POLICY BRIEF

TRANSFORMING FOOD CHAIN STRUCTURE TO REDUCE FOOD LOSS AND WASTE (FLW)

ZeroW tackles Food Loss and Waste (FLW) through a coordinated set of innovations piloted in nine real-world Systemic Innovation Living Labs (SILLs) aiming to achieve significant reductions across all stages of the food supply chain - from pre-harvest to consumption. A dedicated Policy Team complements this work by defining a 'Just Transition Pathway' toward near-zero FLW, offering a practical framework to bridge systemic barriers (e.g., fragmented and lengthy nature of the food supply chains, the digital divide, challenges in scaling innovative waste reduction technologies) and on-the-ground FLW solutions. Drawing on economic modelling and insights from the stakeholders and the SILLs, the team identified key recommendations promoting a flexible, equity-focused transition.

Introduction

Reducing Food Loss and Waste (FLW) is a critical priority for achieving the goals of the European Green Deal and the Farm to Fork Strategy, both of which aim to make food systems fairer, healthier, and more environmentally sustainable. This policy brief outlines key policy recommendations to shape the food value chain structure to prevent and reduce FLW, using technological, organisational, and governance innovations for a just transition pathway.

It aims to support policymakers to reach the newly adopted binding food waste reduction targets, and in fostering digital and logistical innovations to transform the food chain structure and make it shorter, more resilient, and more sustainable.

Policy Problem

Despite the EU's strong commitment to reducing FLW under the Farm to Fork Strategy and Circular Economy Action Plan, current approaches remain mainly focused on technological and end-of-chain solutions (e.g., retail, consumer behaviour, waste management) while paying little attention to structural issues in the food supply chain. Specifically, the concentration of power in long, centralised food supply chains and insufficient support for resilient, short food supply chains (SFSCs) hinder systemic progress.

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SFSCs are understood as systems where food production and consumption are geographically close and involve few or no intermediaries. Without targeted interventions to rebalance the food system structure, by investing in local food networks, logistics infrastructure, data interoperability, and equitable access to innovation, FLW reduction efforts may lead to unintended environmental and social consequences, such as increased agricultural emissions, biodiversity loss, and the exclusion of small-scale producers from new markets and technologies.

Evidence from Project

ZeroW provided critical insights into the structural challenges of the food chain and helped us develop targeted policy recommendations by combining advanced modelling, literature analysis, and real-world experimentation. Through a comprehensive approach, we were able to identify both systemic issues contributing to FLW and some necessary conditions for a just and effective transition.

The project carried out some general and partial equilibrium modelling analyses to shed light on the key spillovers in FLW reduction measures.
The MAGNET analysis General Equilibrium Model (which captures the effects of FLW reduction measures on the whole economic system) uncovered significant environmental spillovers. While reducing FLW lowers greenhouse gas emissions in waste management, it may paradoxically result in increased emissions in primary agriculture and non-food sectors. This unintended consequence arises from the intensified agricultural production needed to meet higher food demand and affordability, particularly for commodities with high FLW rates, alongside increased use of chemical fertilisers. The expanded land use tied to greater production was flagged as a critical environmental risk due to its potential to exacerbate biodiversity loss and degrade ecosystems. Additionally, the use of AI-based innovations could also generate environmental spillovers. These findings led to a key policy recommendation: FLW reduction must go hand in hand with investments in sustainable agricultural practices to avoid adverse environmental impacts.

Additionally, the Partial Equilibrium Model (which captures the effects of FLW reduction measures on a single commodity value chain) highlighted the cost-benefit trade-offs. Although FLW reduction offers environmental benefits, the strategies themselves often come with high implementation costs. Therefore, a core recommendation was the need to reduce abatement costs to ensure the economic viability of FLW policies and improve their adoption across the food system.

Complementing these modelling insights, the ZeroW Policy Team identified a 'Just Transition Pathway'. Grounded in an extensive literature review, the 'Just Transition Pathway' offers a forward-looking vision of more resilient and equitable food systems. At the core of this definition stand the needs of the most vulnerable actors in the food system (both consumers and supply chain actors). From this perspective, SFSCs not only help cut FLW but also empower actors who are weaker in the conventional long supply chain, including producers and less affluent consumers. A just transition must therefore ensure that innovation benefits all participants in the food system, regardless of scale or location. However, transitioning towards a SFSC system comes with scaling challenges such as limited production capacity, logistical difficulties, and competition with mass-market products. In response, the project called for public investment in logistics infrastructure, digital platforms, and last-mile delivery solutions.

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Furthermore, the literature review emphasised the importance of equity considerations: economic barriers may prevent small-scale actors from participating in SFSCs, making targeted support essential. FLW monitoring also emerged as a priority to support systemic change. Key actions should include mandatory waste data disclosure, investment in digital infrastructure, standardised measurement tools, and incentive structures to catalyse reduction initiatives.

