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# SUSTAINABLE PACKAGING IN PRACTICE – HOW D4PACK SUPPORTS THE SME SECTOR

## ZRÓWNOWAŻONE OPAKOWANIA W PRAKTYCE – JAK D4PACK WSPIERA SEKTOR MŚP

**ABSTRACT:** The article presents the concept and implementation process of the international research project D4PACK, aimed at supporting small and medium-sized enterprises in designing sustainable packaging. The main outcome of the project will be a decision-support tool for packaging selection based on environmental, economic, and technological data. The results of the first pilot phase, conducted in four Central European countries, are discussed, along with the most common barriers to implementing sustainable solutions in SMEs. Special attention is given to the regulatory context (PPWR, SUP, CSRD) and the role of project partners in creating and testing the tool. D4PACK addresses the urgent need for decision-making support for companies lacking their own R&D resources.

**Key words:** D4PACK, EGET, sustainable packaging, PPWR, circular economy, SME, risk analysis, packaging decisions, Interreg, agri-food sector, environmental innovations

**STRESZCZENIE:** Artykuł przedstawia założenia oraz przebieg realizacji międzynarodowego projektu badawczego D4PACK, którego celem jest wsparcie małych i średnich przedsiębiorstw w projektowaniu zrównoważonych opakowań. Głównym rezultatem projektu będzie narzędzie wspomagające podejmowanie decyzji opakowaniowych w oparciu o dane środowiskowe, ekonomiczne i technologiczne. Omówiono rezultaty pierwszej fazy pilotażu, prowadzonego w czterech krajach Europy Środkowej, oraz wskazano najczęściej występujące bariery wdrażania zrównoważonych rozwiązań w MŚP. Szczególną uwagę poświęcono kontekstowi regulacyjnemu (PPWR, SUP, CSRD) oraz roli partnerów projektu w tworzeniu i testowaniu narzędzia. D4PACK stanowi odpowiedź na pilną potrzebę wsparcia decyzyjnego dla firm nieposiadających własnych zasobów badawczo-rozwojowych.

**Słowa kluczowe:** D4PACK, EGET, opakowania zrównoważone, PPWR, circular economy, MŚP, analiza ryzyka, decyzje opakowaniowe, Interreg, sektor rolno-spożywczy, innowacje środowiskowe

### INTRODUCTION

The modern packaging industry stands at a critical turning point. Under growing regulatory pressure, consumer demands, and global environmental challenges, companies in the agri-food sector must rethink their approach to packaging design and use. It is no longer only about aesthetics, functionality, and

price – today, climate impact, recyclability, and compliance with increasingly strict EU regulations are equally important.

According to the proposed new Packaging and Packaging Waste Regulation (PPWR, COM(2022) 677) of the European Parliament and Council, by 2030 all packaging placed on the EU market must be recyclable, and its weight and volume must

be reduced to a minimum. At the same time, more and more enterprises are subject to the Corporate Sustainability Reporting Directive (CSRD), which includes reporting on packaging's environmental impact. The industry thus faces a dual challenge: to act responsibly while keeping pace with regulatory and market demands.

Large corporations have their own R&D departments, employ LCA, ESG, and compliance specialists, and draw on legal and strategic consultancy. In contrast, small and medium-sized enterprises – which make up 99% of companies in the EU – often lack such resources. In practice, this means making decisions under uncertainty, without access to tools that would enable reliable comparison of packaging options from environmental, economic, and logistical perspectives.

D4PACK was created precisely to meet these needs – an international research initiative implemented under the Interreg Central Europe programme. Its goal is to develop tools to help SMEs make informed, data-based packaging decisions rather than relying on guesswork. The project aims to produce a digital tool that will allow companies to easily assess risks, costs, and benefits of different packaging strategies.

### CHALLENGES FOR SMES IN THE CONTEXT OF SUSTAINABLE PACKAGING

For SMEs operating in the food sector, packaging transformation is not only an environmental issue but also an organisational, financial, and strategic challenge.

