ENOUGH

EUROPEAN FOOD CHAIN SUPPLY TO REDUCE GHG EMISSIONS BY 2050

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EXECUTIVE SUMMARY

Climate change presents one of the most critical challenges of our time, demanding urgent and transformative action across all economic sectors. The European food supply chain, while a cornerstone of the EU's economy and global food security, is a significant contributor to greenhouse gas emissions, accounting for an estimated one-third of the global total. In response, the European Union has positioned itself as a global leader through the European Green Deal and its cornerstone food policy, the Farm to Fork Strategy. However, a considerable implementation gap remains between political ambition and on-the-ground reality.

This white paper, a deliverable (D7.9) of the H2020 ENOUGH project, synthesizes interdisciplinary research to provide evidence-based policy recommendations. Our analysis identifies a critical systemic bias: current policy and research efforts disproportionately target agricultural production (pre-farm gate), neglecting the substantial mitigation potential of downstream stages. Data from the ENOUGH project inventory reveals that direct (Scope 1) and energy-related (Scope 2) emissions from these industrial stages constitute a major share of the food supply chain's footprint, a fact often overlooked in strategic planning.

The transition is further complicated by the structure of the EU food industry, which is predominantly composed of small and medium-sized enterprises. These actors face unique barriers to decarbonization, including limited access to capital, complex reporting requirements, and a lack of technical capacity. Concurrently, a market failure exists; consumer demand for sustainable products remains insufficient to drive the necessary private investment, leaving small and medium size companied dependent on public funding.

To address these multifaceted challenges, we propose a coherent set of policy recommendations structured around five interdependent pillars:

1. *Orchestrating Strategic Finance:* Redirecting and de-risking capital through blended finance models, simplifying access for SMEs, and reinvesting carbon pricing revenues to ensure a just transition.
2. *Sharpening Regulatory Frameworks:* Developing and enforcing stage-specific regulations, such as mandatory energy performance standards for transport refrigeration and cold storage, and harmonizing emissions reporting across the single market.
3. *Prioritizing Targeted R&I:* Recalibrating research funding (e.g., Horizon Europe) to bridge the gap between innovation and deployment, specifically for industrial decarbonization technologies and logistics optimization.
4. *Fostering Inclusive Capacity Building:* Investing in workforce training for low-carbon technologies and launching consumer awareness campaigns to link dietary choices and food waste reduction to climate impact.
5. *Enhancing Market Demand:* Accelerating the harmonization of a mandatory EU-wide ecolabel and integrating strict sustainability criteria into public procurement to create stable, large-scale demand for low-carbon products.

The successful decarbonization of the EU's FSC by 2050 is contingent upon implementing this integrated policy package. It must simultaneously address supply-side constraints and stimulate demand-side drivers, ensuring the transition is not only technologically feasible but also socially equitable and economically resilient, securing the future of Europe's food system in a changing climate.

Deliverable D7.9

1 INTRODUCTION

Climate change is one of the most pressing challenges of the twenty-first century, with profound consequences for biodiversity, social stability, and food security (Del Borghi et al., 2022; Naumann et al., 2018; Otto et al., 2017). The Paris Agreement set the target of limiting global warming to 1.5 °C, which requires urgent action across all productive sectors to reach net-zero emissions by 2050 (United Nations, 2015). Among these sectors, food systems deserve special attention. They are essential to feeding a growing global population but are also estimated to contribute nearly one-third of anthropogenic greenhouse gas (GHG) emissions (Crippa et al., 2021). Current trends in population growth and consumption underscore the urgent need to transform food systems to ensure food security while reducing environmental impacts (Lipper et al., 2020).