From a policy implementation perspective, the project outlined concrete actions for a just transition. These included strengthening the resilience of primary producers through financial and technical support, the adoption of sustainable practices, and ensuring access to innovative solutions, particularly for vulnerable actors. The project also underscored the importance of collaborative investment models (e.g., shared machinery) and peer-to-peer knowledge exchange to disseminate innovations across diverse agricultural contexts.

In parallel, the project highlighted the potential and challenges of scaling waste reduction technologies in the Systemic Innovation Living Labs (SILLs).

- SILL1 demonstrated how a data platform tracking FLW across the supply chain can improve decision-making. However, building such a platform raised challenges around business model viability, governance, and semantic interoperability (addressed through the "semantic treehouse" tool).

- SILL3, focused on greenhouse tomato production, tackled pre-harvest and harvest losses due to mismatched supply and demand. It tested AI-based tools for yield and quality forecasting and harvest timing. However, uptake was hindered by farmers' reluctance, lack of data-sharing agreements, and the complexity of setting up marketplaces for excess produce, which ultimately had to be deprioritised.

- SILL4, focused on deploying a mobile food processing unit - a compact, on-wheels hub capable of turning perishable surplus into value-added products, which was tested and validated in real-life scenarios, confirming it is highly suitable for short supply chains and regional actors. The pilot demonstrated how mobility and adaptability enable regional stakeholders to process food on-site, reducing waste and strengthening local food systems.

- SILL5 piloted AI systems to identify cosmetically imperfect produce early and estimate shelf life, aiming to valorise food that would otherwise be lost. Despite the promise, adoption was challenged by resistance from producers and line workers, and the difficulty of sourcing enough data to train the algorithms. This underlined the need for deeper reform of production processes, as technology alone is not enough.

- SILL6 addressed inefficiencies in quality control, currently a manual and periodic process prone to food losses. By developing real-time, digital tools for process optimisation, the project showed potential to reduce losses proactively. Yet again, challenges around operator acceptance and data-sharing for algorithm training were central.

In sum, the project offered a multi-level understanding of the food chain's structural issues, ranging from environmental trade-offs and economic feasibility to technological adoption and social equity. This evidence base informed a comprehensive set of policy recommendations for reducing FLW while ensuring a just and sustainable transition across the agri-food system.

In the following paragraph, a set of key policy recommendations combining the evidence from the project is provided, aiming to guide policymakers in promoting a just transition towards a near-zero FLW system. Particular emphasis will be put on the importance of SFSCs. They are commonly organised through Alternative Food Networks (AFNs), such as community-supported agriculture (CSAs), farmers' markets, solidarity purchasing groups, and food cooperatives. These forms of food governance are crucial in fostering more resilient, inclusive, and sustainable agri-food systems.

Key Policy Recommendations

1. Strengthen SFSCs for resilient primary production

Building on the ZeroW project's findings, particularly from WP1 and WP8, support for SFSCs and AFNs emerges as essential for several interconnected reasons. First, SFSCs can significantly reduce FLW by minimising distribution distances and the number of intermediaries.[1] This leads to lower transport losses, better matching between local supply and demand, and reduced waste from unsold perishables. Second, SFSCs display enhanced resilience in the face of systemic shocks, such as pandemics, geopolitical tensions, and energy crises.[2][3] Third, SFSCs contribute to a just transition by promoting food sovereignty, democratic governance, local employment, and the inclusion of underrepresented actors. Fourth, SFSCs are shown to strengthen local economies. Empirical evidence, including cases from France and China referenced in the project, illustrates that they generate more jobs per hectare and offer more stable employment compared to long, industrialised food supply chains.

Crucially, the project underscored the need for FLW reduction strategies that do not exacerbate environmental spillovers through intensified agricultural production. SFSCs, by tying production to local consumption and reinforcing community-level guarantees, offer a safeguard against unsustainable intensification. They thus align with the project's recommendation to combine FLW policies with sustainable primary production. This approach also addresses the modelling results, which warn of trade-offs, such as increased emissions or biodiversity loss, if FLW reduction measures are implemented without systemic reform.

In light of these findings, supporting SFSCs and AFNs is not only about reducing waste but also about reshaping the food system to be more resilient and sustainable. Their focus on sustainable primary production, their embeddedness in local communities, and their capacity to buffer systemic risks make them key instruments for achieving the ZeroW project's vision of a just, near-zero FLW transition.