Firstly, many companies lack specialist knowledge in materials science, life cycle assessment (LCA), or EU regulatory compliance. Decisions are often based on intuition, supplier marketing claims, or pressure from retail chains. This creates a risk of investing in solutions that do not deliver real environmental benefits – or even worsen the situation (e.g., supposedly “eco” compostable films without industrial processing infrastructure).

Secondly, implementing new packaging requires testing, analysis, and time – all of which generate costs that smaller firms cannot bear without external support. There is a lack of tools to quickly compare scenarios: What happens if we change

the grammage? Is it worth investing in monomaterials? How will the unit cost and raw material availability change?

Thirdly, regulatory changes are rapid and unpredictable. Instead of strategic planning, SMEs often act reactively – implementing changes only when facing fines or contract risks.

The D4PACK project seeks to level the playing field – giving companies a tool to make decisions as effectively as global players, but with far smaller budgets and lead times.

### D4PACK – ORIGINS, GOAL, PARTNERS

D4PACK is a joint initiative of research institutions, industry organisations, and technology partners from five Central European countries. Its overarching aim is to develop a decision-support tool for SMEs designing sustainable packaging.

The project leader is Confindustria Verona, and the consortium includes: Cracow University of Economics, Łukasiewicz – Łódź Institute of Technology, Campden BRI Hungary, PROMA-PACK Ltd, Innoskart, the Slovenian Chamber of Agriculture and Forestry, and the Czech Federation of Food Industries. PwC – a leading global consulting firm with experience in risk analysis, sustainability, and strategic business advisory – serves as an advisory partner.

Some partners are responsible for research and testing, others for implementation aspects, and PwC for innovation risk assessment. This multi-layered structure ensures scientific robustness on the one hand and market usability on the other. D4PACK is funded under the Interreg Central Europe programme and is based on the concept of an integrated Technology Transfer Service (TTS), at the heart of which will be the EGET tool.

### EGET – A DIGITAL COMPASS FOR SMES

EGET is a digital tool designed to help SMEs evaluate packaging in terms of sustainability compliance, cost-effectiveness, and implementation risk.

The tool will be available online and based on a database enabling the analysis of various packaging scenarios. By answering a series of questions, the user will receive recommendations on material choice, design strategy, and regulatory compliance. EGET is not a full-scale LCA tool

but a practical interface tailored to SME resources and competencies, supporting operational decision-making.

## PILOT ACTIONS

### – TESTING THE TOOL IN SME REALITIES

One of the key elements of D4PACK is pilot testing – practical trials of the decision-support system (DSS) in real SME environments within the packaging sector. The activities are divided into two stages:

1. **Stage 1** – Case studies of 12 companies from Italy, Hungary, Czechia, and Slovenia. Partners conducted in-depth interviews and scenario analyses to understand current needs, limitations, and expectations regarding packaging.
2. **Stage 2** – Testing the EGET beta version in 60 companies, assessing interface quality, accuracy of results, and potential for application in real purchasing and production processes.

Pilot coordination is led by Łukasiewicz – ŁIT. Testing is scheduled to conclude in autumn 2025, with the final version of EGET to be made available on an open-access basis as part of the integrated TTS platform.

The pilots involved dozens of agri-food companies from the meat, dairy, and fruit-vegetable industries – sectors selected for their sensitivity to product shelf life, logistics, sanitary requirements, and the need for strong protection against external factors.

### MEAT SECTOR

For meat processing companies, the main issues were extending product shelf life while reducing plastic content. Vacuum and modified atmosphere packaging (MAP) remain dominant technologies, often requiring multi-layer film structures that are difficult to recycle but ensure tightness and microbiological safety.

Firms reported limited access to alternative materials meeting quality, logistics, and environmental requirements simultaneously. Cost constraints were another significant barrier, with most “eco” options entailing a substantial increase in unit costs.