Within Europe, the food industry plays a dual role. On one hand, it is a central pillar of the European economy, integrating a vast network of small and medium-sized enterprises (SMEs) and multinational corporations that operate locally, nationally, and internationally (Kühne et al., 2010; Wijnands et al., 2007). On the other hand, the sector contributes significantly to the EU's emissions profile, both before the farm gate and in downstream stages such as processing, transportation, storage, and consumption (Clark et al., 2020; Paustian et al., 2016). Cold-chain logistics and refrigeration, for example, are particularly energy-intensive, with transport phases alone accounting for up to 80% of emissions in perishable food segments (Habibur Rahman et al., 2023; Li et al., 2025). Emissions are further amplified by refrigerant leaks from retail and domestic systems (Foster et al., 2023). Likewise, dietary patterns have a major influence on environmental impacts, with animal-protein-rich diets associated with disproportionately high emissions compared to plant-based alternatives (Carlsson-Kanyama & González, 2009; Ripple et al., 2014).

To address these challenges, the European Union (EU) has positioned itself as a frontrunner in the global transition to net-zero, with the European Green Deal (EGD) providing a comprehensive framework for decarbonizing productive sectors (European Commission, 2021a). Within this framework, the Farm to Fork (F2F) strategy acts as the flagship initiative for the food sector, aiming to reduce the environmental footprint of the European food supply chain (FSC), promote healthier and more sustainable diets, and minimize food waste (European Commission, 2020a). Complementary policy frameworks, including the Biodiversity Strategy, the Circular Economy Action Plan, the Zero-Pollution Ambition, and the Just Transition Mechanism, add further layers of governance. However, despite these commitments, gaps remain between ambition and implementation, as many measures are still under negotiation or lack the necessary enforcement mechanisms (Baldock & Hart, 2021). Achieving meaningful change will require strong political will, stakeholder engagement, and targeted financial support.

Against this backdrop, this white paper consolidates the assessments and policy recommendations developed across eight deliverables within the ENOUGH project, focusing on the decarbonization of the FSC in the EU. While considering perspectives of multiple stakeholders, the work developed by the ENOUGH project compiles policy gaps, assesses the

feasibility of interventions, and policy benchmarking against existing frameworks. By synthesizing evidence from production, logistics, storage, and consumption, the paper highlights synergies and gaps in the current policy landscape and offers concrete recommendations to guide policymakers, industry, and civil society. The ultimate aim is to support the EU's ambition to achieve carbon neutrality by 2050 while ensuring food security, protecting ecosystems, and maintaining economic resilience.

2 POLICY LANDSCAPE AND BACKGROUND

Designing feasible policies to promote sustainable food consumption and production has become a central priority for the EU, as ambitious climate and sustainability targets must be translated into tangible outcomes for citizens, businesses, and institutions. Feasibility in this context requires measures that are economically viable, socially equitable, and politically acceptable, thus ensuring broad support and effective implementation across Member States (European Commission, 2021b). The F2F strategy introduced under the EGD, emphasizes the need for an integrated approach that simultaneously addresses production, processing, consumption, and waste management (Crippa et al., 2021; Parks, 2022).

A key lesson from the F2F strategy is that advancing sustainable food systems cannot rely on simplistic or one-dimensional solutions. Instead, policy packages must combine informational, economic, and regulatory measures that encourage consumers and producers to shift toward lower-impact choices. For example, harmonized front-of-pack nutrition and sustainability labelling has been discussed as a tool to empower consumers with transparent information, while reforms in public procurement could create reliable markets for sustainable foods in schools, hospitals, and public institutions (European Commission, 2020b). Such initiatives align with broader goals of social equity, ensuring that sustainable and healthy diets are accessible and affordable across all income groups, thereby preventing sustainability from becoming a privilege for wealthier citizens (Pettifor, 2019).

The policy landscape also reflects a growing recognition that industrial stages beyond the farm gate, such as food processing, packaging, retail, and distribution, require specific legislative and market attention (Crippa et al., 2021). The F2F action plan proposes transformative measures including circular business models for food processors, reusable and sustainable packaging solutions, and marketing standards that promote low-impact products. These measures also aim to account for the EU's role as a major food importer and exporter, acknowledging the global footprint of European consumption (European Commission, 2023a).

