



**GIANT
LEAPS**

POLICY BRIEF 9

Circularity in alternative protein production



OBJECTIVE

Alternative proteins including plants, insects, microalgae, microbial products, and cultivated meat, offer a pathway to a low-carbon, resource-efficient EU food system that aligns with the European Green Deal, Farm to Fork Strategy, and Circular Economy Action Plan. The GIANT LEAPS project assessed circularity potentials of alternative protein sources, revealing untapped potential in valorising biowaste into nutrient-retaining feedstocks, which can reduce GHG emissions, land use, and import dependency while fostering resilient regional value chains. Lack of incentives for circularity assessments and barriers to waste-derived substrates under Novel Foods rules hinder progress, while logistical challenges limit scale-up. This policy brief, informed by alternative protein producers and the GIANT LEAPS sustainability and circularity assessments, offers three recommendations: (1) incentivise transparent circularity assessments with nutrient metrics and open data platforms; (2) support eco-design and regional waste-to-protein partnerships; (3) enable tiered, risk-proportionate innovation for new substrates via streamlined authorisations.

KEY POLICY RECOMMENDATIONS

A dietary shift from animal-based proteins to alternative proteins is expected to reduce the environmental impact of food production and consumption. However, this transition also presents potential concerns on food circularity that must be addressed proactively.

Recommendations and Call for Action

1. Provide incentives for assessment of circularity potential

- ✓ Encourage disclosure of nutrient recovery and biotransformation data
- ✓ Incentivise open data sharing via preferential access to public research and development (R&D) funding
- ✓ Expand EU-supported data platforms and accessibility of assessment results (such as GIANT LEAPS cloud data platform) for researchers, policymakers, and small and medium enterprises (SMEs)
- ✓ Establish clear rules on data confidentiality to protect sensitive business information

2. Provide support for enhancing circularity in alternative protein production

- ✓ Incentivise circular production systems
- ✓ Support regional partnerships between side stream providers and alternative protein producers
- ✓ Develop and implement indicators for circularity performance
- ✓ Ensure that measures to improve food-system circularity do not shift environmental burdens to other domains

3. Enable safe innovation pathways for new types of substrates

- ✓ Streamline research authorisations
- ✓ Introduce a tiered market validation system
- ✓ Facilitate and modernise EFSA risk assessments
- ✓ Fund infrastructure for circularity



POLICY RECOMMENDATIONS

Recommendation 1: Provide incentives for assessment of circularity potential

A significant challenge in conducting comprehensive circularity potential assessments in the GIANT LEAPS project is the lack of accessible high-quality data and the lack of existing assessments identifying the current state of recovery and return of nutrients in circular protein systems. To address this, we suggest providing incentives for protein producers and research institutions for assessing the circularity potential of protein production systems.

Call for action:

- ✓ **Encourage disclosure of nutrient recovery and biotransformation data** for alternative protein production systems and inclusion of a reporting mandate in forthcoming EU circular economy legislation (e.g., revision of the Circular Economy Action Plan): through funding mechanisms, regulations, and Environmental, Social and Governance (ESG) reporting requirements
- ✓ **Incentivise open data sharing** via preferential access to public research and development (R&D) funding
- ✓ **Expand EU-supported data platforms and accessibility of assessment results** (such as GIANT LEAPS cloud data platform) for researchers, policymakers, and small and medium enterprises (SMEs)
- ✓ **Establish clear rules on data confidentiality** to protect sensitive business information

Recommendation 2: Provide support for enhancing circularity in alternative protein production

Circularity is essential for environmentally sustainable protein production, but it remains underutilised in practice. Assessing nutrient flows, waste valorisation, and losses across supply chains has the potential to enable design for circularity. SMEs that bring innovative circular methods to the market often face difficulties in navigating the complex regulatory frameworks and in achieving economies of scale.

Case study-specific recommendation for edible insect production

Suggestion: feed edible insects with substrates that are not used as ingredients for food

Edible insect production can contribute to food system circularity by converting low-value organic side streams into high-quality protein. Insect rearing can utilise agri-food by-products and former foodstuffs that are not suitable or no longer intended for human consumption, thereby retaining nutrients within the food system and reducing competition for land and primary feed resources. A key advantage of insects is their high feed-conversion efficiency combined with an ability to utilise a wide range of feed substrates. This enables the upcycling of diverse organic side streams, including substrates produced in surplus for human consumption (e.g., wheat bran) and those that cannot be, at least partially, digested by humans. However, several nutrient streams are currently excluded from insect feed use due to regulatory constraints, including catering waste, former foodstuffs of animal origin, and manure substrates, despite emerging evidence that controlled use could enhance circularity without compromising food safety. In addition, insect production generates co-products such as frass, which can be valorised as soil amendments or fertilisers, supporting the cycling of nutrients back to primary production. To realise this circularity potential, policy should focus on enabling the safe use of a wider range of low-risk side streams as substrates for edible insect production, supported by a clear guidance on substrate safety and potential to reduce environmental impacts. GIANT LEAPS' quantitative analysis Deliverable 5.4 finds that feed substitution by food waste can reduce the total environmental impacts of cricket production by around 16% at higher substitution levels.