Examples of policy actions under Recommendation 1:

- Provide grants, public credit, or loan guarantees to support the start-up and scaling of SFSC initiatives, leveraging EU funds such as the Common Agricultural Policy (CAP) and Rural Development Policy. [4]
- Conduct feasibility studies and strategic diagnostics to assess local readiness for SFSCs, including logistics capacity, agricultural base, and economic niches.
- Apply tax exemptions or incentives for local producers (e.g. France's tax breaks, Italy's "Zero Kilometer" law), and stabilise incomes within SFSCs considering part-time, seasonal, and family labour. [5] [6]
- Provide access to, or rental of, public infrastructure (e.g., logistics centers, cold storage, food processing facilities) for SFSC actors.
- Promote green public procurement prioritising local and organic food in institutions (e.g., schools, hospitals), and set clear municipal targets or quotas for local sourcing (e.g., Florence's 70% requirement, UK's "30:30" campaign).
- Strengthen producer cooperatives and clusters to ensure quality, supply consistency, and shared logistics and storage systems.
- Enable large-scale public-private investments in SFSC innovation, particularly in logistics and digitalisation, and use public funds to correct market failures and ensure inclusive access to infrastructure.
- Foster training, peer-learning, and knowledge-sharing platforms among producers, logistics actors, and consumers, including EU-supported "beacon" SFSC initiatives.
- Ensure fair and competitive pricing for SFSC products, promoting cost parity with long supply chains by reducing externalities (e.g., carbon pricing) and internalising social/environmental benefits.
- Facilitate access for small-scale, young, and women farmers by offering land, training, and tailored support, including agricultural incubators and pilot areas for sustainable local production.
- Develop a legal definition of Alternative Food Networks at the EU level and introduce municipal or supra-municipal carbon taxes or incentives supporting zero-kilometer production.
- Promote public enterprises in primary production services (e.g., food processing, waste and forest management) to lower entry barriers and enhance inclusion.

2. Enhance agricultural sustainability through innovation and digital data access

Digitalisation and sustainability are frequently referred to as the "twin transitions" shaping the future of the European food system. Although they stem from different origins and pursue distinct objectives, their interaction can be mutually beneficial, particularly in addressing FLW. By enabling data-driven decision-making throughout the food chain, from production to consumption, digital tools can help optimise logistics, anticipate surplus, and enhance redistribution strategies.

The ZeroW project offers a compelling example of how digital technologies, especially those supporting interoperable data exchange, can address structural barriers to reducing FLW and support more sustainable outcomes. Yet, realising the full potential of digital innovation for a fair and inclusive transition requires engaging with a series of systemic challenges. The dominant food chain, due to its scale and complexity, often grapples with entrenched data silos, limited transparency, and a resistance to infrastructural change. At the same time, while SFSCs demonstrate greater flexibility and local responsiveness, they frequently encounter obstacles such as constrained access to digital tools, capital, and logistics infrastructure. Furthermore, there is the need to address cultural concerns by acknowledging farmers' fear of losing their artisan identity and communicating the practical and environmental benefits of digitalisation, especially regarding FLW reduction, as suggested by the implementation of the ZeroW SILLs.

Examples of policy actions under Recommendation 2:

- Establish a European "Data Space" for FLW to enable secure, interoperable data sharing across actors, supported by incentives like regulatory credits, tax breaks, and pilot public-private partnerships for real-time inventory tracking. This is particularly relevant for monitoring FLW and guiding the value chain transition. A crucial lesson learned in SILL1 was that demonstrating immediate benefits (like improved client relationships or compliance) is key to securing data contributions from farmers and service providers.

- Ensure equitable access to digital infrastructure by addressing barriers such as poor broadband, low digital literacy, and high costs in rural or geopolitically vulnerable regions; tailor funding schemes (e.g., CAP, rural development funds) to local needs and avoid a one-size-fits-all approach.

- Promote the co-development of digital tools with farmers to ensure they are context-specific, compatible with existing practices, and scalable across diverse farm types and locations. Use public funding (e.g. CAP) to support participatory co-design processes and compensate farmers for their contributions to tool development and testing.

- Improve transparency and accessibility of financial instruments for digitalisation (e.g., grants, subsidies, tax reliefs), especially for small farms and underrepresented groups.

- Incentivise digital solution providers to offer free trials, flexible pricing, and customised solutions that address different user profiles and farm structures.

- Design inclusive policy measures that explicitly integrate gender, recognising, for example, the roles of women in managing smaller, sustainable farms and favouring peer-led knowledge sharing.

- Align regulations and policy timelines with the digital innovation lifecycle and Return on Investment (ROI) to prevent conflicts and support adoption.

- Promote digitalisation as a pathway to encourage farm succession and attract younger generations to farming.

- Invest in diverse, inclusive, and adaptive training formats that blend technical and soft skills, co-designed with users (e.g., women managing farm administration), and offer both live and digital learning tailored to SMEs and farmers of all ages.

