Interreg CENTRAL EUROPE

Co-funded by the European Union

GREENE 4.0

D3.4.2: Pilot and Testing Report

Final Version

2 2026

Document control sheet

Work package Number	3
Work package Title	GREENE 4.0 Innovation platform
Activity Number	3.4
Activity Title	Piloting and testing of new GREENE 4.0 value chains
Deliverable Number	3.4.2
Deliverable Title	Pilot and Testing report
Dissemination level	Confidential, only for members of the consortium
Main Author	Maja Sušec (PTP)
Contributors	Daniel Tement (PTP)
Quality Assurance	Marko Močnik (PTP)

Versioning and Contribution History

Version	Date	Author / Editor / Reviewer	Contributors	Description/Comments
V_01	10.2.25	Maja Sušec (PTP)	Daniel Tement (PTP)	Table of Content & first draft
V_02	5.3.25	All partners		Peer review
V_03	10.3.25	Maja Sušec (PTP)	Daniel Tement (PTP)	Second draft
V_04	15.3.25	Marko Močnik (PTP)		Quality check
F_01	27.3.25	Maja Sušec (PTP)	Daniel Tement (PTP)	Final version
Due date of deliverable		28.2.2025		

CONTENT

A. Introduction

The GREENE 4.0 project aims to accelerate the green and digital transformation of small and medium-sized enterprises (SMEs) in Central Europe by fostering innovation ecosystems, strengthening collaboration between technology providers and industry, and facilitating the testing and validation of innovative solutions in real operational environments.

SMEs represent the backbone of the Central European economy but often face structural barriers when attempting to adopt innovative technologies or sustainability-oriented business models. These barriers include limited financial resources, lack of internal technical expertise, fragmented innovation ecosystems, and uncertainty regarding the return on investment associated with new technologies. The GREENE 4.0 project addresses these challenges by creating an integrated innovation framework that connects SMEs with solution providers, research organisations, and innovation support actors.

Within the project structure, Work Package 3 – GREENE 4.0 Innovation Platform focuses on translating innovation concepts into practical implementation. In particular, Activity 3.4 – Pilot Testing of New GREENE 4.0 Value Chains aims to validate innovative green and digital solutions through real-life deployment in SME environments across participating Central European regions.

The pilot activities were designed to move beyond theoretical innovation support by enabling direct experimentation and practical validation of new technologies and solutions. Through the pilots, SMEs were able to test innovations under real operational conditions, while technology providers gained valuable feedback on usability, performance, and scalability.

Across Central Europe, several national pilot projects were implemented, each representing a collaboration between a solution provider and a solution seeker (SME). These collaborations were facilitated through the B2GreenHub ecosystem, which served as a matchmaking and coordination platform connecting innovation actors across the participating regions.

The pilot implementations covered a wide range of sectors and technological domains, including advanced manufacturing, automation, digital communication tools, sustainable materials, production monitoring systems, and lifecycle management technologies. Together, these pilots represent a diverse portfolio of innovation experiments that illustrate how SMEs in Central Europe can adopt new technologies to enhance sustainability, efficiency, and competitiveness.

This report provides a comprehensive Central European overview of the pilot actions implemented within the GREENE 4.0 project. It integrates the findings from all national pilot reports and presents a consolidated analysis of the pilot activities, including their objectives, implementation processes, outcomes, and lessons learned.

B. Objectives of the pilot actions

The pilot activities implemented within the GREENE 4.0 project were designed to support the practical realisation of the project's broader strategic goals: enabling SMEs in Central Europe to adopt innovative technologies that contribute to both **digital transformation and environmental sustainability**.

In the context of Activity 3.4, the primary objective was to **validate innovative solutions developed within the GREENE 4.0 Innovation Programmes through real-world testing in SME environments**. This validation process is essential for bridging the gap between technological development and market adoption, particularly in regions where SMEs often lack the resources to independently test and implement advanced innovations.

One of the core objectives of the pilot actions was to **increase the Technology Readiness Level (TRL) of the tested solutions**. Many of the participating solution providers were emerging technology companies or research-based innovation projects whose solutions had not yet been fully tested in operational SME environments. Through the pilot activities, these solutions were deployed in real industrial or business contexts, enabling developers to assess their technical performance, usability, and scalability.

Another key objective was to **facilitate the creation of new value chains within the Central European innovation ecosystem**. Each pilot represented a new collaboration between a technology provider and an SME operating in a specific industrial or service sector. These partnerships demonstrate how regional innovation ecosystems can support the exchange of knowledge, expertise, and technology.

The pilots also aimed to **support SMEs in identifying and addressing operational challenges related to digitalisation and sustainability**. Many SMEs participating in the project faced issues such as inefficient internal processes, limited digital infrastructure, fragmented communication workflows, or a lack of transparency regarding environmental impacts. By implementing innovative solutions tailored to these challenges, the pilot activities provided SMEs with practical tools to improve efficiency and sustainability.

Additionally, the pilot actions served as an important **learning mechanism for innovation policy and support organisations**. By observing how SMEs interact with new technologies and identifying barriers to implementation, project partners gained valuable insights into how innovation support programmes can be designed more effectively.

The pilot activities therefore served multiple purposes: validating technological solutions, strengthening collaboration within the innovation ecosystem, supporting SME transformation, and generating knowledge that can inform future innovation policies and programmes in Central Europe.

C. Pilot implementation methodology

The implementation of the pilot actions followed a structured methodology defined within the GREENE 4.0 Pilot and Testing Framework (Deliverable D3.4.1). This methodology ensured that all pilot activities across the participating regions were conducted in a consistent and coordinated manner, allowing for meaningful comparison and cross-regional analysis.

The pilot process began with the integration of both solution providers and solution seekers into the B2GreenHub ecosystem, the digital platform developed within the GREENE 4.0 project to facilitate collaboration between innovation actors. Through this platform, participating SMEs and technology providers were able to present their needs and capabilities, making it easier to identify potential collaboration opportunities.

Once both parties had been registered within the ecosystem, project facilitators conducted an initial needs assessment with the participating SMEs. This step involved evaluating the company's current level of digitalisation, operational processes, and sustainability practices. In many cases, the assessment included the use of structured tools such as the User Acceptance Model (UAM) questionnaire, which helped identify potential barriers to technology adoption and determine whether the proposed solution was suitable for the SME environment.

Following the assessment phase, project facilitators supported the matchmaking process between solution providers and SMEs. This step involved defining the scope of the pilot, identifying the specific operational problem to be addressed, and agreeing on the expected outcomes of the collaboration.

The next phase involved the technical deployment of the pilot solutions. Depending on the nature of the solution, this deployment could involve software installation, hardware integration, workflow configuration, or experimental testing of new materials. All pilot implementations were carried out in real operational environments, such as manufacturing facilities, business service operations, or specialised testing laboratories.

During the implementation phase, the participating SMEs actively used the solutions within their daily operations. This allowed the project partners to observe how the solutions performed under realistic conditions and to collect feedback regarding usability, efficiency, and potential areas for improvement.

Finally, the pilot activities concluded with a validation and evaluation phase, during which the results of the pilot were documented and analysed. This phase included collecting feedback from both solution providers and SMEs, assessing the impact of the solution on operational processes, and identifying opportunities for further development or replication.

By following this structured methodology, the GREENE 4.0 project ensured that all pilot actions contributed to a coherent and comprehensive understanding of how innovative solutions can support SME transformation in Central Europe.

D. Overview of Central European pilot implementations

Across the participating Central European regions, a diverse portfolio of pilot actions was implemented, reflecting the wide range of technological challenges and innovation opportunities faced by SMEs in the region.

One of the most environmentally oriented pilots was implemented in Hungary, where the focus was on developing a sustainable packaging solution based on mycelium-based composite materials. The pilot involved laboratory testing and prototyping of a biodegradable packaging product called MycoCrate, which uses agricultural by-products and fungal growth processes to create a structural packaging material. The objective of this pilot was to explore whether such bio-based materials could serve as viable alternatives to conventional fossil-based packaging materials. The national report is attached as an annex.

In Italy, the pilot focused on industrial automation and digital transformation in manufacturing logistics. The solution implemented involved a robotic system capable of automating the loading and unloading of materials in a vertical warehouse. By integrating a robotic arm with a mobile robot platform, the system enabled automated handling of materials within the warehouse environment. The pilot demonstrated the potential for flexible robotic automation to improve efficiency in SME production environments. The national report is attached as an annex.

A different type of digital transformation was explored in Poland, where the pilot addressed operational inefficiencies in customer communication within a traditional food production company. The implemented solution consisted of a structured online contact form integrated into the company's website. By enabling customers to submit structured requests related to orders, events, and business partnerships, the system significantly reduced administrative workload and improved response times. The national report is attached as an annex.

In Slovenia, the pilot focused on the automation of digital marketing and communication processes through the implementation of an AI-driven content factory system. The system uses artificial intelligence to generate and distribute social media content across multiple platforms, including LinkedIn, Instagram, and Facebook. The pilot demonstrated how AI-based tools can help SMEs maintain a consistent online presence while reducing the time required for content creation and management. The national report is attached as an annex.

The Czech Republic pilot addressed the challenge of production transparency in manufacturing environments. A real-time Manufacturing Execution System (MES) monitoring solution was deployed in a plastic injection moulding company. The system collected machine data, monitored operational states, and provided visual dashboards displaying key production metrics such as machine utilisation and downtime. This pilot highlighted the importance of real-time data collection for improving production efficiency. The national report is attached as an annex.

In Germany, the pilot explored advanced digital technologies for manufacturing by implementing a digital companion system supporting the assembly and lifecycle monitoring of hybrid electric engines. The solution integrates digital twin concepts, sensor data collection, and augmented reality interfaces to support workers during complex assembly tasks and improve traceability of production processes. The national report is attached as an annex.

Finally, a pilot planned in Austria aimed to conduct a Life Cycle Analysis (LCA) for lighting products. Although the pilot did not proceed to implementation due to financial constraints faced by the participating SME, the matchmaking process successfully demonstrated the potential for collaboration between research institutions and industrial partners in the field of sustainability assessment. The national report is attached as an annex.

E. Cross-regional analysis of pilot results

When analysing the results of the pilot activities across the participating Central European regions, several common themes emerge that highlight both the opportunities and challenges associated with SME innovation. One of the most notable findings is the strong role of digital technologies in enabling operational improvements for SMEs. Many of the implemented solutions focused on increasing transparency, automation, and efficiency within business processes. For example, the MES monitoring system implemented in the Czech Republic enabled real-time monitoring of machine performance, allowing production managers to identify downtime patterns and improve process efficiency. Similarly, the robotic warehouse automation solution implemented in Italy demonstrated how automation technologies can reduce manual handling and increase operational reliability.

Another important theme is the growing relevance of artificial intelligence and data-driven tools for SMEs. The Slovenian pilot showed how AI can be applied to automate content creation and communication workflows, allowing small companies with limited marketing resources to maintain a professional digital presence. The German pilot further illustrated how advanced digital technologies such as augmented reality and digital twins can support complex manufacturing processes.

Sustainability-oriented innovation also played an important role within the pilot activities. The Hungarian pilot focusing on mycelium-based packaging materials demonstrated the potential for bio-based materials to replace fossil-based products in packaging applications. Although further research is required to improve certain material properties, the pilot showed that circular material solutions can be developed using locally available agricultural resources. Despite the overall success of the pilot activities, several challenges were also identified. SMEs often face resource constraints and financial uncertainty, which can affect their willingness to invest in new technologies. This was illustrated by the Austrian pilot, where the participating SME decided not to proceed with the planned Life Cycle Analysis due to budgetary considerations. These findings highlight the importance of continued support mechanisms for SMEs, including financial instruments, innovation advisory services, and accessible digital tools.

F. Lessons learned and future perspectives

The implementation of the pilot actions within the GREENE 4.0 project provides valuable insights into how innovation ecosystems can support SME transformation in Central Europe.

One of the most important lessons learned is that structured facilitation plays a critical role in enabling successful collaboration between technology providers and SMEs. The B2GreenHub ecosystem served as an effective platform for matchmaking and coordination, ensuring that both parties had a clear understanding of the objectives and expectations of the pilot activities.

Another key lesson concerns the importance of simplicity and accessibility in technology adoption. Solutions that required minimal changes to existing infrastructure or that could be implemented quickly were generally more easily adopted by SMEs. For example, the digital communication tools implemented in Poland and Slovenia were integrated into existing workflows with minimal disruption.

At the same time, the pilots also demonstrated the potential for more advanced technologies to deliver significant long-term benefits. Solutions such as robotic automation, digital twins, and real-time production monitoring systems have the potential to significantly improve productivity and sustainability in manufacturing sectors.

Looking ahead, the results of the pilot activities suggest that future innovation programmes should continue to focus on combining technological experimentation with practical SME support services. Providing SMEs with opportunities to test innovations in real operational environments reduces the perceived risk associated with adopting new technologies.

Furthermore, the pilots demonstrate the importance of cross-regional collaboration within the Central European innovation ecosystem. By sharing experiences and knowledge across regions, SMEs and innovation actors can accelerate the diffusion of successful solutions.

In conclusion, the pilot actions implemented within the GREENE 4.0 project represent an important step toward building a more resilient, sustainable, and digitally advanced SME sector in Central Europe.

