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Exploring multiple pathways and policy mixes for transforming European food systems

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Contents

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Summary

The study adopted an innovative approach that combined foresight and transition research methods to explore multiple pathways for transforming European food systems. The methodological approach consisted of six main steps:

1. Initial desk research reviewing the literature on food systems and methodological frameworks
2. First workshop utilising the Future Wheel and X-curve framework for sustainability transitions
3. Follow-up desk research integrating from the initial workshop
4. Morphological analysis to identify and structure potential future scenarios
5. Second workshop for policy option validation and refining pathways
6. Final comparative analysis with existing EU policies to assess alignment and gaps

Three key methodological tools were central to the study:

The Future Wheel method was used to explore direct and indirect consequences of potential changes, helping participants visualise implications in a structured and systematic way. It facilitated brainstorming on key questions regarding scenario sustainability and completeness, enhancing the depth of analysis.

The X-curve framework for sustainability transitions was applied to examine the dynamics between building up sustainable practices while phasing out unsustainable systems. The framework highlighted policies required for different transition phases (emergence, acceleration, stabilisation) and underscored the importance of developing effective phase-out strategies.

Morphological analysis was employed to systematically explore policy combinations across ten key dimensions of food system governance. This method identified four consistent policy pathways: Nature First, High Tech, Top-down, and Mixed Approaches. The analysis involved pairwise consistency assessments of policy options using a three-point scoring system to ensure rigour and coherence.

The integration of these methods proved highly effective. The X-curve provided a temporal perspective on transition phases, while the morphological analysis enabled a systematic and comprehensive exploration of policy combinations. Additionally, workshop participants' voting on policy options offered practical insights into their feasibility and desirability.

This methodological approach innovatively combines foresight and transition research techniques to deliver a comprehensive analysis of complex food system transformation pathways, incorporating valuable stakeholder perspectives.

1 Introduction

The current structure of European food systems significantly contributes to environmental, climate, and health issues, including resource depletion, biodiversity loss, ecosystem degradation, pollutant emissions, and unhealthy dietary patterns (EEA, 2019a). Both scientific evidence and policy recognise the urgent need to transform the food system. A considerable body of scientific research emphasises the need for comprehensive action to rethink food production, reshape value chains, and reduce meat and dairy consumption (Clapp, 2023; Herzon et al., 2024; Juri et al., 2024; Swinburn et al., 2019).

Urgent and bold action is needed in various areas, including setting a clear vision with legally binding targets, improving policy coordination, creating a conducive food environment for healthy and sustainable diets, embedding food production in broader development perspectives, and enhancing innovation (Ambikapathi et al., 2022; Asquith et al., 2022). Other areas involve improving production methods for environmental resilience, reducing pesticide and antimicrobial use, transitioning to less animal farming, shifting towards plant-based diets, minimising food losses and waste, ensuring a just transition, and supporting a global transition that safeguards food security and the environment. Policies such as the EU's Farm to Fork (F2F) strategy (EC, 2020a) and the Strategic Dialogue for Future Agriculture in the EU (EC, 2024) align with this perspective, aiming to accelerate the transition to a fair, healthy, and environmentally friendly food system (Schebesta and Candel, 2020). The transition to a sustainable food system is both an economic opportunity and a cornerstone for achieving the objectives of the European Green Deal. It is essential for enhancing primary producer incomes and boosting EU competitiveness. EU policies are critical to driving this transformation, shifting the perception of food as a commodity to recognising it as a common good—a paradigm shift referred to as the 'great food transformation' (DG Research and Group of Chief Scientific Advisors, 2020).

In 2020, the Eionet Foresight Group, in collaboration with the EEA, launched the "Scenarios for a Sustainable Europe in 2050" project[1]. This co-creation initiative aimed to develop engaging, plausible, and contrasting visions of a sustainable Europe by 2050. In its first phase, the project introduced four distinct Imaginaries, each reflecting prominent sustainability discourses. These Imaginaries were designed to provoke thought and stimulate discussion about different interpretations of sustainability. The second phase examined how Europe's key production and consumption systems—food, energy, mobility, and the built environment—could evolve within the context of these four Imaginaries (Erdmann et al., 2022).

Box 1 summarises the Imaginaries for food systems, each offering a unique vision of a sustainable food system in 2050. These Imaginaries propose distinct strategies to tackle critical challenges such as climate change, biodiversity loss, and food security.

The transition pathways offered by the Imaginaries lead to diverse socio-economic outcomes and environmental impacts. This report leverages these Imaginaries to identify policy mixes to foster more sustainable food systems in the EU. The policy mixes are analysed in the context of the current policy landscape (Asquith et al., 2022; EC, 2024) to identify key strategic intervention areas for the EU in moving towards more sustainable food systems. Additionally, the report elaborates on the iterative and exploratory co-creation process involved in developing Imaginaries and transformative food policy mixes. This approach is distinctive in integrating various foresight methods to collaboratively design and examine transformative policy-mixes.

[1] https://www.eea.europa.eu/publications/scenarios-for-a-sustainable-europe-2050/the-scenarios

Box 1: The four Imaginaries for a sustainable food Europe in 2050

Technocracy for the common good

National governments wield significant influence over food systems, using digital tools for monitoring and control. Large businesses, guided by state influence, play a pivotal role but maintain political influence through lobbying. Urban areas become innovation hubs for startups focusing on alternative foods, while rural regions witness a decline in income and employment due to digitalisation in agriculture. Food commerce is primarily domestic and European, emphasising domestic growth and reduced reliance on global trade. Production undergoes a digital transformation, emphasising intensive mono-cropping, precision agriculture, and a shift from animal-based nutrition. Novel value chains, including seaweed and algae, gain prominence, contributing to environmental conservation. Diets shift toward locally produced, seasonal, and national foods, reducing animal-based proteins and focusing on health through personalised nutrition. Strong national economies support comprehensive governance of the food system, incorporating digital monitoring for sustainability indicators and a balanced approach to factors like soil health and biodiversity.

Unity in adversity

The EU responds to climate disasters, geopolitical challenges, and financial downturns with a united front, adopting a common constitution. The focus shifts to stringent, top-down environmental regulations, moving away from gross domestic product (GDP) as the primary economic indicator. Large-scale changes in agriculture and food production at the European Union (EU) level impact global trade and consumption patterns. Centralised European food governance leads to challenges with global regional blocks. Significant investments in nature, resilient infrastructures, and cooperative strategies address challenges. The urban landscape integrates natural elements, while rural areas adopt agroforestry and sustainable practices. Food production emphasises security, engaging civil society, and promoting diversity among farms. The shift towards organic and precision agriculture, along with alternative protein sources, emerges. Dietary preferences favour plant-based alternatives, legumes, and personalised nutrition. The governance model results in a resilient agricultural system, reduced sugar consumption, and conscious consumption. Regional supply chains and solidarity-focused policies contribute to reduced food waste and a secure supply chain. European institutions are crucial in transitioning leadership and redistributing activities between urban and rural areas.

