closer to application practice.
Logiqs	BUOT on ventilation hardware and module optimization specifications	BUOT advised the team. Junior researcher Jakub Lojda experimented with the energy consumption estimation of the platform developed in cooperation with Logiqs.
	MNDL on air dynamics and sound on growth effects in the module	The experimentation was abandoned due time constraints from side of Logiqs.
Protiberia	MNDL on sound related pheromone measurements for insects	After the investigation of the various knowledge gaps, the pheromone study was postponed in order to focus on the shorter win options.
	BUOT on developing sensor systems to monitor behavior of insects	Prototype developed and tested on SME footage and a report was written. A group of three students worked on the system monitoring the insects' behaviour as their course project in the Computer Vision course, organised by Michal Hradis. The results are promising, but to realise the potential impact, a significant effort would need to be invested in video data annotation.
Sprout	MNDL on sound based sprouting growth control possibilities	The topic is currently being explored within the final phase of the project. The sound based sprouting stimulation seems to be promising way to reduce time needed for production. Further development to implement the sound mechanostimulation into agricultural practice is needed, but current results are promising for shortening the sprouting time. The outputs obtained within HEC will be used for strengthening the bioacoustics research direction at MNDL and after further verifications, research grant application will be proposed.
	BUOT on sprout readiness research through image recognition	BUOT adviced the team. An initial data set for sprout readiness estimation using image recognition was collected in collaboration with company experts. However, the scale-up potential was not deemed sufficiently high to warrant further exploitation.
	KUL on an AI growing Agent in VR to open the black box of sprouting	PhD candidate Eleni Giannitzi created a VR environment, to test baseline interaction, in which the user will go through the process of growing and collecting the sprouts. The agent has already been implemented with some dialogue. Current improvements are

		elaborated and will lead to a publication in 2026
Staramaki	BUOT and MNDL combined on smart agri mapping experiment	The smart agriculture task, involving continuous measurement of soil conditions, weather situation, and other local attributes, provided relevant data. At MNDL were ran 3 rounds of experiments with focus on nitrogen fwertilization. BUoT presented the (preliminary) results to partners of the prepared ChipsJU project proposal - INSPIRED. If it is supported, we will investigate the topic further. A national collaborative project proposal was also proposed by the consortium of BUoT and MNDL. The indoor cultivation of triticale at MNDL will have to further be optimized, but expertise was established.
	KUL on AI powered stem recognition systems	Not pursued due to focus on collaboration with BuoT and MNDL.
TasteLab	KUL on environmental factor influences on consumer experiences	No student selected the case. The requirement for capturing subjective consumer feedback aligns with KU Leuven (Augment) **'D-STRESS'** project methodology. D-STRESS utilizes conversational agents to collect and analyse 'subjective experiences' and 'contextual information' in real-time. Future scale-up could involve adapting this 'digital phenotyping' approach to food testing, using a conversational bot to capture nuanced taster feedback that static surveys miss.

Table 1: overview of SME – Scientific Match in PPE trajectory – from D3.7

About Hungry EcoCities

Horizon Europe Research and Innovation Action – This Hungry EcoCities project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement 101069990.

This publication (communication) reflects the views only of the author(s), and the European Commission cannot be held responsible for any use which may be made of the information contained therein.

The project is part of the S+T+ARTS programme. S+T+ARTS is an initiative of the European Commission to bring out new forms of innovation at the nexus of arts, science and technology.

Hungry EcoCities aims to explore one of the most pressing challenges of our times: the need for a more healthy, sustainable, responsible, and affordable agri-food system for all enabled by AI. More info: starts.eu/hungryecocities