G. Annexes

- **Annex 1: Pilot and testing report - Hungary:** Implementation of Mycelium-based packaging solutions to replace commercial fossil-based packaging solutions _ MycoCrate
- **Annex 2: Pilot and testing report - Italy:** Implementation of an automated loading and unloading solution for a vertical warehouse
- **Annex 3: Pilot and testing report - Poland:** Implementation of the structured online order form for a food company
- **Annex 4: Pilot and testing report - Slovenia:** Implementation of an AI-driven Content Factory Solution at LDK Tech, Dejan Lorber s.p.
- **Annex 5: Pilot and testing report - Czech Republic:** Implementation of a Real-Time MES Monitoring Solution at COLORplastic, spol. s r.o.
- **Annex 6: Pilot and testing report - Germany:** Implementation of DIREKT digital companion solution for hybrid electric engines at CHESCO GmbH
- **Annex 7: Pilot and testing report - Austria:** Implementation of a life cycle analysis

Interreg CENTRAL EUROPE

Co-funded by the European Union

GREENE 4.0

D3.4.2: Pilot and testing report - Hungary

Implementation of Mycelium-based packaging solutions to replace commercial fossil-based packaging solutions _ MycoCrate

1. Executive summary

This document presents the implementation report of the pilot activity carried out under Service C – Support of pilot testing in realistic operational environments within the GREENE 4.0 project. The pilot focused on developing and testing MycoCrate, a mycelium-based sustainable packaging solution (MycoCrate) designed to replace fossil-based, non-biodegradable packaging materials with environmentally friendly ones. The implementation was conducted by Szimbio Lab in collaboration with UgrinPack-Erdősi LTD. The objective was to validate the material's growth conditions, mechanical properties, and environmental impact through an in situ prototyping process and a Life Cycle Assessment.

2. Introduction and context

The GREENE 4.0 project supports SMEs in their green and digital transformation by testing new sustainable value chains. This pilot, part of Activity 3.4, validates an innovative bio-based solution in a real operational environment. The MycoCrate project specifically addresses the need for circular material utilization by transforming agricultural byproducts into high-value packaging.

The main objectives were:

- To identify the most effective fungal-substrate combinations for packaging function through radial growth tests.
- To assess the most effective fungal substrate combinations' usability in packaging applications through mechanical testing (compressive strength, anti-fungal properties, and water absorption).
- To validate operational feasibility by manufacturing a standard-sized prototype.
- To demonstrate a new local green value chain between the agriculture, bio-material developer, and a packaging manufacturer.

3. Pilot Participants

3.1. Solution Provider

Company name: Szimbio Lab, Dóra Márföldi

Country: Hungary

Role: Solution provider

Solution: mycelium-based solutions for replacing fossil-based packaging items, including material research, material testing, and prototyping.

Szimbio Lab is an innovative bio-based materials solutions lab, focusing on mycelium-based composite development.

3.2. Solution Seeker / Pilot Environment

Company name: UgrinPack-Erdősi LTD

Country: Hungary

Role: Solution seeker/pilot host

UgrinPack LTD is a Hungarian SME operating in the packaging industry. The founder of the First Hungarian Packaging Technology Cluster is seeking sustainable solutions.

4. Description of the Piloted Solution

The piloted solution is "MycoCrate," a solid mycelium-based composite packaging that replaces fossil-based packaging. It uses the natural growth of fungal hyphae to bind organic agricultural waste into a structural material.

Key features implemented:

Circular material use: Utilization of hemp fiber, hemp shives, rapeseed straw, and wheat straw as substrate.

Material testing: exploring the material properties that affect the usability in packaging

Sustainable Manufacturing: carbon footprint assessment in the lab-scale manufacturing

Biodegradability: A fully compostable alternative to expanded polystyrene (EPS).

5. Pilot Methodology and Implementation Process

This chapter documents the actual technical implementation of the MycoCrate project's workflow used during the pilot. The implementation followed a structured workflow divided into four main Work Packages (WP), which are described as implementation steps:

Step 1: Fundamental research on the growth conditions of various fungal-substrate combinations (WP1) _ Identifying the best fungal-substrate combinations for further testing and prototyping

Investigation of the growth conditions of various fungal-substrate combinations with radial growth tests, including 4 fungal strains (*Fomes fomentarius, Ganoderma lucidum, Trametes hirsua, Trametes versicolor)* and four waste-sourced biomass (hemp fiber, hemp shives, rapeseed straw, wheat straw)

identifying the two combinations with the fastest mycelial growth and the strongest hyphal structure to conduct further assessments, and

supplementary tasks: particle size analysis and chemical characterisation of the substrates used

Outcomes:

The outcomes of the radial growth tests are shown in Figure 1.

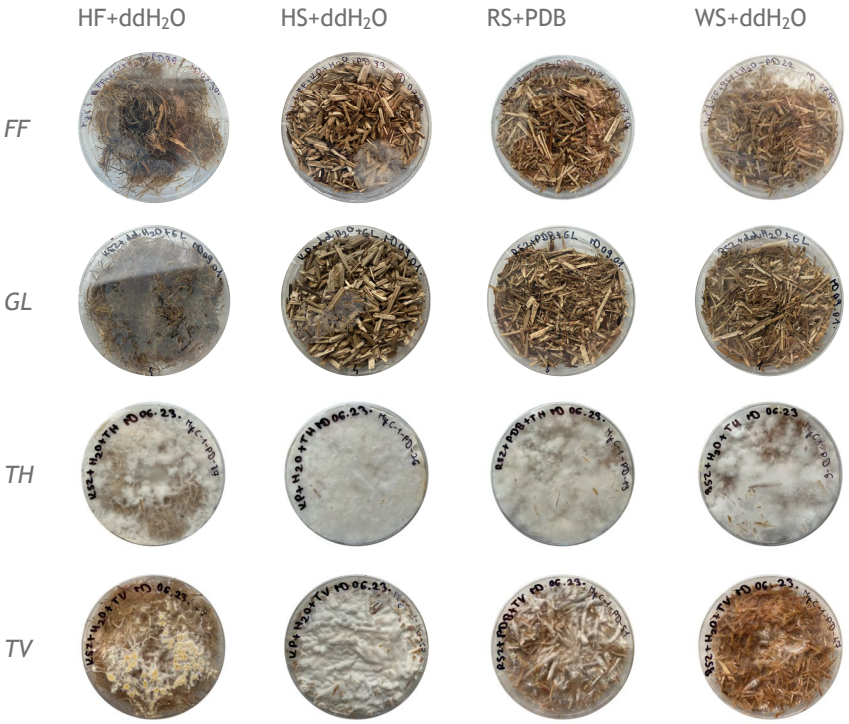


Figure 1. Petri dish specimens with various fungal-substrate combinations after fourteen days of incubation

The fastest and strongest mycelium growth was attributed to the *Trametes hirsuta* fungal strain. This strain was combined with hemp shives and rapeseed straw for the material tests.

Step 2: Material testing (WP2) _ Validation of the viability of the utilization in packaging through material tests

Standard-sized samples were cultivated for four weeks with the two most viral fungal-substrate combinations identified in WP1, for investigations on compressive strength, antifungal test, and water absorption, in accordance with the relevant standards

Compressive strength tests: according to DIN EN ISO 844:2021-07 norm - 10 specimens were assessed per fungal-substrate combination

Water absorption tests: in accordance with the literature [9] - 5 specimens were assessed per fungal-substrate combination

Antifungal tests: according to the DIN EN ISO 846 norm - 5 specimens were assessed per fungal-substrate combination

Outcomes:

Compressive strength tests:

The ***Trametes hirsuta*-hemp shives composite consistently demonstrated enhanced compressive stress and stiffness** (99.51-137.00 kPa at 10% strain), **which is competitive with the compressive stress values of the EPS packaging materials** (101 to 177 kPa).

The ***Trametes hirsuta*-rapeseed straw** combination's stress values were considerably lower (16.54 kPa to 33.88 kPa)

Water absorption tests:

The examination highlighted a **two-phase water-absorption model** for both assessed fungal-substrate combinations, in which the initial capillary infiltration is followed by diffusion-driven saturation

The tested fungal-substrate combinations generally exhibit high water absorption, underscoring the need for further research to improve their water resistance properties.

Antifungal properties:

The visual characterization results are seen for both fungal-substrate combinations in Figure 2.

Limited antifungal performance for both fungal-substrate combinations, suggesting limited inherent antifungal properties

This result suggests that untreated mycelium-based composite materials currently lack sufficient antifungal resistance for direct food-contact packaging applications.

Antifungal performance could potentially be enhanced using natural coating agents; this hypothesis requires experimental validation, and further research is needed to assess coating effectiveness, durability, and safety.

Figure 2. Visual evaluation of the examined fungal-substrate combinations.

Step 3: Prototyping (WP3) _ Development and validation of a small-scale shipping container prototype.

Digital manufacturing of the growth form and cultivation of the MycoCrate prototype

The crate prototype was designed and grown based on a standard-sized commercial plastic shipping crate (40 × 30 × 15 cm)

standard *Trametes hirsuta*-hemp shives fungal-substrate was utilized for the prototype's cultivation

The manufactured prototype is shown in Figure 3.

Figure 3. MycoCrate prototype

Step 4 : LCA (WP4)

Scope: cradle-to-grave LCA in accordance with DIN EN 15804 [16] to assess the carbon footprint of the MycoCrate product

Assessed life cycle stages (System boundaries): production phases (A1-3): raw materials, material transportation, manufacturing, the downstream to the customers (A4), and the end-of-life scenarios (EoLSC)

Functional unit: lab-scale production of 1 40 × 30 × 15 cm MycoCrate product

End-of-life scenarios: home composting (EoLSC1), industrial composting (EoLSC2), recycling as supplementary MBC raw material (70% of the material is recycled, and the rest is incinerated for heat recovery) (EoLSC3), incineration for heat recovery (EoLSC4), landfilling (EoLSC5), and reuse as packaging material (250 km of transportation was calculated for the take-back of packaging material) (EoLSC6).

Data collection: resource materials used, the energy required for growth and manufacturing, and the output flows, all of which are key factors in the production process. Everything was measured based on the lab-scale production

Data type: secondary data, Ecoinvent v3.11 and Agribalyse 3.2 datasets

Utilized software: OpenLCA 2.2

Impact assessment method: EF 3.1 Method

Outcomes:

Across the A1–A4 life-cycle stages, manufacturing (A3) is the dominant contributor to environmental impacts, accounting for 74.21% of net GWP (12.68 kg CO_2 eq) and 64% of fossil-based GWP due to high electricity demand, although it is not the main driver of land-use related GWP.

Transportation to manufacturing (A2) is the second-largest contributor to net GWP at 15.26% (2.61 kg CO_2 eq) and also has a notable share in fossil-based GWP.

Raw material supply (A1) contributes a smaller share to net GWP (7.29%) but is the primary contributor to GWP_land use (81.63%), mainly driven by hemp production.

Downstream transportation (A4) has the lowest impact across all categories, contributing less than 4% to net and fossil GWP and negligible shares to biogenic and land-use GWP.

EoL:

Net GWP outcomes for the developed EoL scenarios, including processing activities and the impact credits generated from recovered products or secondary material streams, are presented in Figure 4.

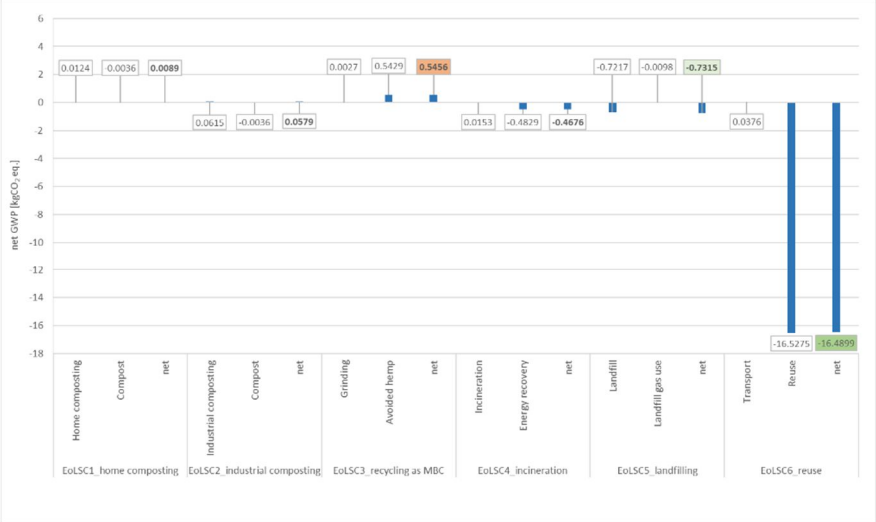


Figure 4. Net GWP impacts of the various elaborated EoLs, including processing activities and recovered materials.

most beneficial EoL scenario: reuse, which achieves 1**6.4899 kg CO_2 savings by extending the material's carbon storage period.**

second most favourable scenario**: landfilling (0.7315 kg CO2 sequestration)**

Incineration for heat recovery is also advantageous, yielding a **CO_2 savings of 0.4676 kg.**

home and industrial composting: **do not contribute to long-term CO_2 reduction and instead result in additional CO_2 emissions.** The **net GWP values are 0.0089 kg CO_2 for home composting and 0.0579 kg CO_2 for industrial composting.**

The most unfavourable scenario: recycling the MBC as a raw material for further MBC production. In this case, the **biomass's biogenic carbon storage potential is reduced** because less hemp husk can re-enter the product system, thereby limiting the flow of biogenic carbon into the material cycle.