The great decoupling

A liberalised global market economy shapes the food system, with large multinational corporations, particularly in biotech and agri-food, driving technological breakthroughs. Nation-states focus on wealth distribution and market regulation, promoting disruptive innovation. The EU's role diminishes without the Euro, catering to major global players. Nature serves as a source of ecosystem services for green growth. Technological advancements, responding to the global food crisis, drive the great decoupling and increase crop yields despite climate challenges. Agro-ecosystem designs and biotechnological innovations revolutionise food production, addressing environmental restoration and pollution. However, GDP growth detachment from environmental impacts leads to unequal well-being distribution. The bioeconomy, rooted in circular business models, accelerates through digitalised agri-food production. Competition for resources constrains open markets, and the circular system depends on biotech and digitalisation. Precision farming, cellular agriculture, and alternative protein sources characterise food production. Major players capitalise on short transport distances, and multinational corporations oversee distributed production. Biotechnological advancements introduce lab-grown meat, plant-based proteins, and insect-derived proteins, diversifying diets and promoting environmentally friendly choices. The use of genetically modified organisms (GMOs) in agriculture may increase, producing nutritionally enriched crops. Urban vertical farming and algae cultivation contribute to vegetable-rich diets. Personalised nutrition plans and innovative food products may emerge. Food policy emphasises food security equilibrium, with companies influencing affordability and accessibility. Limited state resources compromise food quality, and energy

prices influence logistics and local production profitability. Precision farming improves water quality, but access concerns persist, causing tensions globally.

Ecotopia

Local communities prioritise sustainability, adopting a socio-economic paradigm centred on sufficiency and frugality. Technology is used sparingly, and the focus shifts from profit and consumerism to intrinsic value in nature. Economic power is decentralised and vested in local communities and civil society organisations, leading to a dispersed population in ecovillages. Agriculture is smaller in scale, diverse, and organised around locality and season, with many Europeans becoming "prosumers." The energy sector is decentralised, and digital currencies are common. Food production is harmonious with nature, emphasising organic farming and agroecology. The concept of consumers evolves, and community brokers facilitate knowledge exchange and trade. Dietary habits in Ecotopia involve locally sourced, seasonal, and less processed food. Plant-based diets, with protein from legumes and soy, prevail, and agrobiodiversity is emphasised. Animal-based product consumption is significantly reduced, and there's a focus on understanding food origins. Active lifestyles contribute to higher calorie consumption, but healthier diets lead to fewer obesity cases. Food policies prioritise short supply chains, close producer-consumer relationships, and robust safety protocols. Diversified retail and community-supported agriculture are prevalent, although higher food prices due to sustainable practices necessitate ensuring food access for all. Non-carbon intensive agricultural methods are mainstream, and lands are restored to their natural state.

Source: Adapted from (Erdmann et al., 2022).

2 Methodological approach

2.1 Introduction

Food production and consumption represent a highly complex system influenced by different opinions, beliefs, experiences and preferences. Agricultural production follows, on the one hand, ecological constraints and, on the other hand, an economic logic driven by investment, trade and profits. Retailing and processing oligopolies exert significant market influence, shaping production and consumption patterns. Food environments created by retailers, the food industry, food services and restaurants directly affect consumer choices while aiming to meet consumer needs and desires (SAPEA, 2023; Turner et al., 2018). Food consumption is inherently a cultural phenomenon rooted in specific socio-cultural contexts and shaped by shared understandings and practices (Warde, 2016). Agricultural production, heavily reliant on subsidies, plays a vital role in rural economies (Asquith et al., 2022). Addressing such complex systems necessitates a tailored approach to steer and facilitate change. Effective management of transitions requires a combination of approaches, including strategic foresight, transition studies, and well-designed policy mixes. These approaches must be adaptive, participatory, and anticipatory, considering the dynamic nature of food systems and the diverse interests of stakeholders.

This case study is innovative and experimental in this sense, as it brings together methods used in transition research and strategic foresight, offering a novel approach to understanding and driving systemic change in food systems.

2.2 Steps in the project

The project had six main steps:

Desk Research:
The initial phase involved reviewing literature on food systems, including previous works by the EEA: (Asquith et al., 2022a; EEA, 2023a, 2017) ETC (Erdmann et al., 2022; Haraldsson et al., 2024; Lorenz et al., 2024), JRC (Albizzati et al., 2022; Bock et al., 2022; Ericksen, 2008; JRC, 2021), European Commission (EC, 2021, 2020a; E. Commission. D. G. for A. and R. EC, 2021), and European Committee of the Regions[2]) and other relevant sources of literature (e.g. (Dijkshoorn-Dekker, M.W.C. et al., 2022) This provided a comprehensive overview of the current state of European food systems, the existing EU food policy mix, and the EEA Imaginaries and alternative future-oriented considerations about a more sustainable food system. Next to the more content-oriented scoping, also various methodological approaches were explored to identify and test a suitable method and, at the same time, explore innovative alternatives. This included a methodological review of road mapping approaches and frameworks for defining problem frames and structuring analytical schemes for the road mapping exercise (Edmondson et al., 2019; Hebinck et al., 2022a; Silvestri et al., 2022).

1. **First Workshop:**
   On 27 June 2024, an online workshop was held with members of the EIONET Food Systems Group, EEA officials, and selected ETC experts. Using the Imaginaries, the workshop focused on identifying key policy intervention points in European food systems and exploring links between near-term policy decisions and their long-term socio-economic outcomes and environmental impacts. Tools such as the **Futures Wheel** (see section 2.3) and **X-Curve (see section 2.4)** were employed to facilitate this process.
2. **Desk Research (Follow-Up):**
   Building on insights from the first workshop, the team reflected upon the Imaginaries, identifying potential inconsistencies within them and policy levers for each scenario. Specific policy instruments were outlined for each lever to support each Imaginary's different phases of

[2] https://cor.europa.eu/en/our-work/commissions/nat#toc-opinions , accessed December 2024

transitioning food systems (emergence, acceleration, stabilisation). Detailed narratives for each Imaginary were developed, highlighting commonalities and differences. This step required integrating workshop findings with the team's food system expertise, laying a solid foundation for the morphological analysis.

3. **Morphological analysis:**
   The identified policy instruments were grouped into categories based on their focus (e.g., primary production, consumers). These categories yielded a set of distinct groupings (dimensions), with policy options for each dimension initially derived from the corresponding policy instruments. Options were designed to encompass a broad spectrum of possibilities, ensuring distinct perspectives were represented. For example, in managing climate change, the options included an exclusive focus on mitigation, an exclusive focus on adaptation, and a balanced approach seeking synergies between adaptation and mitigation policies.
   A consistency check was performed to identify compatible and incompatible combinations across dimensions. Based on the consistency between policy options and different philosophical and practical perspectives, the team developed four consistent policy pathways: Nature First, High Tech, Top-down, and Mixed Approaches, which were subsequently analysed in detail in Chapter 8. These pathways represent possible routes toward sustainability. Thus, while the Imaginaries informed inputs for the morphological analysis, the analysis extended beyond them, leveraging the Authors' expertise.
4. **Second Workshop:**
   A second workshop, held as part of the EIONET Food Systems Group in Copenhagen on 2-3 October 2024, engaged participants in voting on policy options within each dimension. Votes were cast for options closest to current policies, the most feasible, and the most desirable. Additional feedback was collected on the morphological box, particularly regarding selecting options and groupings.
5. **Analysis and Comparison:**
   The final step involved analysing the results and comparing them with existing EU strategic food policy documents, including the European Commission Farm to Fork Strategy (Asquith et al., 2022b; EC, 2020a) and the Strategic Dialogue on the Future of EU Agriculture (EC, 2024) to assess alignment and identify gaps to inform future policy development.