At the same time, voluntary instruments such as eco-labelling and sustainability certifications, largely driven by NGOs and industry associations, have gained traction as mechanisms to increase consumer awareness and corporate responsibility (Gulbrandsen, 2006; Horne, 2009). However, these initiatives remain fragmented, and their effectiveness depends heavily on the establishment of coherent political frameworks that support widespread adoption and harmonization across the single market (Grunert et al., 2014).

Another dimension of the current policy landscape is the integration of stakeholder-driven initiatives and civil society engagement. Evidence suggests that consumer initiatives, awareness campaigns, and public-private partnerships play an essential role in shifting food

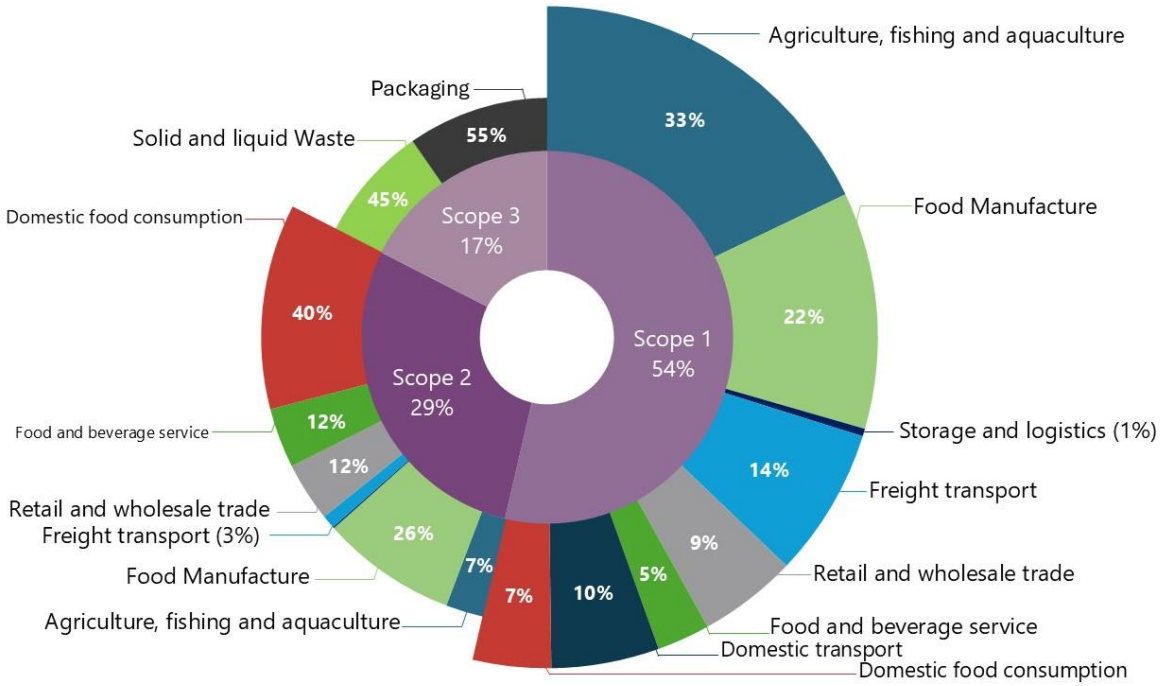
environments and fostering demand for sustainable products (Moreira-Dantas et al., 2022). Such engagement also strengthens legitimacy, ensuring that policies are not perceived as top-down impositions but as co-developed solutions reflecting societal values.

The benchmarking of existing policies highlights both opportunities and persistent gaps. While strong targets exist for pesticide reduction, nutrient management, antimicrobial use, and organic farming uptake, industrial stages of the FSC often lack equally clear and enforceable roadmaps (Busch et al., 2022; Rayner et al., 2008). For example, while the “Fit for 55” package and the Carbon Border Adjustment Mechanism (CBAM) outline critical steps for reducing industrial emissions, their applicability to food processing and retail remains limited (European Council, 2023). Similarly, harmonized reporting frameworks for industrial emissions are still underdeveloped, leaving data gaps that hinder effective monitoring and accountability (Aszódi et al., 2021).