Thanks to the circular substrate utilization, the material contributes to CO_2 sequestration as biogenic carbon.

Although packaging applications exhibit a relatively short service lifespan, the duration of carbon storage can be extended through appropriate EoL treatments.

The elaborated scenarios demonstrated that this extension can be achieved through standard waste management strategies, such as reuse and landfilling. This indicates that implementing mycelium-based composite materials does not require changes to existing waste treatment practices.

6. Roles and Responsibilities

Szimbio Lab, Dóra Márföldi: Responsible for the mycelium-based composite research, the material testings, prototyping, and the LCA data collection

- UgrinPact-Erdősi LTD.: Acted as an industrial user, providing the expertise for the prototyping process.
- Magyar Gazdaságfejlesztési Ügynökség (MGFÜ): Acted as facilitator, ensuring methodological compliance, coordination between parties, and alignment with GREENE 4.0 objectives.

7. Contribution to GREENE 4.0 objectives

The pilot contributes directly to the GREENE 4.0 objectives by:

- Enhancing the circular economy principles through local supply chains
- Contributing to the green transition in the field of packaging with the validation of the mycelium-based composites' usability
- Supporting the development of meaningful connections between industrial stakeholders and providers of green solutions

8. Conclusions and Next Steps

The MycoCrate pilot successfully demonstrated the feasibility of using mycelium-based composite materials as sustainable alternatives to fossil-based packaging.

Key Outcomes:

- Identification of optimal fungal-substrate combinations and validation of physical properties through material tests and prototyping.
- Validation of the material's sustainability through lab-scale carbon footprint assessment

Next Steps:

- Further optimization of growth cycles, industrial scaling with UgrinPack-Erdősi Ltd
- Expanded testing of mold resistance
- longevity testing in diverse shipping environments
- LCA in industrial scale

Interreg CENTRAL EUROPE

Co-funded by the European Union

GREENE 4.0

D3.4.2: Pilot and testing report - Italy

Implementation of an automated loading and unloading solution for a vertical warehouse

1. Executive summary

This document presents the implementation report of the pilot activity carried out under Service C – Support of pilot testing in realistic operational environments within the GREENE 4.0 project. The pilot focused on the implementation of an automated loading and unloading solution for a vertical warehouse, developed by Exsensia srl, in a real operational environment provided by Elettrocablaggi srl.

The pilot was implemented in accordance with the GREENE 4.0 Pilot and Testing Methodology (Deliverable D3.4.1) and followed the structured B2GreenHub client journey. The objective of the pilot was to validate the operational usability, effectiveness, and user acceptance of the solution in a real SME context, contributing to the creation of a new digital value chain between a solution provider and a solution seeker at national level.

2. Introduction and Context

The GREENE 4.0 project aims to support SMEs in their green and digital transformation by creating, testing, and piloting new sustainable value chains. Within this framework, Activity 3.4 focuses on validating innovative solutions developed through the GREENE 4.0 Innovation Programmes by implementing them in real operational environments.

The pilot activity is part of Work Package 3 (WP3) of the GREENE 4.0 project, specifically Activity 3.4 – Piloting and testing of new GREENE 4.0 value chains. The objective of this activity is to test and validate innovative green and digital solutions developed through the Innovation Programmes by implementing them in real operational environments of manufacturing or service-oriented SMEs.

This report documents one national pilot implemented in Italy, connecting a solution provider selected through the GREENE 4.0 Innovation Contest with a solution seeker identified via the B2GreenHub ecosystem. The pilot described in this report represents a national pilot value chain, connecting an Italian solution provider (Exsensia srl) with an Italian solution seeker (Elettrocablaggi srl). This collaboration contributes to the GREENE 4.0 objective of fostering sustainable and digital transformation through structured matchmaking and real-world testing supported by the B2GreenHub ecosystem.

The scope of this pilot was to test and validate an AI-based digital solution in a real SME operational context. The specific objectives were:

- To implement the Exsensia srl solution in a real business environment
- To assess usability and user acceptance by a non-technical SME user
- To validate operational feasibility and integration into daily workflows
- To demonstrate the creation of a new national digital value chain
- To support TRL progression through real-world testing

3. Pilot Participants

3.1. Solution Provider

Company name: Exsensia srl
Country: Italy
Role: Solution provider
Solution: Intuitive Robotic Automation for Vertical Storage Systems

Exsensia srl is an Italian technology company specialized in intuitive and flexible robotic automation software for industrial applications. The company develops a programming platform that enables fast deployment of robotic systems for material handling, machine tending, and logistics automation, reducing integration time and simplifying reconfiguration. Exsensia focuses on solutions for SMEs and industrial partners, supporting the adoption of Industry 4.0 technologies through scalable and user-friendly automation tools.

3.2. Solution Seeker

Company name: Elettrocablaggi srl
Country: Italy
Role: Solution seeker

Elettrocablaggi srl is an Italian SME operating in the manufacturing of electrical wiring and cabling systems for industrial applications. The company manages a high-mix, low-volume production environment, where efficiency in internal logistics and material handling is critical. As solution seeker, Elettrocablaggi aimed to improve the automation level of its warehouse operations through the adoption of a flexible robotic solution suitable for SME-scale production.

4. Description of the Piloted Solution

Elettrocablaggi srl operates in a production environment characterized by high product variability and frequent handling of small and medium-sized batches, where internal logistics and warehouse operations play a critical role. The company faced challenges related to the manual handling of materials between the automatic vertical storage system and the production area, resulting in limited flexibility and inefficiencies during peak workloads.

To address these challenges, Exsensia srl developed and deployed an intuitive robotic automation solution for automated loading and unloading of an automatic warehouse. The solution is based on the integration of a mobile robotic platform, responsible for transporting parts and containers, and a fixed robotic arm installed in proximity to the vertical storage system, in charge of picking and placing operations.

The two robotic systems are coordinated through the Exsensia programming platform, which enables the intuitive definition of robot behaviors, task sequencing, and interaction logic without the need for low-level programming. The solution manages the full operational cycle, including:

- reception of material from the warehouse,
- robotic handling and loading/unloading operations,
- transfer of parts via the mobile robot,
- and safe interaction with the warehouse interface.

The piloted solution was designed to be modular, scalable, and easily reconfigurable, allowing adaptation to different warehouse layouts and production requirements. Deployed in a real SME operational environment, the pilot demonstrated the feasibility of reducing manual handling, increasing process reliability, and enabling a flexible automation approach aligned with Elettrocablaggi's operational needs.

5. Pilot Methodology and Implementation Process

This chapter documents the actual technical and operational implementation of the Exsensia srl solution at Elettrocablaggi srl, based on the real deployed workflow used during the pilot. The implementation follows Step 5 – Testing solutions developed with Innovation Programs of the GREENE 4.0 Pilot and Testing Methodology and provides evidence of real system configuration, execution, and use.

5.1. Step 1 - Entry and Registration in the B2GreenHub Ecosystem

Both Exsensia srl (solution provider) and Elettrocablaggi srl (solution seeker) were formally onboarded into the B2GreenHub ecosystem. This step ensured visibility within the platform, access to GREENE 4.0 tools, and facilitator-supported coordination throughout the pilot.

5.2. Step 2 - User Acceptance and Needs Assessment

An initial assessment of Elettrocablaggi srl green and digital readiness was conducted by the facilitator through the User Acceptance Model Questionnaire. Its main objective is to assess how digital technologies support production processes while enhancing sustainability and operational efficiency. The questionnaire investigates the adoption of digital solutions such as production error checking systems, automated feedback loops, and data-driven monitoring tools. It explores how these technologies improve quality control, reduce errors, and optimize manufacturing workflows. A strong emphasis is placed on user perception, including usability, perceived usefulness, and ease of integration into daily operations. The document also examines the environmental impact of digital transformation, highlighting energy efficiency, waste reduction, and resource optimization. Guidelines and notes support respondents in understanding the questions and aligning answers with real operational practices. Overall, the document aims to collect structured feedback to evaluate both digital performance and green benefits, supporting scalable and sustainable industrial transformation.

From the questionnaire, it emerged that Elettrocablaggi srl is interested in digital transformation, while green transition is still limited in the short term. The company highlighted the ambition to invest resources to increase their digital maturity in manufacturing operations processes, inbound and outbound logistics processes, information flow and organisational activities. This operational context made Elettrocablaggi srl a suitable pilot environment, as it reflects a typical SME scenario targeted by the GREENE 4.0 project, having the need to introduce digital tools but limited internal capacity to develop and manage them.

5.3. Step 3 - Innovation Contest and Innovation Programme delivery

The Innovation Contest of the Interreg GREENE4.0 Project was launched as an international call for proposals aimed at identifying innovative technological solutions capable of accelerating the green and digital transformation of industry. The call was open from 18 April to 31 May 2025, and—following an extension of the original deadline—remained accessible until 14 June 2025. In total, 15 applications were received from technology providers across the participating regions. At the core of the Contest is the Innovation Programme, a tailored support pathway offered to the two best-ranked companies per country. The purpose of the programme is to help selected applicants advance the Technology Readiness Level (TRL) of their proposed solutions by providing specialised services aligned with both their technological maturity and their market potential.

According to this, Exsensia srl, as selected company starting from TRL 6, received the Investment and Market Readiness Programme. In particular, the following services were delivered:

- Access to Funding: Identification of the 2–3 most relevant EU or national funding opportunities.
- Partnership Scouting: A shortlist of potential partners or pilot adopters (companies, clusters, hubs), including introductory contacts where possible.

The service delivery includes three main steps:

1) Kick-off Meeting — to assess the current status of the solution (technology, business model, funding explored) and define 2–3 priority target markets.
2) Service Delivery — Intellimech develops the supporting materials and conducts the scouting and funding research.
3) Final Meeting— delivery of all outputs: pitch deck, funding call list, partner shortlist, and concrete recommendations for the next development steps.

5.4. Step 4 - Matchmaking via B2GreenHub

The connection between Exsensia srl and Elettrocablaggi srl was facilitated through the B2GreenHub platform, ensuring alignment between the solution's capabilities and the solution seeker's needs. The facilitator supported initial coordination and definition of the pilot scope, objectives, and timeline.

The pilot focused on validating usability, content quality, time savings, and overall operational fit rather than quantitative performance metrics.

5.5. Step 5 - Technical Deployment of the Solution

The piloted solution was deployed at Elettrocablaggi srl premises to automate the loading and unloading of an automatic vertical storage system. The objective was to reduce manual handling and validate a flexible robotic workflow suitable for an SME environment.

The system consisted of a fixed robotic arm installed near the warehouse for pick-and-place operations and a mobile robot used to transport materials between the warehouse interface and the transfer area. The entire operational sequence was programmed and coordinated using the Exsensia intuitive robotic programming platform, enabling fast configuration and easy reconfiguration of tasks.

The deployment included site assessment, robot installation and calibration, workflow programming, and system integration. Functional, integration, and repeatability tests were performed in real operating conditions to validate correct synchronization between the robots, handling reliability, and safe operation.

The validation confirmed the feasibility and robustness of the solution, demonstrating improved process repeatability, reduced operator involvement, and effective adoption of flexible robotic automation in a real SME context.

6. Roles and Responsibilities

- Exsensia srl: Responsible for configuring, deploying, and supporting the pilot solution, and for collecting feedback related to system functionality.
- Elettrocablaggi srl: Acted as pilot user, tested the solution in real operational conditions, and provided structured feedback on usability and value.
- Consorzio Intellimech (IMECH): Acted as facilitator, ensuring methodological compliance, coordination between parties, and alignment with GREENE 4.0 objectives.

7. Contribution to GREENE 4.0 Objectives

The pilot contributes directly to the GREENE 4.0 objectives by:

- Creating a new national digital value chain between a solution provider and solution seeker
- Validating a digital transformation solution in a real SME environment
- Supporting behavioural change and user acceptance of AI-driven digital tools
- Providing evidence-based input for future policy recommendations under WP4

8. Conclusions and Next Steps

The pilot implementation of the Exsensia srl at Elettrocablaggi srl was successfully executed in line with the GREENE 4.0 Pilot and Testing Methodology. The activity demonstrated the feasibility, relevance, and value of the solution for SMEs and confirmed its readiness for further scaling and replication.

The pilot validated the effectiveness of combining a fixed robotic arm and a mobile robot for automated warehouse loading and unloading, as well as the usability of the Exsensia programming platform in a real industrial context. The results highlighted the potential of the solution to reduce manual handling, improve process reliability, and support flexible automation strategies in SMEs.

Next steps may include:

- extending the solution to manage additional warehouse stations or storage systems;
- increasing the level of autonomy and decision-making through dynamic task scheduling;
- integrating advanced monitoring and analytics for performance optimization;
- enhancing human–robot interaction features to further simplify operation by non-expert users;
- replicating the solution in other SME environments with similar logistics and handling needs.

These future developments would further strengthen the solution's scalability and contribution to sustainable and digital manufacturing.

Interreg CENTRAL EUROPE

Co-funded by the European Union

GREENE 4.0

D3.4.2: Pilot and testing report – Poland

Implementation of the structured online order form for a food company

1. Executive summary

This document presents the implementation report of the pilot activity carried out mainly under service A facilitation services using the B2GreenHub platform tools and support of pilot testing in realistic operational environments within the GREENE 4.0 project. The pilot focused on the implementation and testing of the tool to simplify orders and improve customer communication developed by Florian Bouron, in a real operational environment provided by Dudzik Ice Cream.