Below, we provide more background on the main tools used (X-Curve, the Future Wheel, and the Morphological Analysis) and more detail on how we applied them.

2.3 Futures wheel

2.3.1 The approach

The Futures Wheel is a foresight method developed by Jerome C. Glenn in 1971. It is designed to graphically visualise the direct and indirect future consequences of a particular change or development (Glenn, 2009). It is a structured brainstorming tool that helps organise thinking and questioning about the future, allowing participants to explore the implications of social, economic, or technological changes.

Creating a Futures Wheel begins with identifying the central change or event to be analysed, placed at the centre of a diagram. Around this central node, participants brainstorm and position the direct consequences, known as first-order effects. These are followed by indirect or second-order effects around the first-order consequences, creating a layered, concentric structure. The Futures Wheel is widely used for its ability to provide a 'what if' experience, helping users anticipate the consequences of an action and the relationships between these consequences. It aids in developing multi-conceptual perspectives about possible future developments, offering a futures-conscious viewpoint that benefits group brainstorming sessions. By moving away from linear thinking, the Futures Wheel encourages a more network-oriented,

organic approach to problem-solving, which can reveal unintended consequences and complex interdependencies (Bengston, 2015).

While the Futures Wheel and the Impact Wheel share similarities in using visual diagrams to explore consequences, they differ in focus and application. The Futures Wheel is primarily concerned with the consequences of a given trend or event, emphasising foresight and exploring future possibilities (Inayatullah, 2008).

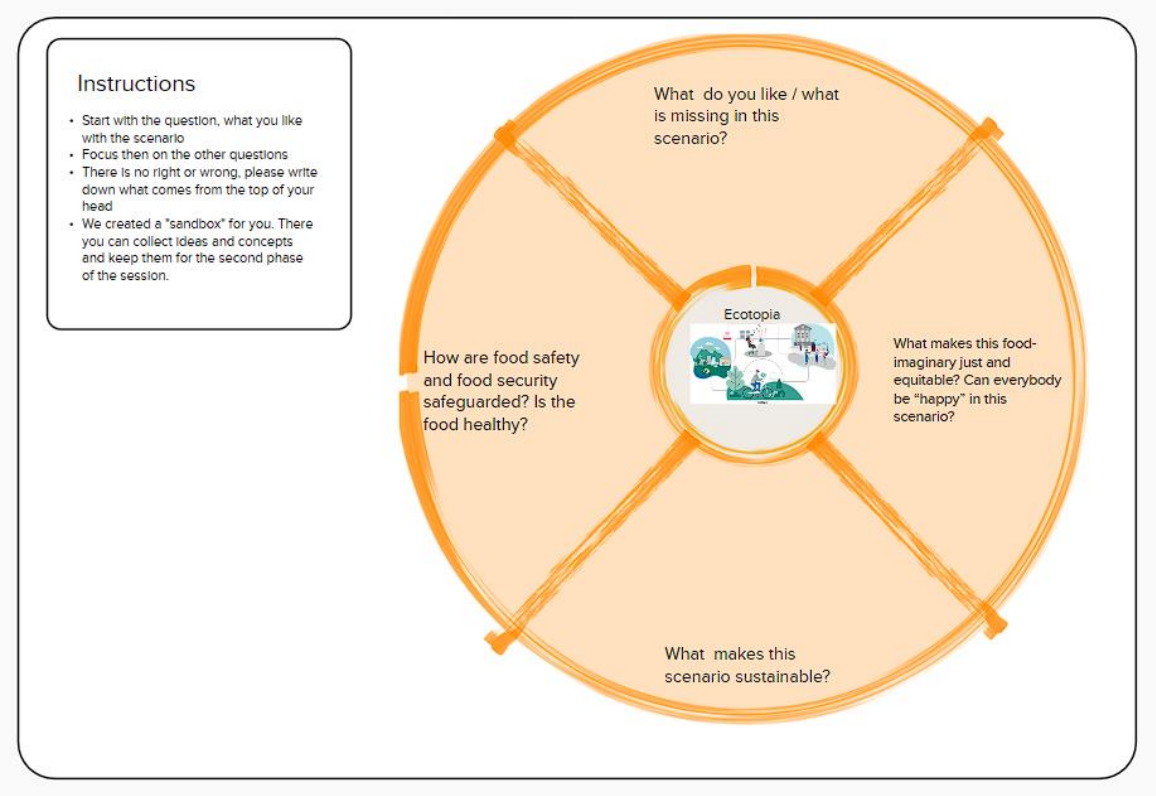
2.3.2 How we applied the Futures Wheel in this project

The Futures Wheel was a key component in the first workshop, serving as a tool to explore and refine the food-related aspects of the Imaginaries. Based on a detailed scenario description provided by the team, participants engaged with the following key questions:

- What aspects of the scenario did the participants find appealing?
- What elements were missing from the scenario?
- What makes the scenario environmentally and socially sustainable, particularly concerning justice, equity, food safety, and food security?

Participants recorded their reflections on *post-it* notes and placed them within a Futures Wheel template (see Figure 1). The Futures Wheel provided a structured and visual approach allowing participants to engage conceptually with the scenario, exploring its broader implications. By examining its environmental and social dimensions, participants gained a clearer understanding of the core elements of the scenario. This activity effectively prepared participants for the subsequent X-Curve exercise, enabling them to approach the analysis with a more informed perspective. As a result, they were better equipped to identify the critical changes required to transition toward a sustainable food system.