- Support peer-to-peer learning by integrating activities like farm visits into CAP-funded knowledge-sharing schemes.
- Provide significant public and private investments to enable digital innovation in SFSCs, particularly where market incentives fall short.

3. Support sustainability transitions in the food chain with interventions targeting logistics and transportation

Sustainable logistics and transportation are essential components of a just transition towards zero FLW, as highlighted throughout the ZeroW project. By enabling efficient, low-carbon, and inclusive systems for the redistribution or valorisation of surplus food, logistics play a key role in reducing waste across the agri-food chain. However, insights from ZeroW's modelling work stress that FLW reduction strategies must be carefully designed to avoid negative environmental and socio-economic spillovers, such as increased emissions from intensified agricultural production. To mitigate these risks, logistics interventions should be accompanied by support for sustainable agricultural practices and equitable economic models.

Moreover, findings from the 'Just Transition Pathway' and the Systemic Innovation Living Labs (SILLs) underscore the importance of strengthening SFSCs through targeted investments in infrastructure, digital platforms, and last-mile delivery. These investments not only enhance climate resilience and reduce urban congestion but also empower vulnerable actors across the supply chain. Ultimately, building a resilient logistics ecosystem is not merely a technical fix but a structural lever for driving systemic change in how food is produced, distributed, and valued.

Examples of policy actions under Recommendation 3:

- Enable reverse logistics by redirecting unsold or surplus food to producers, food banks, composting facilities, or bio-conversion plants. This can be enhanced by FLW monitoring systems coordinated at local/regional level and digital tools to track inefficiencies and optimise recovery routes.

- Establish local/regional urban agri-food logistics hubs that integrate SFSC logistics and reduce long-distance freight traffic. Enable flexible use of underutilised public spaces (e.g., warehouses, market halls) for these hubs, especially in dense cities.

- Accelerate the energy transition in local food logistics by subsidising feasibility studies for biogas or e-fuel production from FLW (including co-digestion with manure) and for agrivoltaics systems powering logistics.

- Provide targeted subsidies and leasing incentives for electric vans, cargo bikes, shared EVs, and EV charging infrastructure in rural and peri-urban areas.

- Fund and incubate cooperative logistics models such as food co-ops and cooperative delivery systems using cargo bikes or small EVs. Provide legal, technical, and financial support for AFNs, smallholders, and low-income actors to invest in logistics infrastructure, EVs, and digital tools.

- Facilitate structured dialogue among AFNs, retailers, and logistics providers to co-invest in infrastructure and overcome coordination barriers. Support regional roundtables with public facilitation and create public agencies or observatories to map flows, identify inefficiencies, coordinate infrastructure, and implement territorial food strategies.

- Shift long-distance transport of agri-food products to rail and intermodal solutions by promoting initiatives that move long-distance transport of preserved, bulk, or packaged foods from road to rail. Prioritise intermodal terminals, refrigerated containers, EV-based first/last-mile delivery, and flexible rail services like night trains or modular carriages suited to food logistics.

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- Promote low-impact and zero-emission last-mile distribution by encouraging consumer adoption of sustainable last-mile options through incentives (e.g., discounts for bike pickup), and ensuring food hubs are accessible via bike paths and public transport, integrating them into urban mobility plans.
- Fund vocational training in low-carbon logistics, fleet management, EV maintenance, cooperative governance, digital supply chains, and FLW prevention. Target support especially to young farmers, small producers, and logistics cooperatives.
- Develop certification and reporting standards for sustainable logistics and embed them in existing EU mechanisms such as the Farm to Fork Strategy and CAP monitoring systems.
- Mandate climate risk assessments for logistics investments, considering hazards like floods and heatwaves. Support resilient infrastructure through passive cooling, insulated storage, and off-grid energy systems in rural and peri-urban logistics hubs.

Conclusion

The ZeroW project clearly demonstrates that reducing FLW requires a systemic transformation of the food supply chain structure, emphasising shorter, more resilient, and inclusive food networks. Strengthening SFSCs not only curbs waste but also promotes environmental sustainability, social equity, and economic resilience by empowering vulnerable actors and fostering local economies. Simultaneously, harnessing digital innovation and ensuring equitable access to data and technology are essential to overcoming structural barriers and enhancing sustainability throughout the food system.

For a just transition aligned with the European Green Deal, the Farm to Fork goals and the newly adopted binding food waste reduction targets, policy must move beyond end-of-chain interventions and address the root structural challenges. This involves public investments in logistics, infrastructure, capacity-building, and tailored support for small-scale producers, alongside robust monitoring and transparent data-sharing frameworks. By combining sustainable agricultural practices with digital and organisational innovations, the EU can foster a fairer, greener, and more efficient food system that benefits producers, consumers, and the environment alike.

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