As the User Acceptance Model (UAM) assessment identified a clear need for skill development at Lody Dudzik, this report details pilot activities delivered under both Service : facilitation services via the B2GreenHub platform and specialised training and mentoring, provided expert guidance in developing operational procedures designed to reduce material consumption and optimize resource efficiency specifically for the food and ice cream industries.

The pilot was implemented in accordance with the GREENE 4.0 Pilot and Testing Methodology (Deliverable D3.4.1) and followed the structured B2GreenHub client journey. The objective of the pilot was to validate the operational usability, effectiveness, and user acceptance of the solution in a real SME context, contributing to the creation of a new digital value chain between a solution provider and a solution seeker at national level.

2. Introduction and Context

The GREENE 4.0 project aims to support SMEs in their green and digital transformation by creating, testing, and piloting new sustainable value chains. Within this framework, Activity 3.4 focuses on validating innovative solutions developed through the GREENE 4.0 Innovation Programmes by implementing them in real operational environments.

The pilot activity is part of Work Package 3 (WP3) of the GREENE 4.0 project, specifically Activity 3.4 – Piloting and testing of new GREENE 4.0 value chains. The objective of this activity is to test and validate innovative green and digital solutions developed through the Innovation Programmes by implementing them in real operational environments of manufacturing or service-oriented SMEs.

This report documents one national pilot implemented in Poland, connecting a solution provider selected through the GREENE 4.0 Innovation Contest with a solution seeker identified via the B2GreenHub ecosystem. The pilot described in this report represents a national pilot value chain in food sector, connecting a Polish solution provider (Florian Bouron) with a Polish solution seeker (Dudzik Ice Cream). This collaboration contributes to the GREENE 4.0 objective of fostering sustainable and digital transformation through structured matchmaking and real-world testing supported by the B2GreenHub ecosystem. The scope of this pilot was to test and validate an digital solution in a real SME operational context. The specific objectives were:

- To implement the solution in a real business environment
- To assess usability and user acceptance by a non-technical SME user
- To validate operational feasibility and integration into daily workflows
- To support TRL progression through real-world testing

3. Pilot Participants

3.1 Solution Provider

Company name: Florian Bouron

Country: Poland

Role: Solution provider

Solution: The solution was a structured online contact form implemented on the company's website. It allows customers and business partners to submit inquiries about availability, special orders, event services, and B2B cooperation directly online, organizing requests into clear categories for easier management

3.2 Solution Seeker

Company name: Dudzik Ice Cream

Country: Poland

Role: Solution seeker, pilot host

Dudzik Ice Cream is a family-owned ice cream producer, making high-quality, natural ice creams since 1971. Located in Dobczyce, Lesser Poland, the company has operated its retail shop in the same location for over fifty years. Dudzik is recognized for its traditional recipes and artisanal approach, offering a wide variety of flavors made from premium ingredients. Alongside maintaining high standards of quality and craftsmanship, the company also focuses on sustainable practices in its production

4. Description of the Piloted Solution

The piloted solution was the implementation of a structured online contact form on Dudzik Ice Cream's website, introduced in direct response to the company's operational challenges. The business was facing a growing number of repetitive inquiries from customers and partners regarding daily offers, special orders, event services, and B2B cooperation. These inquiries were handled manually by staff, which increased workload, extended response times, and limited operational efficiency. The website offered no self-service options, online ordering, or clear information for clients, which created delays and missed opportunities for larger orders and business partnerships.

The online contact form addressed these needs by allowing customers and partners to submit inquiries quickly and directly through the website. Requests were structured into clear categories—such as individual orders, event catering, and B2B collaboration—so the company could better organize, prioritize, and respond to them. This approach reduced repetitive questions, improved communication, shortened response times, and enhanced the overall customer experience, while allowing staff to focus on production and business growth.

B2GreenHub supported the pilot by coordinating the project, defining its scope, objectives, and timelines, and ensuring the solution effectively met the company's specific operational needs.

IMPORTANT: The original implementation plan was more ambitious; however, due to time constraints related to state aid, the project was narrowed down. We did not have sufficient time to provide Services B, C, and D (Consulting, UX Audit, and SEO Training) for solution provider.

5.1 Step 1 - Entry and Registration in the B2GreenHub Ecosystem

Both Florian Bouron, as the solution provider, and Dudzik Ice Cream, as the solution seeker, were formally onboarded into the B2GreenHub ecosystem. This onboarding ensured that both companies gained visibility within the platform, had access to the GREENE 4.0 tools, and benefited from facilitator-supported coordination throughout the pilot.

5.2 Step 2 User Acceptance and Needs Assessment

Initial Readiness Assessment

The pilot process began with an initial assessment of Lody Dudzik's green and digital readiness, conducted by the facilitator through the User Acceptance Model Questionnaire. The primary objective was to evaluate how digital technologies could support production processes while simultaneously enhancing sustainability and operational efficiency. This foundational step provided the data necessary to align the pilot's goals with the company's specific industrial context.

Lody Dudzik demonstrated a high level of commitment to the project from its early stages, playing an active role in the regional mapping process within Work Package 1 (WP1). The partner's involvement specifically included:

- User Acceptance and Needs Assessment: Contributing to the precise alignment of tools with market realities.
- Open Innovation Workshops: Actively participating in the screening and selection process for solution seekers during the workshop conducted on September 20, 2024.

Photo 1. Open Innovation workshop held on 20.09.2024 in Kraków Technology Park

While the assessment identified various needs—such as financial support, knowledge transfer, and specialized training—the technology gap in communication and order management was prioritized as the most critical area for intervention.

Through questionnaires and selection workshops, it was determined that Lody Dudzik, like many SMEs, struggled with fragmented communication channels. The inquiry handling process relied on scattered sources (phone calls, inconsistent emails, and messages), which resulted in:

- A lack of essential data (technical specifications, quantities, delivery dates) at the initial contact stage.
- Increased staff workload due to repetitive follow-up questions.
- Delays in generating quotations and the risk of overlooking or responding too late to customer requests.
- Objective and Characteristics of the Implementation

To address these inefficiencies, the pilot focused on replacing unstructured communication with a structured digital inquiry form. This solution guides the customer step-by-step through the process, aggregating all essential data in one centralized location from the start.

Assessment Finding: This implementation significantly reduces the administrative burden on staff and eliminates communication bottlenecks, accelerating the transition from inquiry to offer.

Lody Dudzik represents an ideal pilot environment for the GREENE 4.0 project. The company has expressed a clear ambition to invest resources into increasing its digital and green maturity within manufacturing operations.

This operational context reflects a classic SME scenario: a strong desire to adopt digital transformation (Twin Transition) paired with limited internal capacity to develop and manage complex IT systems. The pilot confirms that providing streamlined, accessible digital tools is the key to increasing technological maturity in craft and production-based enterprises.

As the UAM assessment demonstrated a high level of interest in the **Twin Transition** (digital and green), Lody Dudzik received comprehensive support through two dedicated service streams:

Lody Dudzik participated in the online curriculum available via the **Green Path Academy** platform. This was further enhanced by two bespoke training sessions tailored to their specific operational needs:

- **Training No. 1: Implementation of Resource Efficiency and Sustainability:** This session focused on integrating effective raw material management within confectionery production. It supported the company's transition toward a sustainable production model, emphasizing strategic planning for a "green" commercial offer.
- **Training No. 2: Optimization of Ice Cream Production and Food Waste Minimization:** A specialized pilot service aimed at upskilling personnel in eco-management. The training prepared participants to optimize technological processes and minimize food loss, directly aligning with **Circular Economy (GOZ)** principles within the food and beverage sector.

1. Step 3 – Innovation contest and innovation programme delivery

The Innovation Contest was launched as an international call for proposals to identify technological solutions capable of accelerating the Twin Transition (green and digital) of the industry. The call remained open from April 18 to June 14, 2025, resulting in 15 high-quality applications from across the participating regions.

Following the selection process, the best-ranked companies entered the Innovation Programme, a tailored support pathway designed to advance their Technology Readiness Level (RL). A prime example of this delivery is the support provided to Florian Bouron, who entered the programme at TRL 3. The company received specialized services under the Minimum Viable Product (MVP) Programme and the Investment and Market Readiness Programme.

The delivery of these services followed a structured the following process:

Kick-off Meeting

A strategic session conducted to evaluate the current status of the solution, including its technological maturity, existing business model, and previously explored funding. During this phase, 2-3 priority target markets were defined to focus the subsequent support.

Service Development (KPT)

The Krakow Technology Park (KPT) team developed bespoke supporting materials and strategic documents tailored to the provider's specific needs.

During this phase, the beneficiary received Service A, delivered through facilitation services that make full use of the B2GreenHub platform's capabilities. This allowed the beneficiary to exchange knowledge with ecosystem participants and enhance competencies in the field of sustainable economy. Specifically, Service A included:

- Presentation of the Open Innovation Map: Utilization of a comprehensive pool of experts specializing in green and digital transitions to provide technical and strategic guidance.
- Presentation of the Funding section : Identification and analysis of the most relevant EU and national funding opportunities to support further R&D and scaling.
- Presentation of the potential Partnership: base of potential partners and pilot adopters (companies, clusters, and hubs), including introductory contacts to facilitate market entry and network expansion.

Due to the limited time the Service B: Consulting and mentoring with technical experts, Service C: UX audit; and Service D were not realized.

Final Phase and Handover

The programme concluded with the delivery of a complete support package, including the curated expert list, a targeted funding call list, and the partner shortlist. This phase also provided concrete strategic recommendations for the next development steps to ensure the continued growth of the technology.

5.3 Capacity Building: Green Path Academy and Training

As the UAM showed a high interest in the Twin Transition, Lody Dudzik completed the online curriculum at the Green Path Academy and received two bespoke training sessions:

- Training No. 1: Implementation of effective raw material management and sustainability principles in confectionery production.
- Training No. 2: Pilot service for eco-management in ice cream production, focusing on minimizing food waste and optimizing technological processes (Circular Economy/GOZ).

Photo 2. Lody Dudzik staff during the training

5.4 Strategic Success: Beyond Project Synergy

A key highlight of this pilot is the long-term investment support initiated by the project. Lody Dudzik expressed interest in financing new equipment and subsequently received support through the Polish Investment Zone (Polska Strefa Inwestycji - PSI).

Important Note: This connection was established thanks to the GREENE 4.0 regional meeting in Dobczyce at the project's inception. It demonstrates the project's success as a catalyst for industrial growth by connecting SMEs with national investment instruments.

5.4 Technical Deployment of the Solution

The technical deployment involved integrating a structured online contact form into Dudzik Ice Cream's existing website. The form was configured to collect and organize inquiries related to daily offers, special orders, event services.

The solution included setting up categorized fields to ensure that requests were automatically structured for easier internal handling. The form was tested within the company's operational environment to

ensure proper functionality, usability, and alignment with daily workflows. After implementation, the system was monitored to verify performance, stability, and its impact on communication efficiency and response times.

The system architecture is based on a simple, web-integrated digital communication tool embedded within Dudzik Ice Cream's existing website.

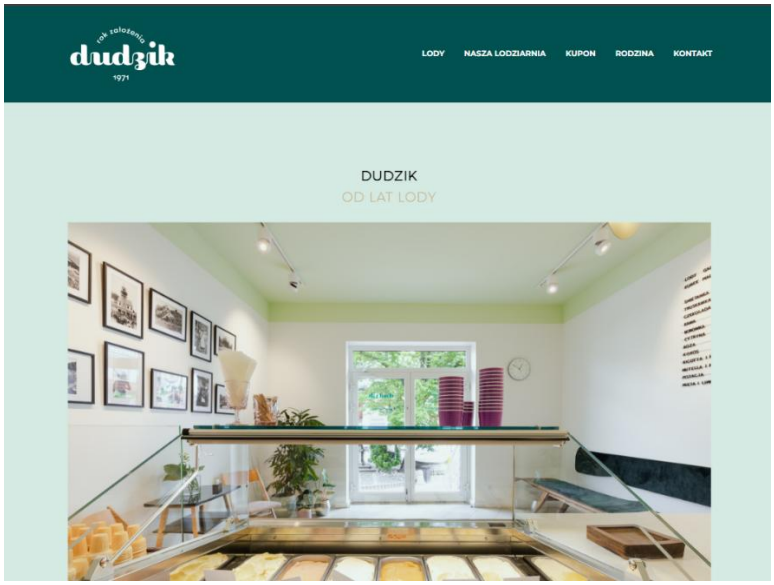


Figure 1. Dudzik Ice Cream official website

Figure 2. Step 1-

Select the type of inquiry or event – The user chooses what the inquiry is about (e.g., reservation type, event service). This helps the company understand the purpose of the request right away. Choose a date and location of the event.