### DAIRY SECTOR

Challenges in the dairy sector primarily concerned ensuring microbiological protection for sensitive products (e.g., yogurts, curd cheese) and maintaining packaging stability under varying temperature conditions – particularly in export to regions with unstable infrastructure. Smart labelling to improve shelf-life management and batch identification was also important.

### FRUIT AND VEGETABLE SECTOR

Fruit and vegetable packers focused on reducing packaging materials and using paper and cardboard as plastic alternatives. Ventilation (e.g., via film perforation) and moisture control were critical, especially for fresh produce requiring natural “breathing.”

## COMMON BARRIERS IDENTIFIED IN PILOTS

Despite sectoral and local differences, pilot actions revealed common challenges across SMEs in Central Europe:

- High cost of sustainable materials, especially per unit of product.
- Limited technical information on alternative packaging and lack of unified comparison standards.
- Technological constraints from existing machinery – e.g., incompatibility with new materials.
- Difficulty in assessing economic feasibility – need for simple tools to calculate costs and benefits during planning.
- Need for educational support and access to expert knowledge, including legal regulations such as PPWR and the Single-Use Plastics Directive (SUP).

Partners are now analysing these barriers and tested solutions to adapt EGET’s functions to actual SME needs and ensure its effectiveness across varied operating conditions.

## CONCLUSIONS AND OUTLOOK

D4PACK stems from the belief that the shift toward sustainable packaging must not remain the privilege of large corporations. SMEs also need support in navigating the complex landscape of regulations, costs, technologies, and consumer expectations. Without analytical tools and expert backing, packaging decisions are often intuitive, reactive, or random – slowing down the green transition of the agri-food sector as a whole.

## Konferencja naukowa

# PRZYSZŁOŚĆ I WYZWANIA RYNKU OPAKOWAŃ

Zapraszamy na konferencję poświęconą kluczowym zagadnieniom związanym z rozwojem rynku opakowań, takim jak ekoprojektowanie, biotworzywa, recykling, wpływ opakowań na zdrowie oraz regulacje Unii Europejskiej (PPWR, SUP).

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With EGET, companies will be able to quickly, reliably, and affordably compare different packaging options in terms of cost, risk, and environmental or regulatory compliance. While EGET will not replace business decisions, it will ground them in solid data rather than assumptions.

Although the project focuses on the food sector, the D4PACK methodology and the tool itself can also be successfully applied in cosmetics, pharmaceuticals, or chemicals. Long-term plans include expanding the database to cover paper and glass packaging and integrating it with B2B platforms, digital product passports, and systems monitoring secondary raw material availability.

The TTS platform, with EGET at its core, could serve not only as an operational tool but also as an advisory and educational hub. Plans include integrating it with regional technology support systems, innovation incubators, and material clusters – democratising access to the knowledge and competencies needed for informed decision-making.

D4PACK will not solve all the packaging industry's problems, but it can remove one of SMEs' main growth barriers: the lack of access to knowledge and data at the decision-making moment. And that is already a significant leap forward.

## REFERENCES AND SOURCES

1. Interreg Central Europe, D4PACK project – official project website: <https://www.interreg-central.eu/projects/d4pack>
2. Cracow University of Economics: Challenges of Sustainable Packaging in the Agri-Food Sector. Research Results of the D4PACK Project, 2024, <https://uek.krakow.pl>
3. D4PACK Proposal (Application Form), approved version, 2023 [consortium internal document]
4. European Parliament and Council of the EU, Proposal for a Regulation on Packaging and Packaging Waste (PPWR), COM(2022) 677 final
5. PwC, working materials – innovation risk assessment component in the D4PACK project, 2024
6. Łukasiewicz – Łódź Institute of Technology, Pilot Scenarios and Interim Report on EGET Tool Testing, 2025 [project materials]
7. European Commission, Packaging Waste – Facts and Figures, [ec.europa.eu/environment](https://ec.europa.eu/environment)