Conventional production-based accounting methods substantially underestimate the climate impact of the EU's food consumption when emissions embodied in trade and land-use change are considered, revealing a critical gap in our understanding of the sector's true footprint (Sandström et al., 2018). This footprint contribution to the climate crisis necessitates a system-wide approach, demanding the design of comprehensive roadmaps for all stages of the food value chain and targeted policy interventions to promote sustainable dietary transitions and reduce systemic inefficiencies (Rabbi, 2025).

However, the food industry’s structure presents unique complexities that generic decarbonization policies would not be able to address. Its emissions are not confined to a single activity but are generated across highly interconnected supply chains, from agricultural production and food processing to transportation, storage, retail, and final domestic consumption. Effective GHG mitigation strategies, therefore, require an understanding of emission sources as categorized by the GHG Protocol. The ENOUGH project inventory data reveals that direct, on-site (Scope 1) emissions account for 54% of the food sector's total, followed by purchased energy (Scope 2) at 29% and value chain (Scope 3) emissions at 17% (Figure 1). While agriculture is a major contributor to Scope 1 emissions, downstream sectors like food manufacture, retail, and domestic consumption are also primary sources of on-site and energy-related emissions, a fact often overlooked in political strategies that disproportionately focus on pre-farm gate activities.

Figure 1. Breakdown of Scope 1,2, and 3 GHG emissions by sectors of the food supply chain in ten European countries (Norway, Germany, United Kingdom, Italy, France, Belgium, Lithuania, Austria, Poland, Hungary) for the base year 2019.



Source: ENOUGH emissions inventory (https://enough-emissions.eu/)

Cold chain logistics, encompassing refrigerated transport and storage, are pivotal yet underappreciated contributors. Life-cycle assessments indicate that the transport phase alone can account for over 80% of emissions within cold chains for products like fruits and vegetables, with refrigerated transportation generating the largest share of GHG outputs (Li et al., 2025). The energy demand for temperature control during pre-cooling, transit, and storage is dramatically higher than for ambient logistics (Habibur Rahman et al., 2023). Emissions from cold storage stem not only from energy consumption but also from refrigerant leaks, with national studies showing that refrigeration can contribute significantly to a country's overall emissions profile (Foster et al., 2023). These stages require highly specific interventions, such as the adoption of natural refrigerants, electrification, and advanced energy efficiency measures, which differ markedly from the strategies needed for agricultural emissions reduction.

Consequently, developing effective policy for this sector mandates a move beyond one-size-fits-all solutions. Policies must be tailored to the specificities of each stage in the value chain, accounting for the distinct technological, operational, and financial barriers they face. For instance, the widespread presence SMEs in processing, retail, and logistics necessitates financial instruments and support mechanisms designed for entities with limited capital and capacity for large-scale investment. Furthermore, policies must be informed by detailed technological roadmaps that identify priority innovations, estimate deployment timelines, and assess adoption barriers. Thus, enabling policymakers to target interventions where they are most impactful and synchronize regulatory, financial, and industrial strategies with market readiness (Winebrake, 2004).

The establishment of markets conducive to green technologies and low-carbon processes within the food system is contingent upon the implementation of coherent political mechanisms and active consumer engagement (Polzin & Sanders, 2020). From a supply-side perspective, the primary impediment to a rapid transition is investment risk, which constrains the flow of capital towards essential climate-friendly investments in energy efficiency and low-carbon technology diffusion (Hrovatin et al., 2016; Polzin, 2017). Despite a sufficiently large European financing portfolio, a qualitative divergence exists between the allocation of current investments and actual needs, with a notable scarcity of private small-scale equity funds dedicated to clean-technology research, development, and demonstrations (Polzin & Sanders, 2020). Consequently, a strategic revamping of financial strategies is imperative to address this gap (Pianta & Lucchese, 2020). Policy instruments such as the EU Taxonomy Regulation serve a critical function in this regard by providing a classification system to direct investments towards economic activities aligned with the EGD, thereby scaling up finance and with the potential to avoid greenwashing (European Commission, 2023b). To diversify funding sources and de-risk innovation, a blended finance approach, incorporating public, private, and consumer-involved mechanisms, is necessary to positively impact innovation chains (Bumpus & Comello, 2017; Bürer & Wüstenhagen, 2009). Furthermore, carbon market adjustments must be coupled with public reinvestment strategies to ensure an equitable transition for actors with limited financial resources (Pianta & Lucchese, 2020).