Figure 1:The Futures Wheel template used in the First workshop



Source: Developed by the authors

2.4 The X-Curve framework

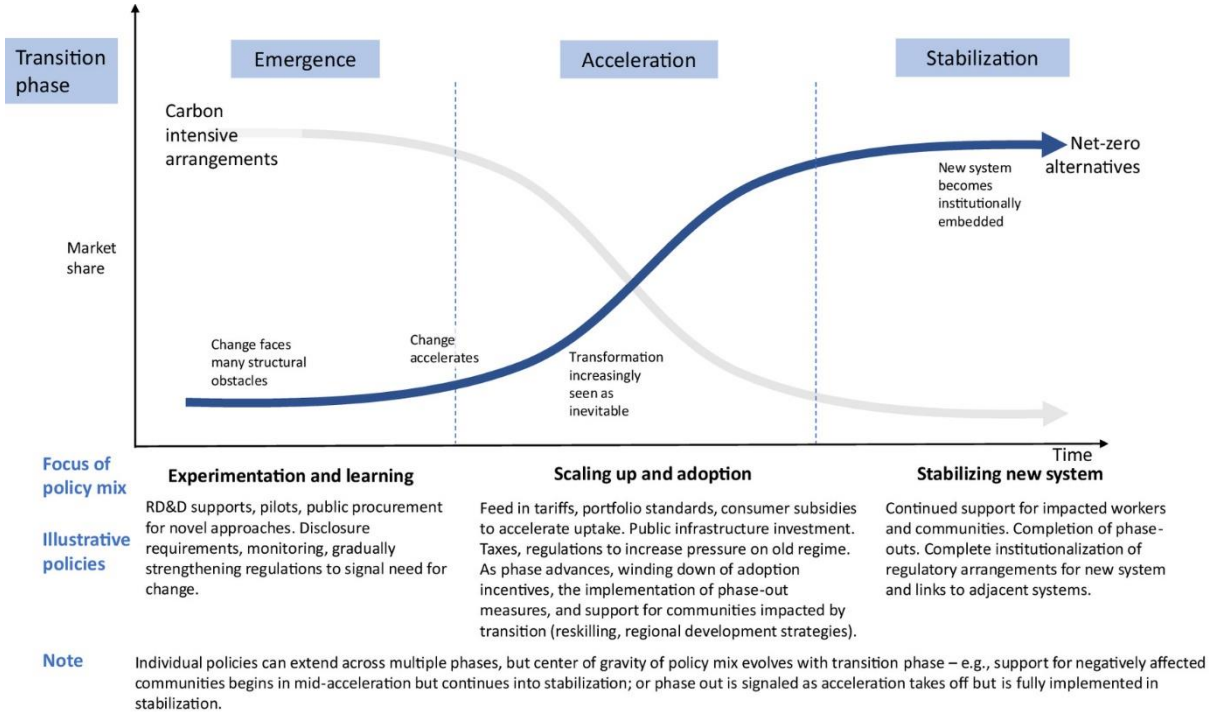
The X-Curve framework is a powerful tool for visualising and managing systemic transitions (Silvestri et al. 2022). It balances the interplay between the build-up of new sustainable practices and the breakdown of unsustainable systems. It provides policymakers and stakeholders with a structured approach to designing targeted interventions, ensuring that societal transformations are both effective and just (Hebinck et al., 2022). The X-Curve has been widely adopted by EU institutions, agencies and international organisations to develop pathways from diverse scenarios. Notable recent applications include the 2023 Strategic Foresight Report by the European Commission Joint Research Centre (Matti et al., 2023) and the Global Foresight Report on Planetary Health and Human Wellbeing by the UN Environment Programme (United Nations Environment Programme, 2024).

2.4.1 Theoretical Foundations of the X-Curve

Sustainability transitions are complex and long-term processes of structural change that enable societal systems to become sustainable. These include profound changes in the dominant ways of doing, thinking, and organising, as well as underlying institutions and values that shape societal systems (Loorbach, 2014). This entails decisions about the direction of change in a context where there are many legitimate perspectives on desirable futures and how to reach them. These large societal processes of change are made up of interacting processes of build-up and breakdown of systems (ibid.; Hebinck et al., 2022; Kivimaa and Kern, 2016a): for the institutionalisation of a 'new' and sustainable system, the 'old' and unsustainable parts of the current system must be broken down. Such change processes are highly political as they include decisions about what change is desired, including both winners and losers of change (Patterson et al., 2017). For sustainability transitions to progress justly, questions of justice need to be reviewed in light of these 'twin dynamics', exploring how changes in the system affect different groups of people, places, and nature (EEA, 2024a).

Different phases of transition can be targeted with specific mixes of policy (Figure 2) (Kaljonen et al., 2024; Kanger et al., 2020). In the emergence phase, policy instruments supporting experimenting and learning are critical, whereas, in the acceleration phase, attention needs to be directed to scaling up and adopting innovations. At the same time, it is essential to introduce, e.g. taxes or tariffs, to increase pressure on the old regime and support people and communities in transition, e.g. by reskilling and with the help of regional development strategies. In the stabilisation phase, continued support to impacted workers and communities is needed in addition to the completion of the phase-out and institutionalisation of novel regulatory arrangements. Clear target-setting and cross-sectoral cooperation are required to steer the directionality of the policy mixes.

Figure 2: The focus of policy mixes in different phases of transition



Source: (Meadowcroft and Rosenbloom, 2023)

The X-curve, combined with a conceptual framework on policy intervention points for sustainability transitions (Kanger et al., 2020), formed the backbone for the previous EEA analysis on the EU food policy mixes (Asquith et al., 2022). This combination provided a robust framework for contextualising the policy actions needed to drive the transition toward a more sustainable food system. This report and its results were utilised as a key reference point for the gap analysis between current and future policy mixes.

The complexity of food systems must be acknowledged when imagining, co-designing or evaluating policy mixes. Achieving a fully coherent policy mix will never be possible. Still, the X-curve can serve as a valuable tool to guide thinking toward appropriate policy interventions at each phase of the transition. It provides a framework for directionality, helping to identify which policy measures need to be in place before introducing subsequent ones. For example, it can inform decisions on when to phase out or redirect existing agricultural support systems, ensuring a structured and strategic approach to transition.

2.4.2 How we applied the X-curve framework in the project

The X-curve framework was applied during the first workshop and the subsequent desk research to identify and characterise different pathways in the respective Imaginaries.

First workshop

In the first workshop, the X-curve was used to map the transition to a sustainable food system. Following the Future Wheel exercise, participants used Post-it notes (see Figure 3) to identify the following:

- Key elements of the current food system that require change;
- New activities and practices that need to be scaled up for sustainability;
- Existing activities and practices that should be phased out.