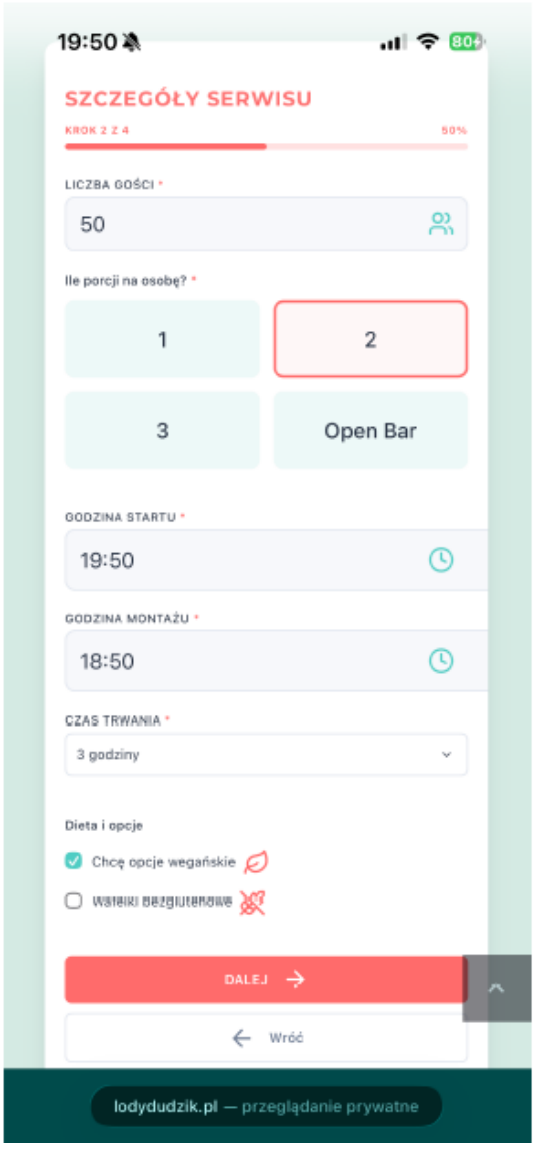


Figure 3. Step 2-

Add details or requirements – the user can type information or special instructions (e.g., number of guests, custom requests) and the specific time of the event

Figure 4. Step 3-

Provide additional information necessary to complete the order

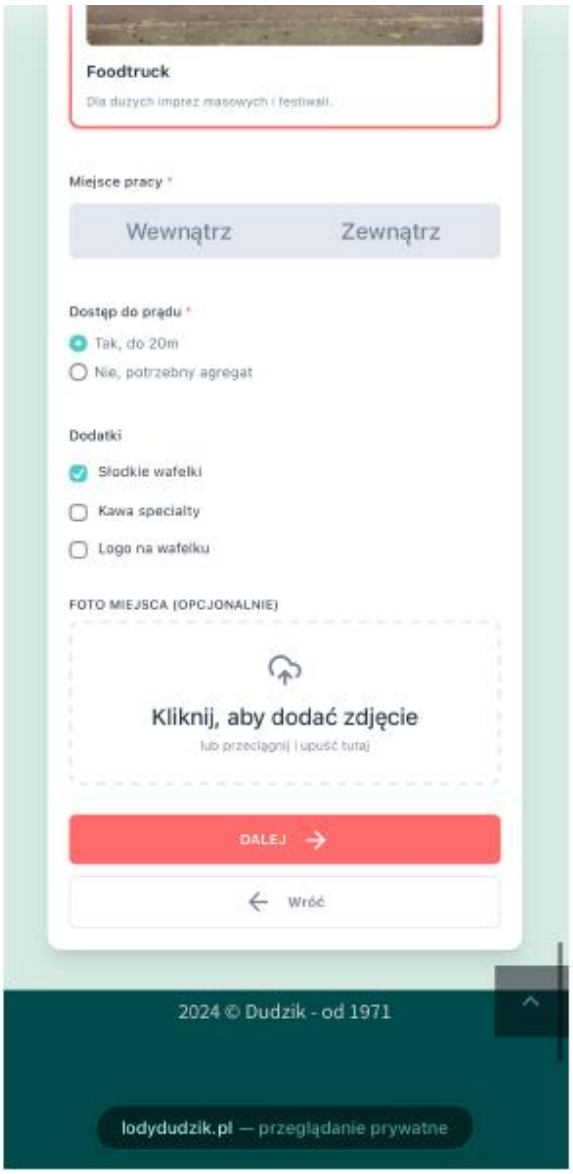


Figure 5. Step 3-

Provide additional information necessary to complete the order

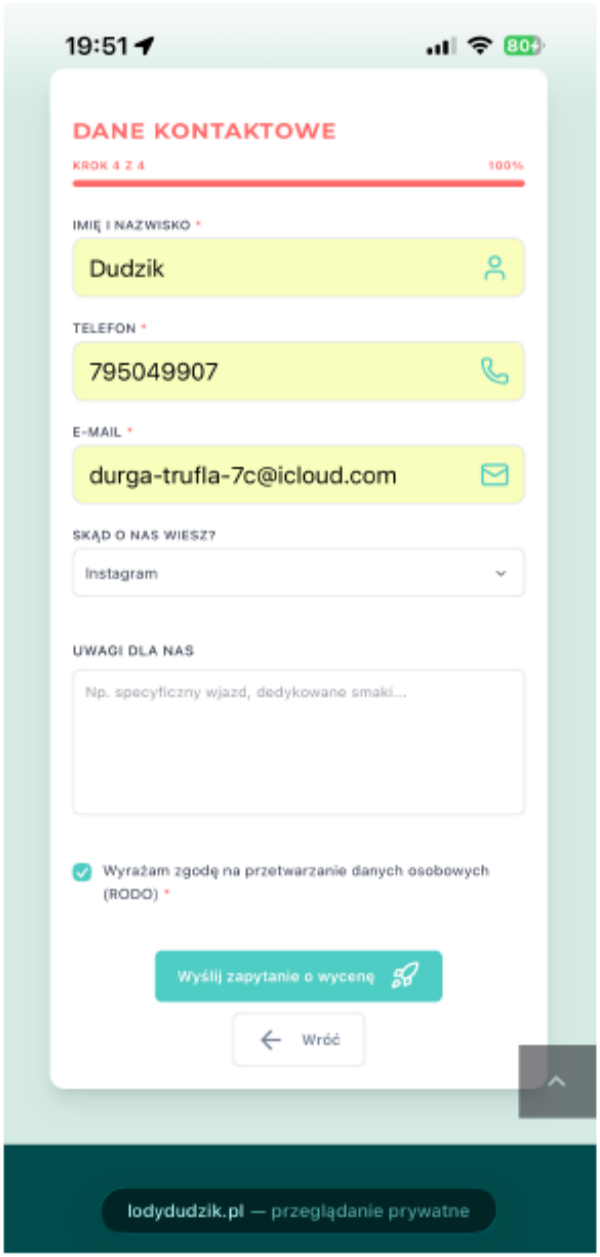


Figure 6. Step 4-

Enter personal and contact details – The user provides their name, phone number, and email address so the company can respond and confirm details.

5.5 Step 4 Monitor and Improve

After the launch of the online contact form, the company will monitor its usage and impact on daily operations. This included tracking the number and type of inquiries submitted through the form, observing changes in the volume of in-person and phone questions, and reviewing response times.

The company also will evaluate how effectively the categorized inquiries supported internal workflow and prioritization. Based on practical use, minor adjustments could be introduced to improve clarity of fields, optimize inquiry categories, or streamline internal handling procedures.

This continuous monitoring ensured that the solution remained aligned with operational needs and supported long-term efficiency improvements.

5. Roles and Responsibilities

- Florian Bouron

  Responsible for designing and implementing the digital solution, configuring the online contact form, categorizing inquiries, and providing technical support during the pilot.

- Dudzik Ice Cream
  Provided the operational environment, integrated the contact form into daily workflows, tested the system in real customer interactions, and offered structured feedback on its effectiveness.

- Krakow Technology Park
  Acted as facilitator, ensuring compliance with D3.4.1 methodology, coordination between Acted as facilitator, ensuring compliance with D3.4.1 methodology, coordination between parties and alignment with GREENE 4.0 objectives.

6. Pilot Results and Outcomes

The pilot confirmed that the structured online contact form solution can be successfully implemented in an SME operational environment. Key outcomes include:

- Noticeable reduction in repetitive in-person and phone inquiries
- Improved response times and more efficient handling of requests
- Better organization and prioritization of individual, event, and B2B inquiries
- High usability and easy integration into daily workflows
- Clear potential for replication in other small and medium-sized enterprises facing similar communication challenges

From the solution seeker's perspective, the pilot delivered tangible operational improvements, reduced staff workload, and enhanced customer experience. From the solution provider's perspective, the pilot validated the practical applicability of the solution in a real business environment and confirmed its readiness for broader market deployment.

7. Contribution to GREENE 4.0 Objectives

The pilot contributes directly to the GREENE 4.0 objectives by:

- Creating a new national digital value chain between a solution provider and solution seeker
- Validating a digital transformation solution in a real SME environment
- Supporting the "Twin Transition" (Green & Digital): Reducing paper waste and energy consumption associated with inefficient, repetitive manual processes through streamlined digital communication.
- Enhancing SME Digital Maturity: Providing a low-entry barrier tool that builds the company's internal capacity to manage more complex digital workflows in the future.
- Reducing Operational "Noise" and Resource Waste: Minimizing human error and the misallocation of resources (time, transport, materials) caused by incomplete or misinterpreted order data.
- Developing a Replicable Pilot Model: Creating a blueprint for other craft-based SMEs (e.g., in the food & beverage sector) to adopt similar digital structures with minimal internal IT overhead.
- Strengthening the Regional Innovation Ecosystem: Promoting the use of the B2GreenHub platform as a sustainable meeting point for technology providers and manufacturing companies.

Acting as a Catalyst for Regional Investment: Leveraging project-initiated networking (e.g., the Dobczyce regional meeting) to bridge the gap between SMEs and national investment frameworks like the Polish Investment Zone.

8. Conclusions and Next Steps

The pilot implementation of the structured online contact form at Dudzik Ice Cream was successfully executed in line with the GREENE 4.0 Pilot and Testing Methodology. The activity demonstrated the feasibility, relevance, and value of the solution for SMEs, confirming its effectiveness in improving communication, workflow efficiency, and customer experience.

The pilot at **Lody Dudzik** serves as a strategic benchmark for the **GREENE 4.0** objectives by successfully creating a new national digital value chain between a cutting-edge solution provider and a traditional SME. By validating a digital transformation tool within a real-world manufacturing environment, the project effectively addresses the **Twin Transition** (Green & Digital).

The implementation not only enhances the company's **digital maturity** through a low-barrier, structured communication system but also directly supports **sustainability** by reducing resource waste (time, materials, and energy) previously caused by fragmented manual processes and human error. Furthermore, this pilot establishes a **replicable model** for other craft-based SMEs, proving that digital tools can be successfully integrated even with limited internal IT capacity. Ultimately, by leveraging the **B2GreenHub platform**, the pilot strengthens the regional innovation ecosystem, fostering a resilient network of business contacts and technical expertise that extends beyond the project's duration.

Next steps may include extending the pilot to cover additional types of inquiries. Further improvements could involve adding automated notifications to alert staff of new submissions, integrating the form with internal management systems for faster processing, and including more detailed fields to capture all necessary order information upfront. Enhancements may also focus on analytics and reporting, enabling the company to track inquiry trends, optimize staffing, and improve planning for events and high-demand periods. These measures would further streamline workflows, reduce manual workload, and enhance overall operational efficiency.

Next steps may also include onboarding additional SMEs facing similar operational challenges. Expanding the pilot to more companies would help test the solution in different environments, gather further feedback, and demonstrate its scalability and adaptability for broader use across small and medium-sized enterprises.

Interreg CENTRAL EUROPE

Co-funded by the European Union

GREENE 4.0

D3.4.2: Pilot and testing report - Slovenia

Implementation of an AI-driven Content Factory Solution at LDK Tech, Dejan Lorber s.p.

1. Executive summary

This document presents the implementation report of the pilot activity carried out under Service C – Support of pilot testing in realistic operational environments within the GREENE 4.0 project. The pilot focused on the implementation and testing of the AI-driven Content Factory for simplified social media publishing across multiple platforms, developed by CreativIQ, Niko Kirič s.p., in a real operational environment provided by LDK Tech, Dejan Lorber s.p.

The pilot was implemented in accordance with the GREENE 4.0 Pilot and Testing Methodology (Deliverable D3.4.1) and followed the structured B2GreenHub client journey. The objective of the pilot was to validate the operational usability, effectiveness, and user acceptance of the solution in a real SME context, contributing to the creation of a new digital value chain between a solution provider and a solution seeker at national level.

2. Introduction and Context

The GREENE 4.0 project aims to support SMEs in their green and digital transformation by creating, testing, and piloting new sustainable value chains. Within this framework, Activity 3.4 focuses on validating innovative solutions developed through the GREENE 4.0 Innovation Programmes by implementing them in real operational environments.

The pilot activity is part of Work Package 3 (WP3) of the GREENE 4.0 project, specifically Activity 3.4 – Piloting and testing of new GREENE 4.0 value chains. The objective of this activity is to test and validate innovative green and digital solutions developed through the Innovation Programmes by implementing them in real operational environments of manufacturing or service-oriented SMEs.

This report documents one national pilot implemented in Slovenia, connecting a solution provider selected through the GREENE 4.0 Innovation Contest with a solution seeker identified via the B2GreenHub ecosystem. The pilot described in this report represents a national pilot value chain, connecting a Slovenian solution provider (CreativIQ) with a Slovenian solution seeker (LDK Tech). This collaboration contributes to the GREENE 4.0 objective of fostering sustainable and digital transformation through structured matchmaking and real-world testing supported by the B2GreenHub ecosystem.

The scope of this pilot was to test and validate an AI-based digital solution in a real SME operational context. The specific objectives were:

- To implement the CreativIQ solution in a real business environment
- To assess usability and user acceptance by a non-technical SME user
- To validate operational feasibility and integration into daily workflows
- To demonstrate the creation of a new national digital value chain
- To support TRL progression through real-world testing

3. Pilot Participants

3.1. Solution Provider

Company name: CreativIQ, Niko Kirič s.p.