Case study-specific recommendation for microalgae

Suggestion: streamline risk assessments for waste-derived substrates and incentivise nutrient recycling

Microalgae production presents an opportunity to enhance food circularity by repurposing industrial by-products and optimising resource reuse. Microalgae cultivation can utilise recirculated nutrients, for example, through sourcing nitrogen and phosphorus from food processing effluents, carbon from agricultural residues, by-products of food processing, or CO₂ captured in industrial processes. Water recirculation also offers circularity opportunities in microalgae production. Water removed during dewatering processes can be reused in subsequent algae cultivation cycles or redirected to other sectors, such as agriculture or aquaculture. Moreover, microalgae production has the potential to transform side streams from protein extraction, including ingredients rich in fibre and polyunsaturated fatty acids into valuable ingredients for food, feed or fertilisers. To support this circularity potential, policy should focus on streamlining risk assessments for waste-derived substrates, establishing natural credit markets (nitrogen, phosphorus, and carbon credits) to incentivise recycling of nutrients, and facilitating the use of biogenic CO₂ for food-grade applications. GIANT LEAPS analysis (Deliverable 5.4) shows that circularity gains are context-dependent: targeted carbon source substitution in the case study microalgae production system has the potential to reduce the environmental impacts by around 3%, while broader substitution of nutrients with circular inputs can increase impacts where additional processing requirements apply.

Case study-specific recommendation for protein products from rapeseed

Suggestion: targeted R&D funding, streamlined market access, and quality standards

European rapeseed, specifically from non-genetically modified winter varieties, presents significant potential for processing into food-grade protein products. These varieties are suitable for developing protein isolates and protein-fibre concentrates, addressing the increasing demand for sustainable and high-quality protein sources. Recent technological advances enable complete valorisation of rapeseed components, including the by-products of oil production, such as rapeseed cake into valuable products. This approach maximises resource utilisation and supports the production of food-grade protein isolates and protein-fibre concentrates. To realise this circularity potential, policy should support the scale-up of integrated biorefinery models that valorise all rapeseed fractions. This could include targeted research and development (R&D) funding, streamlined market access for circular protein ingredients, and quality standards for rapeseed-derived food ingredients.

Call for action:

- ✓ **Incentivise circular production systems** through nudging, information campaigns, targeted actions, funding, and regulation
- ✓ **Support regional partnerships between side-stream providers and alternative protein producers** by developing regional mapping of available waste streams to support access to circular feedstocks
- ✓ **Develop and implement indicators for circularity performance** such as nutrient recovery potential, waste-to-feed ratios, bioconversion yields, and composite metrics such as the Food Circularity Index (FCI) developed in GIANT LEAPS, in the private sector and public procurement

- ✓ **Ensure that measures to improve food-system circularity do not shift environmental burdens to other domains**, for example through substantial increases in GHG emissions caused by energy-intensive pre-treatment of side streams. This need for system-level assessment is confirmed by GIANT LEAPS analysis Deliverable 5.4, which shows that circularity benefits are system-specific: not all food waste recirculation strategies reduce overall environmental impacts

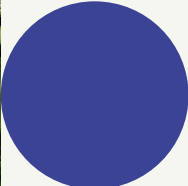
Recommendation 3: Enable safe innovation pathways for new types of substrates

Innovation in circular feedstocks is slowed by current EU regulatory frameworks that are not designed around circular economy principlesⁱ. Barriers related to Novel Foods approval and food safety more broadly (see Policy Briefs [#2](#) and [#3](#)) restrict application of currently non-authorised substrates and result in data gaps that hinder evidence-based approval of new circular production pathways. Risk-proportionate innovation frameworks are needed to enable controlled experimentation with non-authorised substrates, accelerate safe knowledge generation, and maintain rigorous safety standards. This requires updating the approaches that underpin risk assessment for novel foods (see also [Policy Brief #3](#)).

Call for action:

- ✓ **Streamline research authorisations** for testing novel or restricted substrates under controlled conditions
- ✓ **Introduce a tiered market validation system** for products derived from novel substrates, moving from R&D testing outside the food chain to limited non-edible bioproduct chains such as pet food and finally to use in full food and feed chains where safety is demonstrated
- ✓ **Facilitate and modernise EFSA risk assessments** for waste-derived substrates on a case-by-case basis, prioritising low-risk pathways (e.g., food waste to insect protein for fish feed) to build evidence and accelerate the EFSA evaluations and European Commission approvals
- ✓ **Fund infrastructure for circularity**, including reprocessing technologies, biorefineries, waste valorisation hubs, and fermentation feedstock systems, to support circular food production systems

ⁱ For instance, insects were not considered a relevant source of food or feed when Transmissible Spongiform Encephalopathies (TSE) legislation was implemented.