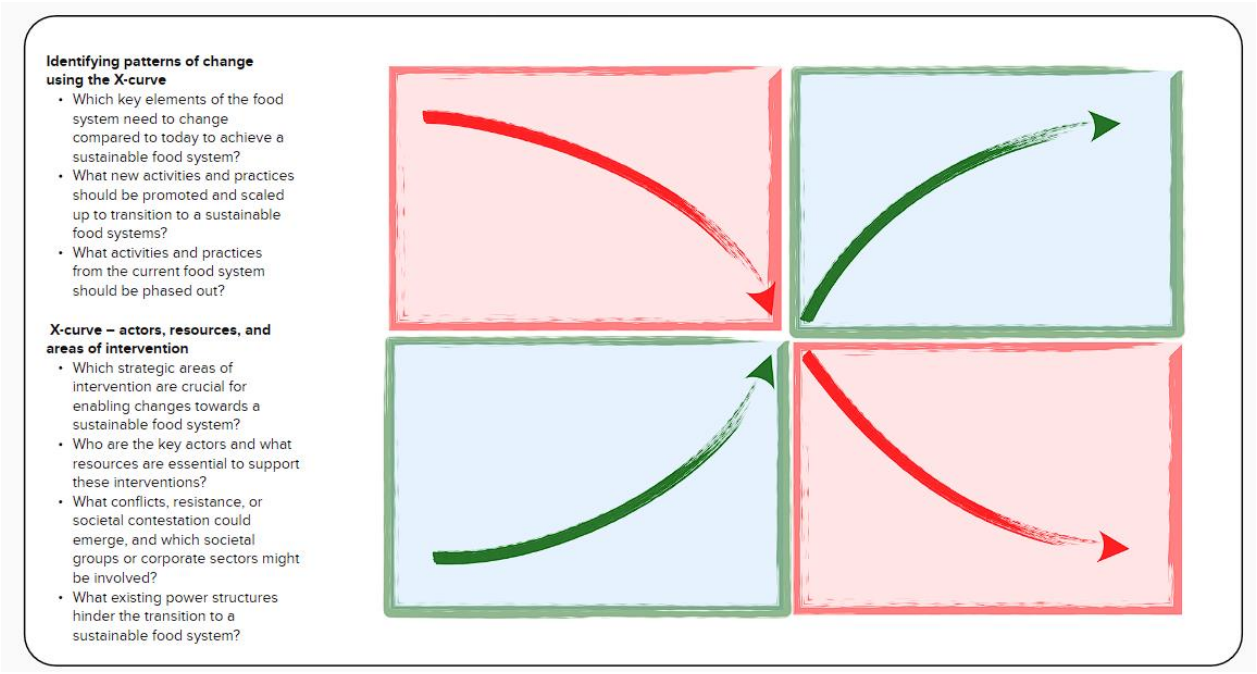
Participants placed their inputs on the X-curve to visually represent the transition processes, highlighting policies required to facilitate these changes. They focused on phasing out unsustainable practices and scaling up sustainable ones. The exercise emphasised the temporal sequence of (policy) actions, with achievements placed in a simplified timeline to illustrate the progression of change.

Additionally, participants were tasked with exploring key questions:

> Which strategic areas of intervention are crucial for enabling changes towards a sustainable food system?
> Who are the key actors, and what resources are required to support these interventions?
> What conflicts, resistance, or societal contestation could arise, and which societal groups or corporate sectors might be involved?

The session concluded with a group discussion to refine and align the inputs, setting a strong foundation for further analysis in the desk research phase. This collaborative approach provided valuable insights into phasing out unsustainable practices, scaling up sustainable ones, and addressing the broader challenges of transitioning to a sustainable food system.

Figure 3: The X-curve template used in the first workshop



Note: The figure shows a blank canvas without stickies for better readability.

Source: Developed by the authors

Post-Workshop Analysis of the X-Curve Results

Following the first workshop, the team conducted an in-depth analysis of the X-Curve results to refine insights and develop sustainable food system scenarios for each Imaginary. Narratives for each scenario were developed (1) covering the key components of sustainable food systems within each of the Imaginaries, (2) pin-pointing key strategic areas of intervention, and (3) detailing a bit more the policy mixes needed in different phases of transition to reach the imagined sustainable state. In point (3), the focus was to identify measures to:

- Foster the emergence of sustainable practices.
- Scale up successful initiatives.
- Phase out practices incompatible with sustainability goals. Ensure long-term stability of newly established systems.

This phase focused on developing a logical sequence of measures to guide the transition effectively. This analysis integrated workshop findings with the team's expertise, providing a robust foundation for the subsequent morphological analysis**.** The analysis synthesised the workshop insights with expert evaluations, leading to actionable recommendations for fostering emergent practices, scaling up successful initiatives, and ensuring the long-term institutionalisation of sustainable systems.

The X-Curve proved instrumental in structuring discussions and aligning diverse stakeholders, and clarifying the pathways and policies necessary for systemic change. Its application in this project highlights its potential as a strategic framework for addressing complex sustainability challenges across various domains.

2.5 The Morphological Analysis

2.5.1 The Method

The Morphological Analysis (MA), also known as General Morphological Analysis (GMA), was developed by Fritz Zwicky, a Swiss astrophysicist, to explore possible solutions to complex, multidimensional, and non-quantifiable problems. This method is particularly useful in fields where traditional causal modelling and simulation are ineffective, such as engineering design, technological forecasting, policy analysis and foresight. Zwicky applied MA to various fields, including astrophysics, jet and rocket propulsion systems, and even legal aspects of space travel. He believed that by thinking morphologically, we could shape the future through innovative ideas rather than being constrained by existing institutions. Zwicky described this approach as 'totality research,' aiming to derive all possible solutions to a given problem unbiasedly (Ritchey, 2018; Zwicky, 1967).

The process of MA involves several steps. Initially, the problem is broken down into categories or parameters, each assigned a range of values. These values are combined to explore all possible configurations, creating a 'solution space'. A critical part of this process is the 'cross-consistency assessment,' which helps reduce the total set of configurations to a smaller, internally consistent set. This method is particularly effective for problems with many governing factors that cannot be expressed numerically (Álvarez and Ritchey, 2015; Ritchey, 2018).

In strategic foresight, MA explores alternative futures by visualising diverse combinations of identified trends and uncertainties. This involves constructing scenarios around key uncertainties and expanding the scope by manipulating more variables through a morphological analysis matrix (Weimer-Jehle, 2024).

The same approach can be applied to strategy developments, where optional actions/measures can be combined and assessed for consistency and coherence. This approach can also be used to check policy mixes. However, the term "policy mix" can be understood differently. In transition research, a policy mix refers to a combination of measures supporting the different phases of a transition process (emergence,

acceleration, and stabilisation). A policy mix can also be understood as a combination of different measures that work together consistently to reach a specific goal. In the latter case, the guiding criteria for the policy mix is the internal consistency and coherence of the combination of measures. The following steps are applied to realise a morphological analysis (Ritchey, 2018):

1. Identifying and defining the parameters (or dimensions) of the problem complex to be investigated
2. Assigning each parameter a range of relevant values or "states" (option or variant).
3. A morphological field— also known as a "Zwicky box"—is constructed by comparing the parameters in an n-dimensional configuration space.
4. A configuration contains one value from each parameter, thus marking out a particular state or (formal) solution in the problem complex.
5. If the field were small enough, the working group could examine all the configurations in the field to establish which are consistent, possible, viable, practical, interesting, etc., and which are not.
6. If there are four parameters with four variants each, the box contains 44=256 (parameter exp options) possible combinations.
7. Thus, the next step in the analysis process is to examine the consistency of the relationships between the field parameters and "reduce" the field by weeding out all mutually contradictory conditions. As each pair of conditions is examined, a judgment is made whether – or to what extent the pair can coexist, i.e. represent a consistent relationship.
8. There are two principal types of inconsistencies involved here: purely logical contradictions (i.e. those based on the nature of the concepts involved) and empirical constraints (i.e. relationships judged to be highly improbable or implausible on empirical grounds).