On the demand side, consumer preferences play a pivotal role in market formation, particularly through dietary shifts towards plant-based alternatives which possess a significantly lower carbon footprint than animal-based proteins (Poore & Nemecek, 2018). Consumer initiatives focused on information transfer, related to food origin, waste reduction, and sustainable consumption, are vital for raising awareness and shaping demand (Moreira-Dantas et al., 2022). Nevertheless, current engagement efforts remain disproportionately focused on the production stage, indicating a need for more integrated initiatives that address the entire food supply chain and improve stakeholder collaboration for emissions reporting and technological transition (Mathews et al., 2010; McCollum et al., 2018).

Taken together, this policy background shows that the EU has laid out a strong strategic direction under the F2F, but substantial work remains to ensure coherence across all FSC stages, especially in the industrial sector.

3 MAIN POLICY GAPS

Transitioning to a net-zero emissions food sector represents one of the most complex and necessary undertakings of the EGD. As mentioned before, this transformation extends far beyond agricultural production, encompassing the entire FSC from processing, packaging, and transport to retail, domestic consumption, and waste management. The current policy landscape, while ambitious in its direction reveals significant gaps in specificity, enforcement, and financial targeting. A primary challenge is the disproportionate focus on pre-farm gate activities, leaving the considerable emission-reduction potential of downstream stages underexploited. Furthermore, the widespread presence of SMEs, which form the backbone of the European food industry, faces unique hurdles: they are often constrained by limited capital, weaker market integration, and a lack of tailored support to adopt high-cost, low-carbon technologies.

The divergence between the availability of mature, energy-efficient technologies and their market adoption underscores a critical failure in the current ecosystem. Financial mechanisms, though numerous, are often broadly designed and fail to bridge the gap between research & innovation (R&I) and commercial deployment. Investments remain skewed, with continued financing of fossil-based technologies and insufficient capital allocated to the demonstration and diffusion phases of clean technology. This is compounded by an R&I agenda, as seen in the Food 2030 pathways[1], that has yet to fully prioritize the operational decarbonization of the industrial food sector, focusing instead on broader systemic issues. To address these multifaceted challenges, policy interventions must be coherent, synergistic, and meticulously tailored to address the specific barriers within each segment of the food value chain. The following recommendations are structured around five central thematic pillars essential for a successful and just transition.

3.1 Thematic 1: Orchestrating strategic finance and de-risking investment

A restructuring of financial flows is needed to align capital with climate objectives. While the European financing portfolio is substantial, its impact is diluted by a qualitative misalignment between where investments are currently placed and where they are most urgently needed. To rectify this, public institutions must assume a greater role in de-risking private investment, particularly in high-risk areas like research and development (R&D) and technology demonstrations for low-carbon technologies. This can be achieved by expanding the scope and accessibility of mechanisms like the EU Taxonomy and the Cohesion Fund to explicitly prioritize and streamline funding for projects focused on energy efficiency, natural refrigerant adoption, and heating and cooling innovations within the food industry.

Given that capital is unlikely to originate from a single source, policy must actively encourage the diversification of investment funds. Blended finance models that strategically combine public capital with private, consumer-involved, and private funds can effectively leverage greater resources and share risk. Particular attention must be paid to ensuring that carbon market adjustments and taxation policies are accompanied by robust public reinvestment schemes. This recycling of revenue is crucial to prevent the transition from disproportionately

[1] Food 2030 - Publications Office of the EU

impacting SMEs and other players with fewer financial resources, thereby safeguarding competitiveness and ensuring an equitable transformation.