Country: Slovenia

Role: Solution provider

Solution: AI-driven Content Factory for simplified social media publishing across multiple platforms

CreativIQ is the developer of a modular, AI-powered workflow that automates content creation, visual generation, approval, publishing, and archiving across multiple social media platforms.

3.2. Solution Seeker / Pilot Environment

Company name: LDK Tech, Dejan Lorber s.p.

Country: Slovenia

Role: Solution seeker / pilot host

LDK Tech operates as a small enterprise requiring regular, high-quality digital communication and social media presence, while facing typical SME constraints related to time, resources, and marketing capacity. The company was identified as a suitable pilot partner through the B2GreenHub platform.

4. Description of the Piloted Solution

The piloted solution is an AI-driven Content Factory designed to automate and streamline the full lifecycle of social media content creation and publishing. The workflow generates platform-optimized text and visual content for X (Twitter), Instagram, Facebook, LinkedIn, Threads, and YouTube Shorts from a single content input.

- Key functional elements implemented during the pilot include:
- AI-based generation of platform-specific social media posts
- Dynamic prompt and schema management via external sources (Google Docs)
- Automated AI image generation aligned with brand guidelines
- Approval workflows via email notifications
- Automated or semi-automated publishing to selected platforms
- Content and asset archiving to cloud repositories

The solution is cloud-based, modular, and does not require integration with physical manufacturing systems, making it suitable for SMEs seeking rapid digitalisation of marketing and communication processes.

5. Pilot Methodology and Implementation Process

This chapter documents the **actual technical and operational implementation** of the CreativIQ solution at **LDK Tech, Dejan Lorber s.p.**, based on the **real deployed workflow** used during the pilot. The implementation follows **Step 5 – Testing solutions developed with Innovation Programs** of the GREENE 4.0 Pilot and Testing Methodology and provides evidence of real system configuration, execution, and use.

5.1. Step 1 - Entry and Registration in the B2GreenHub Ecosystem

Both CreativIQ (solution provider) and LDK Tech (solution seeker) were formally onboarded into the B2GreenHub ecosystem. This step ensured visibility within the platform, access to GREENE 4.0 tools, and facilitator-supported coordination throughout the pilot.

5.2. Step 2 - User Acceptance and Needs Assessment

An initial qualitative assessment of LDK Tech's digital communication needs and readiness was conducted by the facilitator. The assessment identified inefficiencies in manual content creation, inconsistent publishing frequency, and limited capacity to tailor content across platforms. These findings confirmed the relevance of the CreativIQ solution for pilot testing.

LDK Tech is a small enterprise with limited internal marketing resources and no dedicated content production team. Prior to the pilot, social media communication was performed manually, on an irregular basis, and required significant time investment for content creation, formatting, visual preparation, and publishing across different platforms.

This operational context made LDK Tech a suitable pilot environment, as it reflects a typical SME scenario targeted by the GREENE 4.0 project: high need for digital tools + limited internal capacity.

5.3. Step 3 - Technical Deployment of the Solution

The implementation started with the **technical configuration of the Content Factory workflow** for LDK Tech. This included:

- Setting up the AI-driven content generation workflow
- Configuring platform-specific schemas for:
    - LinkedIn
    - Instagram
    - Facebook
    - X (Twitter)
- Aligning system prompts with LDK Tech's brand tone and communication goals

- Enabling AI-based image generation matching post content
- Activating approval and notification mechanisms via email and Telegram

No changes to LDK Tech's existing IT infrastructure were required. The solution operates fully in a **cloud-based environment**, enabling rapid onboarding and low implementation effort, which is a key requirement for SME adoption.

5.3.1. Overall System Architecture and Workflow

The implemented pilot solution consists of a **modular, multi-agent AI workflow** that integrates content generation, approval, publishing, notifications, and archiving into a single automated pipeline.

The complete workflow architecture implemented during the pilot is presented in **Figure 1**.

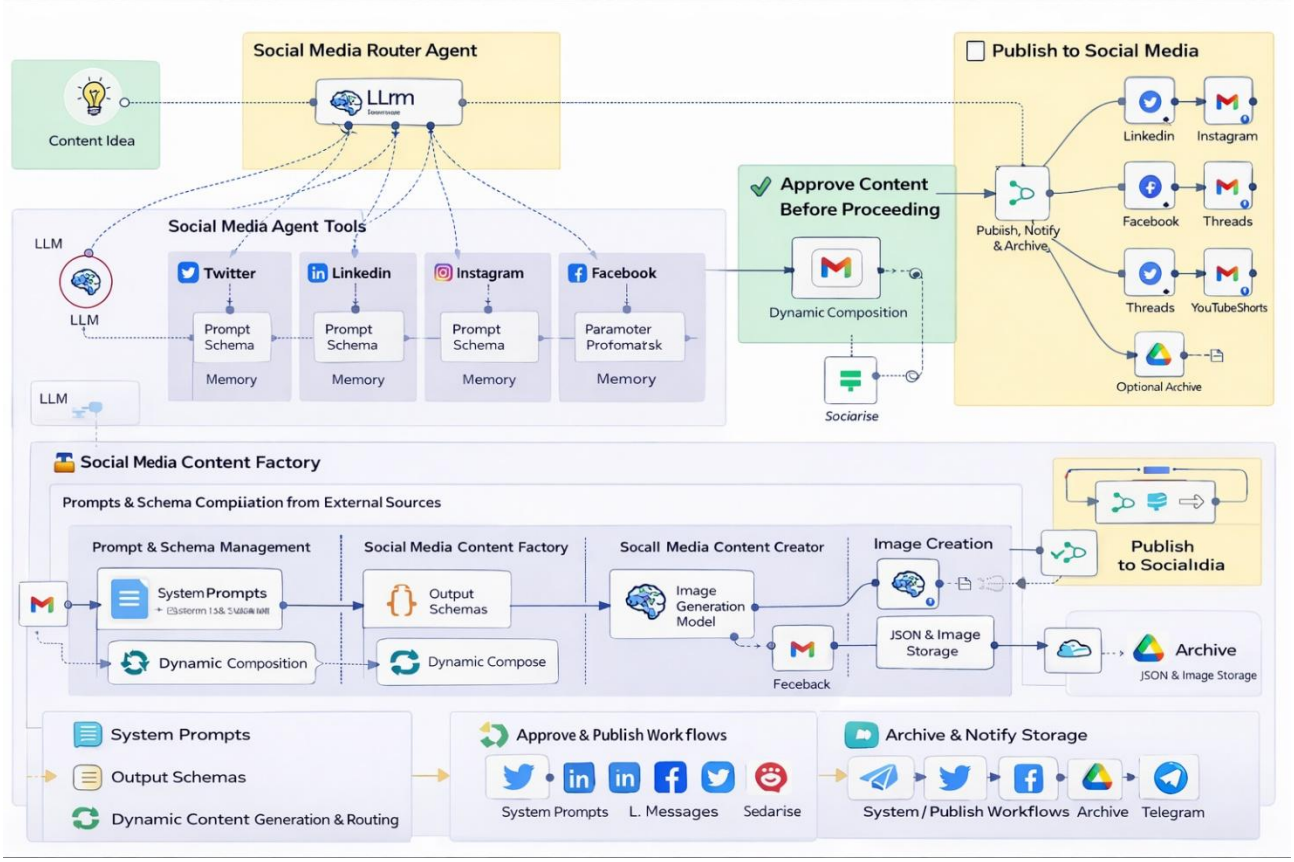


Figure 1: Overall workflow architecture of the AI-driven Content Factory implemented at LDK Tech

The architecture demonstrates:

- end-to-end automation from content idea to publication,
- separation of responsibilities between orchestration, generation, and publishing,
- cloud-based deployment without modification of the pilot company's internal IT systems.

5.3.2. Social Media Router Agent and Platform-Specific Content Generation

At the core of the implementation is the **Social Media Router Agent**, responsible for orchestrating content distribution across platforms. As shown in **Figure 2**, the router dynamically forwards a single content input to **platform-specific AI agents**.

Each agent is configured with:

- dedicated system prompts,
- platform-specific output schemas,
- formatting and length constraints.

This enables the automatic generation of tailored content for LinkedIn, Instagram, Facebook, X (Twitter), Threads, and YouTube Shorts, while maintaining consistent brand messaging.

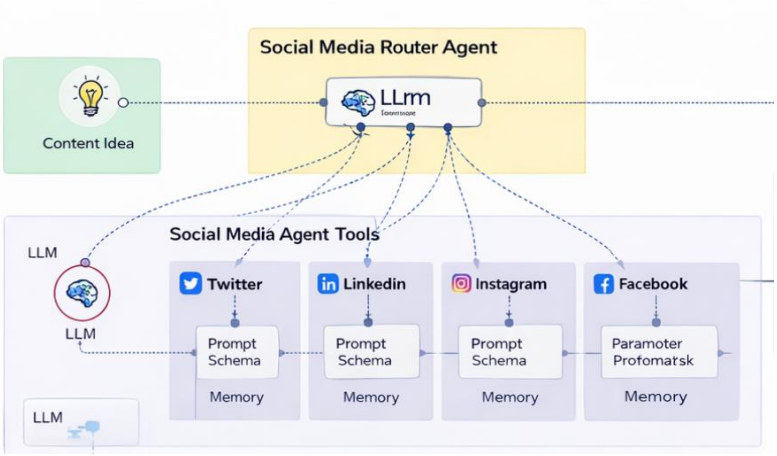


Figure 2: Social Media Router Agent with platform-specific AI agents

This component confirms the solution's ability to manage **multi-platform digital communication from a single control point**, a key operational benefit for SMEs.

5.3.3. AI Content and Image Generation Layer

The content generation layer, presented in **Figure 3**, combines structured text generation with AI-based image creation. Content prompts and output schemas are composed dynamically from external sources, allowing flexible adaptation without code changes.

The workflow includes:

- AI-generated platform-optimised text content,
- automatic generation of matching visual assets,
- schema validation prior to approval and publishing.

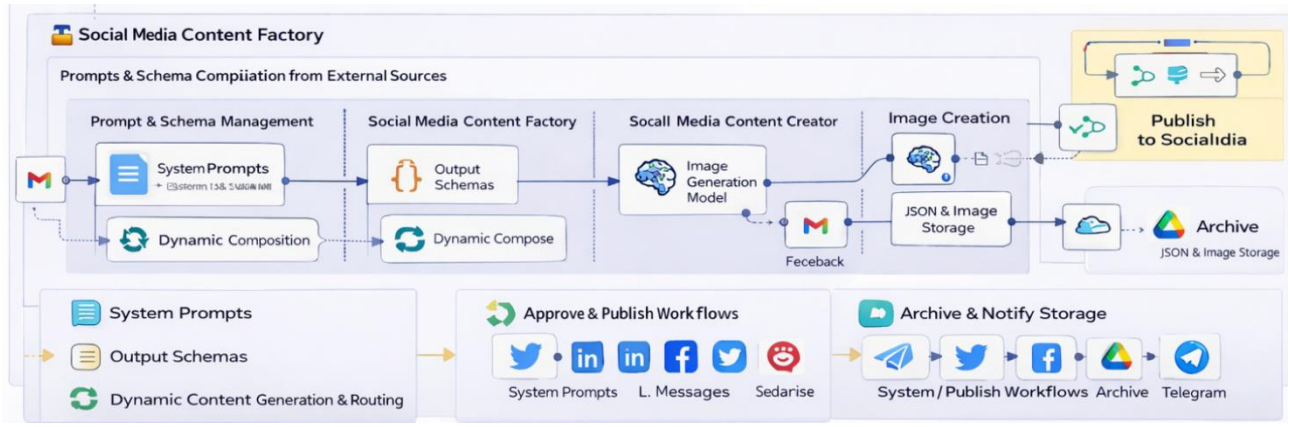


Figure 3: AI-based content and image generation layer

This layer was actively used during the pilot to generate real communication materials for LDK Tech and validated the feasibility of replacing manual copywriting and graphic design processes.

5.3.4. Approval Workflow and Human-in-the-Loop Control

Before publication, all generated content passes through a **mandatory human approval stage**, ensuring editorial control and compliance with company communication standards.

As shown in **Figure 4**, the approval process includes:

- automatic preparation of approval requests,
- delivery via email (Gmail integration),
- controlled release of content only after user approval.

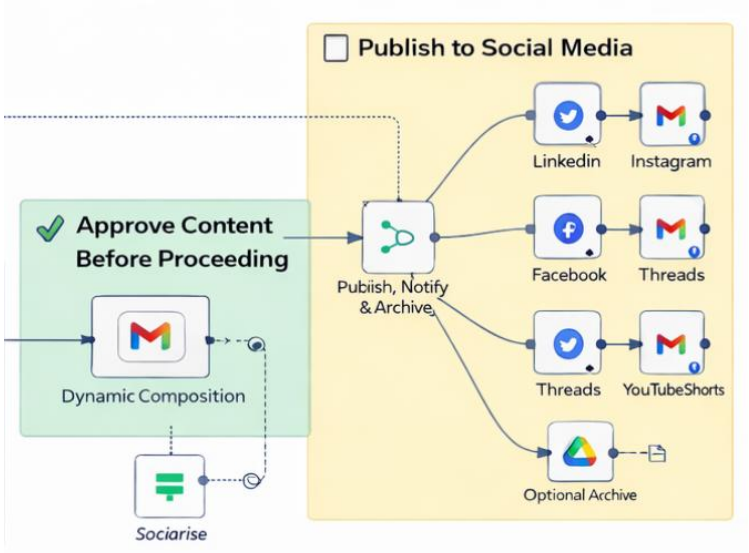


Figure 4: Content approval workflow with email-based human validation

This human-in-the-loop mechanism proved essential for user trust and acceptance and represents a critical element of the real-world implementation.