Figure 4: Schematic overview of a morphological box

Parameter P1	Parameter P2	Parameter P3	Parameter P4
Option 1.1 / Variant 1	Option 2.1 / Variant 1	Option 3.1 / Variant 1	Option 4.1 / Variant 1
Option 1.2 / Variant 2	Option 2.2 / Variant 2	Option 3.2 / Variant 2	Option 4.2 / Variant 2
Option 1.3 / Variant 3	Option 2.3 / Variant 3	Option 3.3 / Variant 3	Option 4.3 / Variant 3
Option ...1.n /Variant ...m	Option ...2.n /Variant ...m	Option ...3.n /Variant ...n	Option ...4.n /Variant ...n

Note: This is a schematic representation of a morphological or a so-called Zwicky-box. A possible configuration is marked in light grey (options 1.2, 2.2, 3.3, 4.1). A box with four parameters and 4 options each has 256 possible combinations.

Source: Own compilation, based on Ritchey (2018)

2.5.2 How we applied morphological analysis in the project

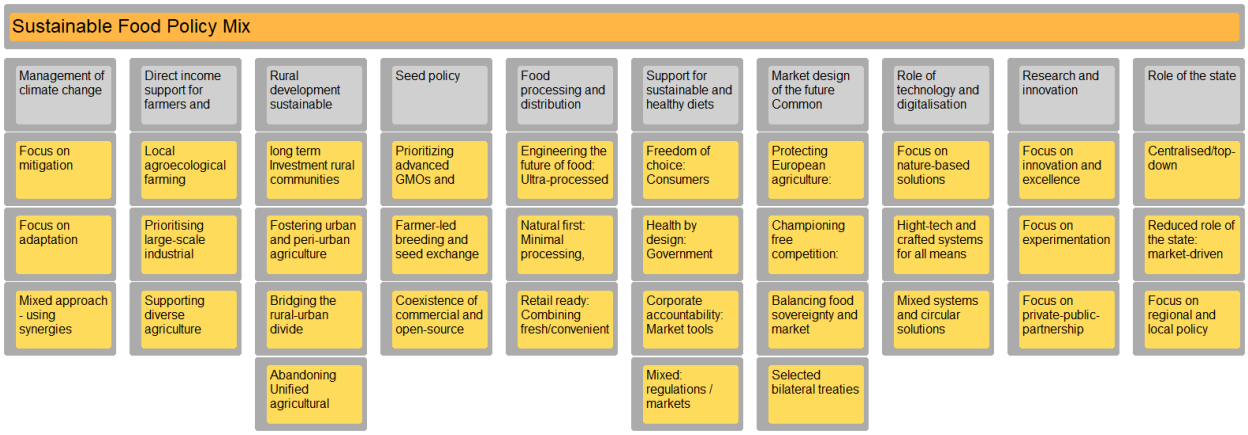
The morphological analysis was conducted to identify coherent and feasible policy combinations for sustainable food systems. The analytical framework was developed through a bottom-up approach, informed by the X-curve framework and workshop outcomes.

The development of the morphological analysis framework followed a structured and systematic approach. First, a comprehensive set of actions and measures was gathered from the X-curve workshops

and systematically clustered into key intervention areas. These clusters served as the fundamental parameters of the morphological box. For each intervention area, a range of options was identified from the initial X-curve analysis and subsequent deliberations. The final morphological box represented a synthesis of insights gathered during the workshop preparation and the actual workshop proceedings.

While the x-curve approach focuses on a temporal sequence, the morphological box is more static. However, as the alternative approaches identified for the morphological analysis are based on the x-curve material, the temporal scale is somewhat connected. However, due to the lack of resources, a profound analysis of the temporal sequence “inside” the morphological box was not done. This circumstance and outlook is briefly discussed in Chapter 70.

Figure 5: The morphological box for a sustainable food policy mix



Note: This figure is a screenshot, mainly aimed to illustrate the morphological box. For technical reasons, some titles are not fully visible. Please consult annex 1 for a full description of the morphological box.

Source: Own elaboration. Screenshot from Parmenides Eidos™, October 2024.

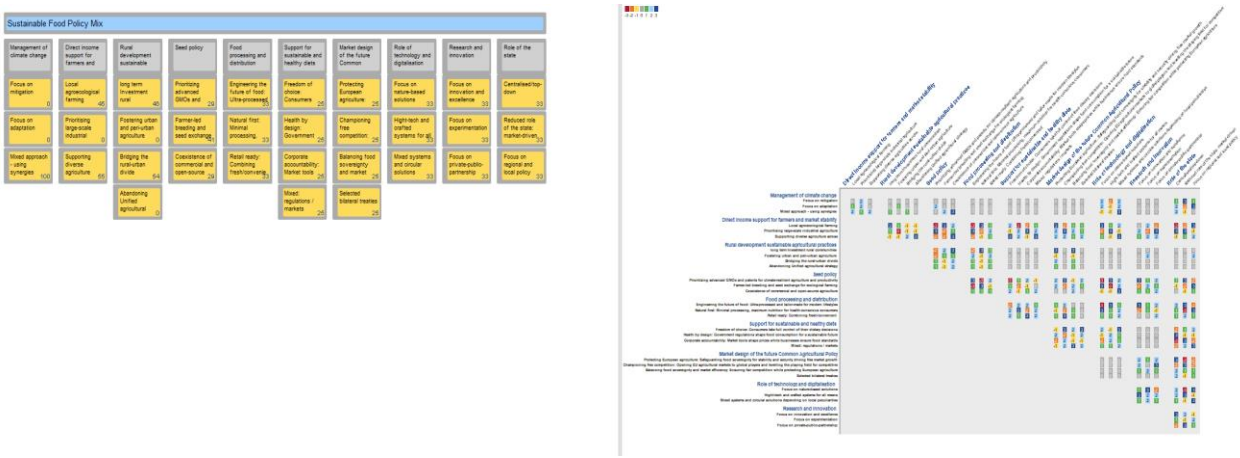
The "seed policy" parameter is a representative example to illustrate the parameter development process. This parameter emerged directly from discussions during the Ecotopia workshop. Three distinct policy options were identified:

1. Genetics and patents approach focussing on resilient and efficient agricultural production through modern biotechnology;
2. Traditional farming approach emphasising farmer-led seed reproduction and heritage varieties.
3. Hybrid approach combining elements of both strategies while maintaining strong regulatory oversight.

- The options outlined in the box range from those closely aligned with current policies to more innovative concepts that may require extensive political negotiation and may not yet be highly feasible. Depending on context and experience, specific options may be preferred over others. To facilitate discussion, participants were presented with three key questions: Which option is closest to today?
- Which option is most feasible?
- Which option is most desired?

Participants of the EIONET Food Expert Workshop provided their responses, and the results are illustrated in Figure 13. The general purpose of the morphological box is to identify coherent and consistent combinations of policies. A policy mix derived from the morphological box consists of one option selected for each policy intervention area. To ensure consistency across the selected options, software was utilised, and the authors completed a consistency matrix.