3.2 Thematic 2: Sharpening regulatory frameworks and enforcement

Existing regulations, such as the F-gas Regulation, provide the necessary tools to decarbonize the food cold chain but lack the specificity and enforcement rigor to drive comprehensive change across food industry stages. Policy efforts must move beyond general directionality to establish precise stage-specific technical standards. This includes developing and enforcing mandatory minimum energy performance standards for transport refrigeration units (TRUs), cold storage facilities, and domestic appliances. Enhanced reporting, verification procedures, and stricter penalties for non-compliance are essential to prevent leakage and ensure accountability.

Furthermore, regulatory frameworks should be designed to actively stimulate market creation for clean technologies. Policies must enhance the competitiveness of businesses that produce and utilize systems with alternative low GWP natural refrigerants. This involves not only phasing out high-GWP products but also supporting the entire innovation chain, from manufacturing to end-use, ensuring that sustainable alternatives are not only available but also economically viable and preferred in the market.

3.3 Thematic 3: Prioritizing targeted research, innovation, and deployment

The current allocation of R&I funding, as evidenced by the Horizon Europe program, reveals an unequal distribution of resources across the FSC stages, with industrial decarbonization remaining underrepresented (Moreira-Dantas et al., 2023). Future R&I strategies must be re-calibrated to bridge the gap between scientific advancement and real-world application. Funding should be strategically directed towards priorities such as the integration of renewable energy sources into industrial food processes, the development of energy-efficient cooling and heating innovations, and the optimization of logistics to reduce transport emissions.

Crucially, innovation policy must extend beyond technology development to encompass its deployment. This requires dedicated support for pilot projects, testing facilities, and scale-up initiatives that allow SMEs to trial and integrate new technologies with minimal risk. Harmonizing R&I digital platforms and standards across the EU would foster collaboration, prevent duplication of efforts, and create a structure that enables science and industry to co-create solutions to complex operational challenges, such as carbon removal in production practices or sustainable waste management.

3.4 Thematic 4: Fostering inclusive capacity building and consumer engagement

The transition requires a parallel investment in human capital and consumer awareness. Policy must mandate and fund the development of comprehensive training programs for the existing workforce, including technicians, fleet managers, cold storage operators, and food handlers, to build expertise in operating and maintaining new low-carbon technologies and adhering to best practices in energy efficiency.

On the demand side, while product labelling is a step forward, policy must address the deeper barrier of affordability. Instruments such as targeted grants or interest-free loans for low-

income households might enable sustainable choices to be economically accessible. These financial instruments should be coupled with sustained public education campaigns that move beyond labelling to inform consumers about the carbon footprint of food choices, the energy-saving benefits of household appliances (e.g., pressure cookers or induction stoves), and the importance of behavioural changes like minimizing food waste. Finally, a strong policy approach is needed to define and implement minimum sustainability standards for public procurement, using the purchasing power of the state to create stable demand for sustainably produced food and drive market transformation.

3.5 Thematic Recommendation 5: Enhancing market demand through consumer engagement and producers' transparency

Recommendations are designed based on the EU food producers survey (D7.6). The survey reveals a critical dependency on public funding to drive sustainability actions, identifying governmental or public-sector resources as primary financial sources. While policies targeting the supply side are essential, particularly for SMEs lacking technical and financial capacity, fostering a parallel demand-pull is equally crucial for a self-sustaining transition. Producers, especially SMEs engaged in processing and distribution, indicate a strategic shift from serving local and national markets to integrating into broader EU and international supply chains. This expansion necessitates meeting the sustainability standards demanded by these larger markets. However, the low adoption of sustainability certifications and the challenges in accessing complex public funding highlight a gap between corporate capabilities and market expectations. Therefore, policy must bridge this gap by stimulating market demand for sustainable products and empowering consumers to drive change through informed choices. Furthermore, integrating sustainability criteria into public procurement policies for schools, hospitals, and government agencies would create stable, large-scale demand for verified sustainable food products and services, providing a reliable market for producers who are transitioning their operations. These demand-side measures would complement existing supply-side financial support, creating a more resilient and market-driven ecosystem for the sustainable transformation of the EU food sector.