5.3.5. Publishing, Notifications, and Content Archiving

Once approved, content is automatically published to the selected social media platforms. The final stage of the workflow, illustrated in **Figure 5**, includes:

- platform-specific publishing connectors,
- real-time workflow status notifications via Telegram,
- automatic archiving of posts and images to Google Drive.

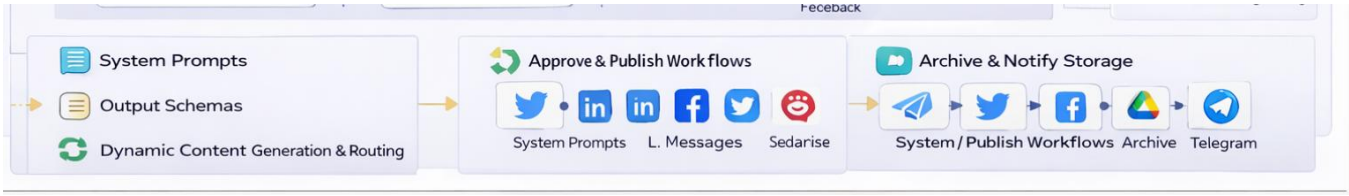


Figure 5 Publishing, notification, and archiving components of the implemented workflow

This stage ensures transparency, traceability, and reusability of content, supporting both operational efficiency and compliance requirements.

5.3.6. Operational Use and Validation at LDK Tech

The deployed workflow was used by **LDK Tech** for real communication activities during the pilot period. The solution replaced previously manual, fragmented processes and enabled the company to:

- maintain a regular multi-platform social media presence,
- reduce time spent on content creation and publishing,
- improve consistency of messaging and visual identity,
- manage communication tasks without technical expertise.

The pilot confirms that the solution is **operationally viable**, **user-accepted**, and **replicable across other SMEs**, fulfilling the objectives of the GREENE 4.0 pilot activity.

5.4. Step 4 – Matchmaking via B2GreenHub

The connection between CreativIQ and LDK Tech was facilitated through the B2GreenHub platform, ensuring alignment between the solution's capabilities and the solution seeker's needs. The facilitator supported initial coordination and definition of the pilot scope, objectives, and timeline.

The pilot focused on validating usability, content quality, time savings, and overall operational fit rather than quantitative performance metrics.

6. Roles and Responsibilities

- CreativIQ, Niko Kirič s.p.: Responsible for configuring, deploying, and supporting the pilot solution, and for collecting feedback related to system functionality.
- LDK Tech, Dejan Lorber s.p.: Acted as pilot user, tested the solution in real operational conditions, and provided structured feedback on usability and value.
- Pomurje Technology Park (PTP): Acted as facilitator, ensuring methodological compliance, coordination between parties, and alignment with GREENE 4.0 objectives.

7. Pilot Results and Outcomes

The pilot confirmed that the CreativIQ solution can be successfully implemented in an SME operational environment. Key outcomes include:

- Significant reduction in time required for social media content creation and publishing
- Improved consistency of messaging and visual identity across platforms
- High usability for non-technical users
- Clear potential for scalability and replication in other SMEs

From the solution seeker's perspective, the pilot demonstrated tangible operational benefits and reduced dependency on manual marketing processes. From the solution provider's perspective, the pilot validated real-world applicability and strengthened market readiness.

8. Contribution to GREENE 4.0 Objectives

The pilot contributes directly to the GREENE 4.0 objectives by:

- Creating a new national digital value chain between a solution provider and solution seeker
- Validating a digital transformation solution in a real SME environment
- Supporting behavioural change and user acceptance of AI-driven digital tools
- Providing evidence-based input for future policy recommendations under WP4

9. Conclusions and Next Steps

The pilot implementation of the CreativIQ Content Factory at LDK Tech was successfully executed in line with the GREENE 4.0 Pilot and Testing Methodology. The activity demonstrated the feasibility, relevance, and value of the solution for SMEs and confirmed its readiness for further scaling and replication.

Next steps may include extended pilot duration, onboarding of additional SMEs, further refinement of analytics and reporting features, and preparation for broader market uptake and investment.

Interreg CENTRAL EUROPE

Co-funded by the European Union

GREENE 4.0

D3.4.2: Pilot and testing report – Czech Republic

Implementation of a Real-Time MES Monitoring Solution at COLORplastic, spol. s r.o.

1. Executive summary

This document presents the implementation report of the pilot activity carried out under Activity 3.4 – Piloting and testing of new GREENE 4.0 value chains within the GREENE 4.0 project.

The pilot focused on the deployment and testing of a real-time MES monitoring solution developed by Noxem s.r.o. in a real operational environment provided by COLORplastic, spol. s r.o., a Czech SME operating in plastic injection moulding for the automotive sector.

The pilot was implemented in accordance with the GREENE 4.0 Pilot and Testing Methodology (Deliverable D3.4.1) and followed the structured B2GreenHub client journey. The objective was to validate the operational feasibility, usability and value of a digital production monitoring solution in SME conditions and to demonstrate the creation of a new national smart and green value chain.

2. Introduction and Context

The GREENE 4.0 project supports SMEs in their green and digital transition by generating, testing and validating new smart and sustainable value chains.

Activity 3.4 focuses on validating innovative digital and green solutions developed within the GREENE 4.0 Innovation Programmes by implementing them in real operational environments.

This report documents one national pilot implemented in the Czech Republic, connecting:

- a Czech solution provider (Noxem s.r.o.)
- a Czech manufacturing SME (COLORplastic, spol. s r.o.)

The pilot represents a national digital value chain within the plastics and automotive manufacturing cluster and contributes to GREENE 4.0 objectives by supporting Industry 4.0 transition and resource efficiency in plastic injection moulding processes.

The specific objectives were:

- To implement the Noxem MES solution in a real injection moulding environment
- To validate usability and integration into daily manufacturing workflows
- To assess operational transparency improvements
- To support TRL progression through real-world deployment
- To demonstrate the creation of a new national digital value chain

3. Pilot Participants

3.1. Solution Provider

Company name: Noxem s.r.o.
Country: Czech Republic
Role: Solution provider
Solution: Real-time MES production monitoring system

Noxem s.r.o. provides a simple and scalable MES solution for real-time monitoring of manufacturing processes. The system automatically collects machine data via proprietary hardware and visualises key production indicators in a web-based interface.

3.2. Solution Seeker / Pilot Environment

Company name: COLORplastic, spol. s r.o.
Country: Czech Republic
Role: Solution seeker / pilot host

COLORplastic is an SME specialised in injection moulding of plastic components and assembly for the automotive sector. The company operates modern ENGEL injection moulding machines and focuses on quality, efficiency and continuous process improvement.

4. Description of the Piloted Solution

The piloted solution is a real-time MES monitoring system designed to increase transparency of injection moulding operations.

The system includes:

- Installation of proprietary data-collection hardware on selected ENGEL injection moulding machines
- Automatic detection of machine states (running, idle, downtime)
- Monitoring of production cycles and output
- Centralised data storage
- Web-based dashboard visualisation

The solution enables real-time monitoring of:

- Machine utilisation rates
- Duration and frequency of downtime
- Production cycles
- Output per machine

- Production deviations

The system was configured specifically for plastic injection moulding processes, ensuring compatibility with SME operational conditions without major disruption.

5. Pilot Methodology and Implementation Process

The pilot followed the GREENE 4.0 Pilot and Testing Methodology (D3.4.1) and the structured B2GreenHub client journey.

5.1. Step 1

Both Noxem and COLORplastic were onboarded into the B2GreenHub ecosystem. The facilitator (ICUK) ensured alignment of expectations and pilot scope definition.

5.2. Step 2

An initial assessment was conducted to identify:

- Current data availability
- Existing manual recording processes
- Key inefficiencies in injection moulding operations

Relevant KPIs were defined:

- Machine utilisation
- Downtime duration and frequency
- Production cycle time
- Output per shift

This phase confirmed the need for automated real-time data collection.

5.3. Step 3

The implementation included:

- Installation of Noxem's data-collection hardware on selected ENGEL machines
- Configuration of machine-state detection logic
- Setup of centralised web interface
- Calibration and initial testing

The deployment was carried out without significant production interruption.

5.4. Step 4

The solution was tested during regular production operations.

Validation focused on:

- Accuracy of machine-state detection
- Stability of data transmission
- Usability of dashboards
- Practical relevance of monitored KPIs

The pilot confirmed:

- Improved visibility of downtime
- Identification of previously unnoticed idle periods
- Establishment of measurable production baseline data

The solution demonstrated operational robustness and SME compatibility.

6. Roles and Responsibilities

Noxem s.r.o.
Responsible for hardware installation, software configuration, system calibration and technical support.

COLORplastic, spol. s r.o.
Provided operational environment, tested the system in real production, and provided structured feedback.

ICUK (PP6)
Acted as facilitator, ensuring compliance with D3.4.1 methodology, coordination between parties and alignment with GREENE 4.0 objectives.

7. Contribution to GREENE 4.0 Objectives

The pilot contributes to GREENE 4.0 by:

- Creating a new national digital value chain in the plastics manufacturing sector
- Supporting digital transformation of an SME in automotive supply chain
- Increasing operational transparency and data-driven decision-making
- Supporting resource efficiency and reduction of material waste through better process monitoring
- Contributing to Industry 4.0 transition in traditional manufacturing sectors

8. Conclusions and Next Steps

The pilot successfully demonstrated that a scalable MES solution can be deployed in SME plastic injection moulding operations without major disruption. The pilot contributed to increasing the Technology Readiness Level (TRL) of the solution by validating its performance in a real industrial environment. ICUK (PP6) acted exclusively as facilitator and methodological coordinator of the pilot process, ensuring alignment with Deliverable D3.4.1 and coordination between the solution provider and the host. The tested digital solution was implemented directly between Noxem s.r.o. and COLORplastic, spol. s r.o.,

Key outcomes:

- Real-time visibility of machine utilisation
- Identification of downtime patterns
- Improved transparency of injection moulding performance
- Creation of baseline KPIs for further optimisation

Next steps:

- Expansion of monitoring to additional machines
- Integration of advanced analytics and OEE calculations
- Deeper analysis of scrap rate correlations
- Exploration of energy consumption integration
- Replication in other Czech manufacturing SMEs

The pilot confirms the feasibility of building smart and green value chains in the Czech plastics manufacturing cluster and supports further scaling within the GREENE 4.0 ecosystem.

Interreg CENTRAL EUROPE

Co-funded by the European Union

GREENE 4.0

D3.4.2: Pilot and testing report - Germany

Implementation of DIREKT digital companion solution for hybrid electric engines at CHESCO GmbH

1. Executive summary

This document presents the implementation report of the pilot activity carried out by PP2 within the GREENE 4.0 project. The pilot focused on the implementation of a digital companion solution for hybrid electric engines at CHESCO GmbH, a demonstrator and incubator.

The pilot was implemented in accordance with the GREENE 4.0 Pilot and Testing Methodology (Deliverable D3.4.1) and followed the structured B2GreenHub client journey. The objective of the pilot was to validate the operational usability, effectiveness, and user acceptance of the solution in a real SME context, contributing to the creation of a new digital value chain between a solution provider and a solution seeker at national level.

2. Introduction and Context

The GREENE 4.0 project aims to support SMEs in their green and digital transformation by creating, testing, and piloting new sustainable value chains. Within this framework, Activity 3.4 focuses on validating innovative solutions developed through the GREENE 4.0 Innovation Programmes by implementing them in real operational environments.

The pilot activity is part of Work Package 3 (WP3) of the GREENE 4.0 project, specifically Activity 3.4 – Piloting and testing of new GREENE 4.0 value chains. The objective of this activity is to test and validate innovative green and digital solutions developed through the Innovation Programmes by implementing them in real operational environments of manufacturing or service-oriented SMEs.

This report documents one national pilot implemented in Germany, connecting a solution provider selected through the GREENE 4.0 Innovation Contest with a solution seeker (in this case, a pilot environment). The pilot described in this report represents a national pilot value chain, connecting an German solution provider (DIREKT project) with an German solution seeker (CHESCO GmbH). This collaboration contributes to the GREENE 4.0 objective of fostering sustainable and digital transformation through structured matchmaking and real-world testing supported by the B2GreenHub ecosystem.

The scope of this pilot was to test and validate a digital companion solution for lifecycle and performance tracking in hybrid electric engines in a simulated, but realistic SME operational context. The specific objectives were:

- To implement DIREKT solution in a realistic business environment
- To assess usability and user acceptance by a typical SME user (line worker or service staff)
- To validate operational feasibility and integration into production workflows
- To demonstrate the creation of a new national digital value chain
- To support TRL progression through real-world testing

3. Pilot Participants

3.1. Solution Provider

Project name: DIREKT ("Digitaler Lebenszyklus (hybrid-)elektrischer Antriebssysteme")
Country: Germany
Role: Solution provider
Solution: Digital life cycle of (hybrid) electric drive systems

DIREKT is a research project at BTU Cottbus aimed at improving how (hybrid-)electric propulsion systems are assembled and supported by piloting connected digital solutions that link engineering intent with real shopfloor execution. Its main objective is to develop an assembly-centered approach that keeps product data and step-by-step instructions consistent, while capturing evidence from the line to validate key steps and quality. A central outcome is the "Assembly Companion" in a shared 3D environment, used for clearer worker guidance and immersive training. By closing the loop between planned processes and what actually happens during assembly, this solution can reduce errors, strengthen traceability, and make improvements easier to carry into future builds.