Figure 6: Morphological box and consistency analysis



Note: This is a screenshot taken from the software Parmenides Eidos ™. The left side provides an idea of the morphological box, whereas the right side shows an overview of the consistency matrix.

Source: Own elaboration. Screenshot from Parmenides Eidos™, October 2024.

Each option underwent a pairwise consistency check with all other options. The assessment employed a three-point scoring system: a score of "-3" indicated mutually exclusive options, "0" represented independent options, and "+3" signified mutually supportive options. This comprehensive analysis generated more than 135,000 potential combinations, from which the most consistent policy mixes were identified through subsequent cluster analysis.

The consistency assessment involved multiple expert evaluations. Each expert in the ETC team independently completed a consistency matrix. While individual matrices revealed notable variations in specific assessments, a striking pattern of convergence emerged across five matrices. This alignment enabled the identification of four distinct policy mixes that exhibited strong consistency across all expert evaluations, reinforcing the reliability of the analytical approach.

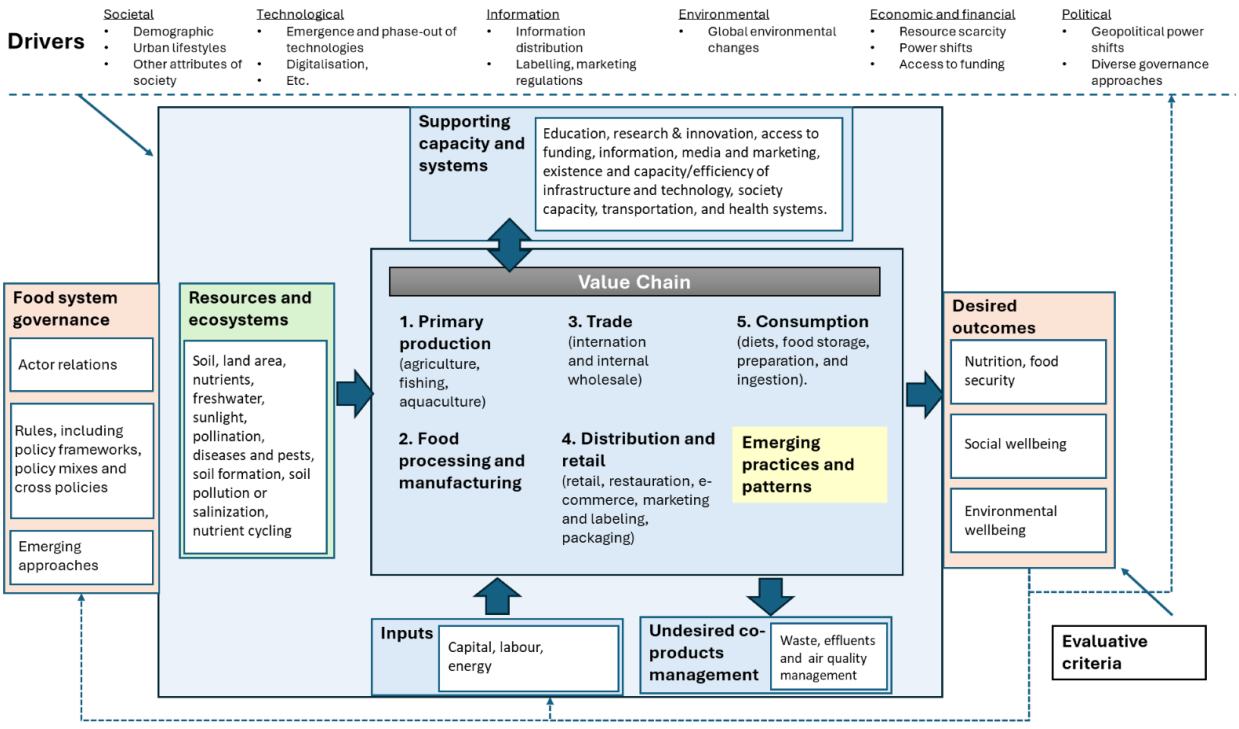
3 The current state of the European food system

Food systems are inherently complex, comprising numerous interconnected components, including key drivers, capacities, value chain processes, and desired outcomes. Figure 7 provides an overview of these elements, highlighting the influence of societal, technological, informational, environmental, economic, and political drivers in shaping the food value chain, resource use, and emerging practices. The value chain spans primary production, processing, trade, distribution, and consumption, all supported by inputs like capital, labour, energy and resources and ecosystem functions. Central to the system are supporting capacities—education, infrastructure, technology, and societal engagement—that drive efficiency and sustainability.

The desired outcomes regarding nutrition and food security, as well as social and environmental well-being, are always essential to keep in mind when assessing the functioning of food systems (Ericksen, 2008). However, as noted in the introduction, food systems often fail to deliver these outcomes comprehensively. Moreover, food systems have undesired co-products, such as waste and pollution, even as they aim to achieve nutritional, social, and environmental sustainability goals. To achieve these outcomes, it is essential to understand how the food value chain functions, utilises resources and inputs and builds capacities. This understanding enables the development of more targeted and effective policy mixes. Foresight and imaginaries, as applied in this report, can offer valuable insights into how drivers may change along different trajectories.

Figure 8 and subsequent sections below outline the key sustainability challenges currently associated with food production, processing, distribution, consumption, and governance in the EU. These challenges underscore the importance of aligning the functioning of the food value chain with desired outcomes to address existing gaps and foster sustainable food systems.

Figure 7: Framework of Food System Dynamics: Drivers, Value Chain Processes, Governance, and Desired Outcomes



Source: Own elaboration, based on Background report, Food System, Task 3.1.,2022, ETC ST.

3.1 Food production, processing and retail

Primary food production in Europe encompasses agriculture, fishing, and aquaculture, significantly shaped by the EU's Common Agricultural Policy (CAP). This sector employs 12 million farmers, 100,000 fishers, and over 300,000 workers in related industries. However, the number of farms declined from 14.5 million in 2005 to 10.3 million in 2016, driven by workforce ageing and consolidation into larger, and more extensive operations (Eurostat, 2022a).

The food manufacturing sector is a major economic driver, employing 4.5 million people and generating a turnover of €1,093 billion, representing 7% of the EU's GDP (FoodDrink Europe, 2022). SMEs dominate the industry, comprising 99.1% of companies. A relatively small number of food and drink manufacturers and wholesale suppliers significantly influence upstream production and downstream retail and consumer services (EEA, 2017).

European agriculture reflects diverse climates, soils, and socio-economic conditions shaped by EU regulations, subsidies, and trade policies. Since the 1950s, technological advancements have boosted productivity, with arable land comprising 60% of agricultural areas alongside permanent crops and grasslands. Despite these gains, intensive monocultures pose risks to biodiversity, soil health, and water quality. Nevertheless, 9% of farmland is within Natura 2000 sites (EC, 2017), 30% is high-nature-value farmland, and organic farming now covers 9.1% of agricultural land (Eurostat, 2021).

The food system remains heavily reliant on fossil fuels for transportation, machinery, and synthetic inputs, though sustainable practices, such as extensive grazing and small-family farming, persist. Global trade and technological integration further link European food production to international supply chains.