4 RECOMMENDATIONS IN A NUTSHELL

4.1 Thematic recommendation 1: Orchestrating strategic finance and de-risking investment

Gap Identified: Policies are general and mostly focused on agriculture, disregarding post-farm-gate stages (processing, transport, etc.) and lacking a harmonized monitoring system for SMEs.

Recommendations:

Develop stage-specific regulations to create and enforce targeted policies for high-emission post-farm-gate stages like food processing, refrigerated transport, and packaging, moving beyond the current agricultural focus.

Mandate harmonized emissions reporting**:** Accelerate the development and implementation of a single, EU-wide digital reporting standard for corporate emissions (Scope 1, 2, and 3) tailored to the capabilities of SMEs, as a cornerstone for benchmarking and compliance.

Bridge the investment gap: Increase public funding for high-risk R&D and demonstration projects for clean technologies, particularly for SMEs.

Promote blended finance: Develop models that strategically combine public, private, and philanthropic capital to share risk and leverage greater resources.

Ensure a just transition: Reinvest revenues from carbon pricing mechanisms (like CBAM) into support schemes to prevent disproportionate impacts on SMEs and vulnerable players.

Simplify access: Streamline and reduce the bureaucracy of public funding application processes to improve accessibility for SMEs.

4.2 Thematic recommendation 2: Sharpening regulatory frameworks and enforcement

Gap Identified: Misallocation of R&D funds, with Horizon 2020 dedicating 31% to food production but only 2% to processing and transport.

Recommendations:

Re-balance R&I funding allocations: Advocate for a significant reallocation of EU research funding (e.g., in Horizon Europe) to specifically address the decarbonization of high-impact stages like industrial processing, cold chains, and logistics.

Create a dedicated funding stream: Establish a streamlined funding instrument within existing EU mechanisms (e.g., InvestEU) specifically for demonstration and deployment of clean technologies in post-farm-gate SME operations.

Extend and enforce regulations: Develop and enforce mandatory minimum energy performance standards (MEPS) for currently under-regulated areas, such as TRUs.

Stimulate markets for clean technologies: Use regulatory tools to enhance the competitiveness of businesses that produce and use systems with natural refrigerants.

Harmonize reporting: Develop a single, harmonized EU-wide emissions reporting framework for the food supply chain to ensure consistency and compliance with directives like the directive on corporate sustainability due diligence.

4.3 Thematic recommendation 3: Prioritizing targeted research, innovation, and deployment

Gap Identified: The challenge of integrating member states with varying economic capacities and aligning with international agendas.

Recommendations:

Strengthen Just Transition mechanisms**:** Enhance and tailor the scope of the Just Transition Fund to support the technological transformation of carbon-intensive regions and SMEs within the food industry, not just the energy sector.

Align trade and climate policy: Proactively integrate CBAM and Corporate Sustainability Due Diligence Directive (CSDDD) standards into all new EU trade agreements to create a level playing field and incentivize sustainable production in partner countries.

Re-calibrate R&I funding: Rebalance Horizon Europe and other funding programs to address the underrepresentation of industrial decarbonization and post-farm-gate stages (processing, transport, cold chain).

Focus on deployment: Shift funding beyond technology development to include pilot projects, testing facilities, and scale-up initiatives that help SMEs integrate new technologies.

Foster collaboration: Harmonize digital R&I platforms and standards across the EU to prevent duplication and encourage co-creation between science and industry.