BACKGROUND INFORMATION

Need for a shift towards more circular alternative protein production systems

Food systems drive roughly one third of anthropogenic greenhouse gas emissions and significant resource pressures through fertiliser, water, and land use¹. Circular production approaches can mitigate these resource pressures by reducing resource losses, retaining nutrients within the food system, and valorising organic side streams that would otherwise be wasted. There is an untapped circularity potential of approximately 38-47 million tonnes of biowaste per year in the EU, which could be captured and processed into nutrient-retaining bio-based feedstocks². Alternative proteins produced from organic side streams, e.g., agri-food residues, industrial by-products and food waste, can retain nutrients in the EU food and feed system, reduce greenhouse-gas (GHG) and land-use impacts, and increase the value of these streams³. Systems that convert waste and side streams into protein have a potential to support more resilient regional value chains, yet large differences exist in nutrient recovery efficiency and environmental performance between systems depending on the feedstock characteristics of side streams and the processing technologies applied^{4,5}. Adoption of circular practices that convert waste and side streams into protein and their scale-up are often constrained by regulatory uncertainty regarding use of waste-derived inputs in food and feed and logistical challenges in securing safe and traceable side streams at sufficient, stable volumes⁶. The EU bio-economy sector alone generates €583 billion in annual value added⁷, and better use of organic side streams in alternative protein production could potentially unlock multi-billion-euro opportunities by 2030⁸, creating jobs, reducing waste treatment costs, and substituting imported production inputs, provided regulatory and infrastructural barriers are addressed.

EU regulations impacting circularity

The European Green Deal⁹ sets the big-picture goal of climate neutrality by 2050, requiring circular resource use across all sectors, including food systems, to cut waste and boost efficiency. The Farm to Fork Strategy¹⁰, the part of the Green Deal concerned with food system transition, promotes sustainable production, reducing nutrient loss, and halving food waste by 2030. The Circular Economy Action Plan¹¹ is aimed at promoting circularity by designing out waste from the start, keeping materials, e.g., organic side streams, in use longer through better recycling and upcycling. Together, these create the EU policy basis for increasing circularity in alternative protein production and turning EU biowaste into valuable feedstocks while meeting Green Deal ambitions.

Food circularity

Circular food systems are food systems in which the production, processing, distribution and consumption of food are organised in such a way to minimise resource losses and maintain the value of nutrients within the system for as long as technically and safely possible¹². This can be achieved by minimising waste streams and retaining food in the human food chain, followed by using unavoidable residual streams as a resource in food production (including composting and feed), energy production (anaerobic digestion) or non-food products¹³, in line with circular economy¹⁴ and waste hierarchy principles¹⁵.

Unlike linear food systems, circular food systems require a systems perspective that integrates nutrient cycling, resource efficiency, and waste prevention across all stages of the value chain. Due to their biological nature, circularity is constrained by factors such as perishability, safety, and losses resulting from the decomposition of organic matter. Circularity in food systems also requires integration of environmental, socio-economic, and nutritional dimensions to ensure that circular practices do not compromise environmental sustainability, food safety, or nutrient functionality¹⁶. To ensure that circular production methods deliver tangible improvements to the European food system, three core conditions must be fulfilled^{17,18}:

1. **Environmental sustainability:** nutrient-recycling strategies must reduce overall environmental impacts.
2. **Safety:** introducing new substrates or production methods must not compromise food or feed safety.
3. **Economic viability:** circular production models must be financially viable to enable scaling and long-term adoption.

The integrated sustainability assessment of novel proteins within the GIANT LEAPS project revealed several problematic areas in terms of circularity: e.g., missing incentives for enhancing circularity of alternative protein production systems from the outset, which is currently left to the discretion of technology developers and producers. Frequently, efficient use of individual organic by-products is hindered by lack of attention in the EU legislative frameworks governing circular economy and by logistical issues that hamper transition of circular production from pilot scale to commercial scale. Based on these gaps, GIANT LEAPS puts forward recommendations for potential policy improvements.

ABOUT GIANT LEAPS

The EU-funded project 'GIANT LEAPS' aims to accelerate the dietary shift towards a more sustainable and healthier food system, aligning with the EU Green Deal objectives and the Farm to Fork Strategy. The ambition of GIANT LEAPS is to transform European diets by reducing the consumption of traditional animal-based proteins, targeting a goal where 50% of total protein dietary intake is derived from alternative protein sources – such as plants, microalgae, insects, and single-cell proteins – by 2030. To achieve this goal, GIANT LEAPS employs a multi-actor approach, actively engaging with policymakers, production sectors, and European citizens. This collaboration fosters key innovations, methodologies, datasets and information that empower all stakeholders in the food system to make informed decisions, strategic investments, and sustainable choices. Ultimately, the Project seeks to facilitate a large-scale dietary shift towards alternative protein-rich foods, maximising both nutritional and environmental impacts.

DISCLAIMER

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