3.2. Solution Seeker / Pilot Environment

Company name: CHESCO GmbH
Country: Germany
Role: Pilot environment

CHESCO GmbH was founded to strengthen the transfer of university knowledge and technology into industry and funded programs. It participates as a partner in research initiatives and operates using the infrastructure of the CHESCO research factory. CHESCO has a dedicated test area for electro-mechanical drive systems and components, as well as specialized environments (for example climatic/pressure chambers or vibration and shock testing facilities).

4. Description of the Piloted Solution

The piloted solution is a type of "digital companion" for assembling modern (hybrid-)electric propulsion systems. It creates a continuously updated digital representation of the product and the assembly process, linked to what is happening on the factory floor. The goals are to help workers assemble complex systems more reliably, to reduce avoidable mistakes, and to make it easier to understand and document what was done. In the background, it follows the idea that a product has a digital counterpart (or twin) across its entire lifecycle so lessons learned during assembly can improve later builds and even future maintenance.

At the planning and engineering level, the solution brings together the information that defines what should be built (such as product structure, technical requirements, step-by-step assembly instructions etc.) so it stays consistent even when designs change. Instead of relying on scattered documents and manual updates, this approach keeps the "official" version of the process synchronized across teams. That reduces misunderstandings between engineering and production and makes it easier to roll out improvements. In simple terms, it's about guaranteeing that everyone sees the same, current guidance and that updates can flow through without confusion.

On the shopfloor, the solution connects to equipment and sensors that can observe and record key parts of the assembly process. For example, cameras and control systems can capture evidence that certain steps were performed correctly and provide signals that help validate quality. This supports traceability (being able to answer "what happened, when and how") and makes it easier to spot deviations early, before they turn into expensive rework. The approach is especially useful when precision is of particular importance. If parts must be aligned or fitted within tight limits, the system can provide live confirmations that the expected tolerances are being met and provide clearer feedback when something looks off.

To make guidance easier to follow and training more effective, the solution also uses an interactive 3D environment that can be viewed on an AR headset for learning or real-time support. Workers can see assembly steps visually rather than interpreting dense manuals, and they can practice procedures virtually before working on real hardware. The pilot solution also explores fast ways to create digital versions of real workspaces so the virtual scene matches the physical environment closely, which improves orientation and reduces the "translation effort" between training and reality. Over time, this approach helps make assembly work more consistent and easier to scale, while also improving how know-how and quality evidence are carried forward into later builds.

5. Pilot Methodology and Implementation Process

This chapter documents the actual technical and operational implementation of the DIREKT solution at CHESCO GmbH, based on the real deployed workflow used during the pilot.

5.1. Step 1 - Initial matching and compatibility assessment

At the beginning of the piloting process, CHESCO GmbH was identified as a potential good candidate for a pilot implementation of the DIREKT solution, and contacted to that effect. The teams from both piloting participants then communicated bilaterally to ensure a good compatibility between the requirements of the solution and the capabilities of the piloting labs provided by CHESCO. At the end of this exchange, the DIREKT team was happy to begin working with CHESCO both due to their geographic proximity to each other and CHESCO's status as a well-established and trusted incubation and piloting environment.

5.2. Step 2 - Prepare digital companion for concrete use case

After all initial doubts and questions had been clarified, the DIREKT team began to prepare their solution for the implementation at CHESCO. The initial subject of this implementation was an engine typical for the intended practical applications of the companion, which had been provided by an industry partner. This step therefore included periods of familiarization with the technical parameters, installation of measuring equipment, and validation of the measured outputs.

5.3. Step 3 - Practical application and user acceptance assessment in operational environment

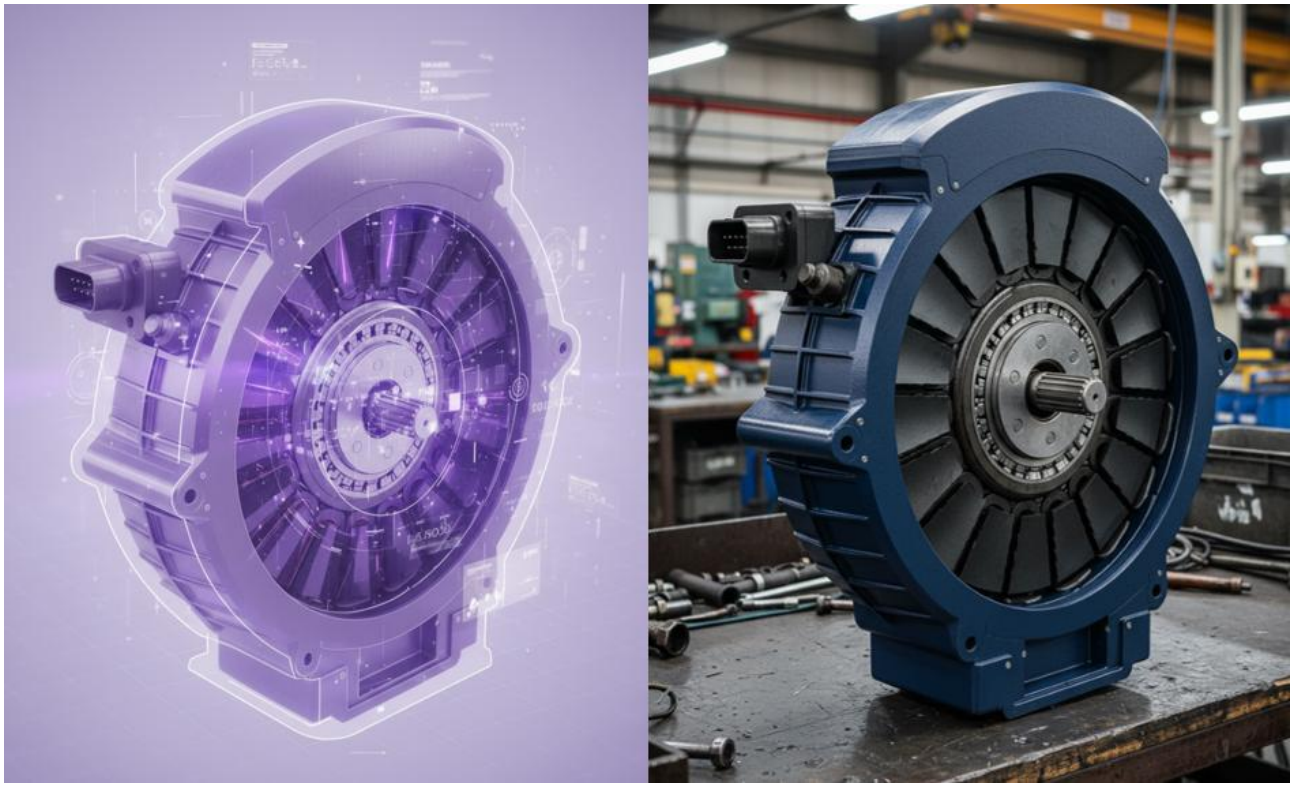
Following this initial validation, the teams then prepared the assembly use case, as one of the main areas of application for the digital companion will be during the assembly process itself. On a test production line, the engine construction process was implemented and successfully integrated with the DIREKT equipment, allowing the DIREKT team to ensure not only the operational validity of the solution, but also its user acceptance. For the latter topic, they focused on identifying potential issues such as ergonomics (e.g. weight of AR glasses during sustained use) and lack of flexibility for short-term adjustments in the production process. One of the target benefits of the solution is to enable rapid iterating and introduction of adjusted models (including, eventually, products beyond the initial focus of hybrid electric engines), so ensuring that the theoretically conceived systems would be able to handle such applications in practice was an important validation step.

A similar process was also completed for the servicing process, which takes place up to years after the assembly and includes a different, for practical reasons somewhat reduced set of sensoring equipment. This implementation was also successful, following a number of adjustments in the system.

5.4. Step 4 - Final validation and documentation of pilot deployment

After all major open issues had been addressed and all tests had been run, DIREKT and CHESCO team members finalized their own documentation of the piloting and testing process and marked the piloting phase as successfully completed. In its role as an incubator for new technological solutions, including

from a university context, CHESCO also agreed to further support the DIREKT team going forward, including regarding the eventual broadening of the solution's scope by applying it to other product categories.



6. Roles and Responsibilities

- DIREKT: Responsible for configuration and deployment of pilot solution, including monitoring of testing processes, as well as creating methodologies for them.
- CHESCO GmbH: Provider of piloting lab / testing environment with realistic operational conditions, as well as subject experts with ability to provide feedback on usability and output validity.
- TGZ Bautzen: Acted as facilitator and project companion, supporting coordination between parties and ensuring compatibility with GREENE 4.0 objectives.

7. Contribution to GREENE 4.0 Objectives

This pilot directly contributes to GREENE 4.0 objectives by:

- Validating a new and transformative technological solution in a realistic operational environment
- Enabling user acceptance for more digital and more efficient production processes
- Supporting the creation of new value chains in the context of the digital transformation in the Central European manufacturing sector

8. Conclusions and Next Steps

The pilot implementation of the DIREKT project's digital companion at CHESCO GmbH was successfully executed, in accordance with the GREENE 4.0 Pilot and Testing methodology. Works within this activity were able to demonstrate feasibility, relevance and value of the solution and confirmed its readiness for further scaling, adaptation to new processes, and replication.

The pilot validated the implementation of a digital companion in the assembly and servicing of hybrid electric engines as a tool for faster and more efficient manufacturing processes and (by enabling more effective monitoring and servicing and, through this, longer lifecycles) more sustainability.

Next steps may include:

- Broadening the scope of the solution for application in other manufacturing areas
- Implementing and further commercializing the solution by working with additional partners
- Performing additional and more extensive usability / user acceptance testing in more diverse environments than the demonstrator labs were able to provide
- (Longer term) Further enhancing system flexibility and autonomy by upgrading software and equipment

Interreg CENTRAL EUROPE

Co-funded by the European Union

GREENE 4.0

D3.4.2: Pilot and testing report - Austria

Implementation of a life cycle analysis

1. Executive summary

This report presents the Austrian pilot activity under the GREENE 4.0 project. The planned pilot aimed at implementing a Life Cycle Analysis (LCA) for planlicht GmbH, to be conducted by the Institute for Sustain & Estate of FH Kufstein Tirol. The objective was to assess environmental impacts of selected lighting products and support structured sustainability management.

Following successful matchmaking and initial agreement within the B2GreenHub ecosystem, the solution provider confirmed full operational readiness to initiate the pilot.

However, after receiving a negative funding decision and conducting internal strategic reassessment, planlicht decided not to initiate additional projects during the current business year.

Consequently, the pilot did not proceed to technical implementation.

The case provides relevant insight into real-world SME decision-making dynamics in sustainability investments under resource constraints.

2. Introduction and Context

Within WP3 – Activity 3.4 of GREENE 4.0, pilot activities aim to validate green and digital solutions in real SME environments.

In Austria, the planned pilot intended to establish a national green value chain between:

- a regional research institution (FH Kufstein Tirol)
- and an Austrian SME in the lighting sector (planlicht GmbH)

The proposed activity focused on conducting a Life Cycle Analysis to:

- increase transparency on environmental impacts
- support sustainable product development
- strengthen strategic sustainability positioning

The pilot was aligned with GREENE 4.0 objectives of fostering sustainable transformation in SMEs.

3. Pilot Participants

3.1. Solution Provider

Institute for Sustain & Estate | FH Kufstein Tirol Bildungs GmbH | Austria

The institute provides expertise in sustainability assessment, environmental impact analysis and life cycle methodologies. The institute confirmed its availability and readiness to conduct the LCA once formal approval and project confirmation were secured

3.2. Solution Seeker / Pilot Environment

Planlicht GmbH | Austria

Planlicht is an Austrian lighting manufacturer with interest in strengthening its sustainability strategy through structured environmental assessment.

4. Description of the Piloted Solution

The proposed pilot foreseen the implementation of a Life Cycle Analysis (LCA) methodology for selected lighting products of planlicht.

The planned approach would have included:

- definition of goal and scope
- establishment of system boundaries
- structured data collection
- environmental impact assessment
- identification of improvement potentials

The activity was designed to generate transparency regarding environmental impacts and to provide a structured foundation for future sustainability reporting and product optimization.

However, the methodological work had not yet started at the time the collaboration was discontinued.

5. Conclusions and Next Steps

The Austrian pilot successfully completed the matchmaking and alignment phase under the GREENE 4.0 framework.

The solution provider demonstrated readiness to initiate the Life Cycle Analysis implementation. However, due to funding-related uncertainty and subsequent strategic reprioritization, the solution seeker decided not to proceed with the pilot execution.

This case highlights a critical aspect of SME sustainability transformation: investment decisions in environmental assessment tools are strongly influenced by short-term financial certainty and internal resource allocation.

Future collaboration remains possible if economic and strategic conditions improve. The proposed LCA approach remains conceptually transferable and could be activated at a later stage.