4.4 Thematic recommendation 4: Fostering inclusive capacity building and consumer engagement

Gap Identified: The need to stimulate market demand for sustainable goods and recognize the value of harmonizing ecolabels.

Recommendations:

Accelerate the harmonization of ecolabels: Fast-track the development of a mandatory, EU-wide standardized environmental footprint label for food products to reduce consumer confusion and reward producers who invest in sustainability.

Launch a major consumer awareness campaign: Fund and launch an EU-wide information campaign on the climate impact of food choices, directly linking policy goals (EGD) to consumer behaviour and market demand.

Invest in workforce training: Fund comprehensive training programs for technicians, managers, and operators to build expertise in new low-carbon technologies and energy efficiency practices.

Enhance consumer transparency: Implement a standardized, mandatory EU environmental footprint label to empower consumers to make sustainable purchasing decisions.

Drive demand through procurement: Integrate strict sustainability criteria into public procurement policies to create stable, large-scale demand for low-carbon food products.

Improve affordability: Introduce fiscal incentives (e.g., grants) for low-income households to adopt energy-efficient appliances like induction stoves and efficient refrigerators.

4.5 Thematic recommendation 5: Enhancing market demand through consumers' engagement and producers' transparency

Gap Identified: A disconnect exists between EU supply-side sustainability policies and weak market demand for sustainable products. SMEs remain dependent on public funding as consumer demand is an insufficient economic driver. This results in low adoption of certifications and a failure to create market signals for private investment.

Recommendations:

The EU should develop a harmonized emissions reporting framework for food supply chain firms, ensuring that firms measure and disclose emissions consistently according to the CSDDD and CBAM.

Incentivize SMEs to implement sustainability reporting by offering financial support and simplified reporting procedures.

Simplify the application process for public sustainability funds to reduce administrative burdens for SMEs.

Increase financial incentives for SMEs adopting energy-efficient technologies, including targeted grants, tax breaks, and subsidized loans.

Establish technical support programs to help SMEs apply for funding and implement low-carbon solutions effectively.

5 CONCLUSION

The decarbonization of the EU's FSC represents a critical nexus of climate policy, economic resilience, and food security. This white paper has systematically assessed the policy landscape, identifying a clear dissonance between the high-level ambitions of the EGD and the F2F strategy and their operational implementation. The analysis suggests that while agricultural production has received significant policy attention, the substantial emission-reduction potential of post-farm-gate stages remains underexploited. This oversight is compounded by a systemic underinvestment in the research, development, and deployment of clean technologies for these stages, as evidenced by the disproportionate allocation of Horizon 2020 funding.

A central finding is that the heterogeneity of the food sector, particularly the prevalence of SMEs with constrained technical and financial capacities, necessitates a move beyond one-size-fits-all policy solutions. The transition is further hampered by a market failure wherein weak demand signals for sustainable products and fragmented consumer engagement fail to create a self-reinforcing cycle of investment and innovation, leaving SMEs dependent on public funding. Consequently, achieving a net-zero food system by 2050 is contingent upon the design and execution of a coherent, multi-dimensional policy framework that simultaneously addresses supply-side constraints and demand-side drivers.

The recommendations presented herein, structured around strategic finance, sharper regulation, targeted innovation, capacity building, and market stimulation, provide a holistic pathway forward. Financial de-risking mechanisms must be coupled with simplified access procedures for SMEs. Strengthened regulations on energy performance and refrigerants require robust enforcement and harmonized emissions reporting to ensure accountability. Furthermore, recalibrating R&I priorities towards deployment must be (simultaneously) supported by workforce training and initiatives that bridge the consumer-producer gap, such as standardized eco-labelling and sustainable public procurement.

Lastly, the net-zero emissions transition is not solely a technological or economic challenge but also a socio-technical one that demands unwavering political commitment, international alignment, and inclusive governance. By adopting the integrated policy package outlined in this paper, the EU can transform its FSC into a global model of sustainability, ensuring it meets its climate obligations while securing a competitive, equitable, and resilient future for its agri-food sector.

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