Agriculture accounts for 11% of EU greenhouse gas (GHG) emissions[3] and is highly vulnerable to climate change. While emissions from other sectors have decreased, agricultural emissions have stagnated since 2005 (EEA 2022a). Additionally, the sector is a primary source of soil, water, and air pollution and biodiversity loss (EEA, 2019b), with ammonia emissions representing 94% of the EU total (EEA, 2022a). Fisheries face challenges like overfishing, habitat destruction, and stock declines, particularly in the Mediterranean and Black Seas.

Achieving sustainability in European food systems requires ecological practices, reduced chemical use, sustainable resource management, and dietary shifts to lower environmental impacts.

3.2 Food consumption

Over the last 50 years, European food consumption has shifted significantly due to socio-cultural, economic, and policy factors. Animal protein intake is 50% higher than in the 1960s, while energy, red meat, sugars, salt, and fat consumption exceed recommended levels (Eurostat, 2020). In contrast, whole grains, fruits, vegetables, legumes, and nuts are under-consumed, contributing to rising obesity and chronic diseases like cardiovascular disease, diabetes, and cancer (Swinburn et al., 2019). By 2019, 52% of European adults were overweight, with obesity rates increasing across the EU (Eurostat, 2021).

Nutritional poverty and "hidden hunger" remain issues where individuals consume sufficient calories but lack essential nutrients (Benton et al., 2021). In 2019, one in 15 Europeans could not afford a nutritious meal every other day (Eurostat, 2021). Growing awareness of meat's environmental impact is driving a shift toward plant-based diets, particularly among women and the younger generation (Nicolau, 2021). However, dietary guidelines are only beginning to incorporate environmental considerations, offering limited support for low-meat or plant-based diets (Blomhoff et al., 2023; Costa Leite et al., 2020).

Changes in eating habits, such as cold meals, eating alone, and "snackification," reflect less home cooking, increased reliance on food delivery, and higher consumption of processed foods. This trend has contributed to rising packaging and food waste. Kitchens account for 30% of household electricity use, and

[3] This value excludes energy emissions from agriculture and LULUCF net emissions.

a quarter of purchased food is wasted. Households generated 55% of food waste on average in 2020 (Eurostat, 2022).

Dietary shifts are crucial for achieving a sustainable food system (Herzon et al., 2024; Willett et al., 2019). Current policies often focus on behavioural changes, with measures such as labels and information campaigns placing responsibility on consumers. This approach suggests that individuals can "consume their way out of environmental problems" (Soneryd and Uggla, 2015). However, this approach has limited impact due to consumer indifference, information-processing challenges, social norms, and structural barriers. Furthermore, food manufacturers and retailers significantly shape consumer choices through product offerings and marketing strategies (Asquith et al., 2022).

3.3 Food trade

Food trade significantly impacts food security and the environment. With increasing distances between production and consumption, European trade is driven by globalisation and resource competition. Between 2013 and 2023, EU trade in agricultural products had an average annual growth rate of 4.6 %, with exports (4.7 %) increasing slightly more than imports (4.4 %) (Eurostat, 2024). In 2020, the EU exported €179 billion worth of agricultural, fisheries, and food products to non-EU countries (Eurostat, 2021). Europe is a net exporter of meat, dairy, cereals, and wine while importing tropical fruits, coffee, cocoa, tea, soybean products, palm oil, and seafood. However, the export market share of the EU has been declining.

Most food consumed in the EU is produced within the bloc, but two-thirds of trade occurs between EU countries (Eurostat, 2021). However, over 30% of the land used to meet EU food demand lies outside Europe (IPES-Food, 2019). For instance, soybean imports 2018 occupied 4.7 million hectares (De Laurentiis et al., 2022), mainly in South America, linked to deforestation, environmental harm, and human rights abuses (IPES-Food, 2019). Feed imports for livestock and aquaculture add to land-use pressures and overfishing outside Europe, with imports meeting 70% of EU fish demand (EUMOFA, 2022). Using land for feed instead of food also raises food security concerns. As a major global trader, the EU can be pivotal in promoting sustainable and equitable food production and trade standards (Bock et al., 2022).

3.4 Food governance

Food governance encompasses public and private regulations, norms, and practices to achieve diverse food-related goals. The governance of Europe's food system is influenced by global economic and geopolitical shifts, changing values and lifestyles, environmental concerns, and stakeholder voices. Without policy intervention, future food systems risk prioritising competitiveness and exports over health, ecological and socio-economic objectives.

Power concentrations are notable in key value chain segments, including the seed, agrochemical industries, some manufacturing sectors, and retail, with the top 10 retail companies holding over 50% of the EU market (IPES-Food, 2017). Recent EU initiatives, like the Code of Conduct on Responsible Food Business and the Corporate Sustainability Reporting Directive, aim to address these dynamics, though progress has been challenging.

The Common Agricultural Policy (CAP), consuming 37% of the EU's 2014-2020 budget, primarily supports farmers and agricultural productivity, with secondary goals of rural maintenance and environmental protection. The 2023-2027 CAP aims for fairness, environmental focus, and performance orientation, with 40% of expenditure for climate action. However, the effectiveness of this approach depends on national strategic plans, with evaluations indicating the underuse of eco-schemes and limited expansion of compliance conditions (Asquith et al., 2022; Willard, 2022a).

Overall, while the EU has developed comprehensive policies for sustainable development in food, including the Farm to Fork strategy and biodiversity goals, inconsistencies and goal conflicts persist. When introduced, the F2F was evaluated as a game-changer in EU food policy due to its systemic focus (Matthews et al., 2023; Schebesta and Candel, 2020). In 2024, many of the policy initiatives put forward

in the F2F strategy have been halted, including one of its key proposals on the legislative framework for sustainable food systems. In 2024, the President of the European Commission Ursula von der Leyen commissioned a Strategic Dialogue on the Future of EU Agriculture (EC, 2024), which will guide the work of the EC when shaping its Vision for agriculture and food to be delivered in the first 100 days of President von der Leyen's second mandate. The current commission is tasked with revisiting the policy proposals in a changing environment. The changing geopolitical situation and the war in Ukraine have caused dramatic changes in agricultural output and input prices, also reflected in food price inflation. The war in Ukraine has underscored the need to ensure food security and maximise domestic production, putting these issues back on the EU agenda (Pellizzoni et al., 2024; von der Leyen, 2024).

4 The Future Imaginaries of a Sustainable Food Systems in Europe

The future of a sustainable food system varies significantly across the four Imaginaries. In the following sections, we outline (1) key characteristics of a sustainable food system within each of the Imaginaries, (2) strategic areas of intervention, and (3) an in-depth look at the policy mixes required at different phases of the transition to achieve the envisioned sustainable state. These narratives were co-created iteratively with participating stakeholders, including Eionet Food Systems Group members and EEA officials, as detailed in Section 5. The imaginaries differ a bit in their narrative format to acknowledge the original tone of discussions. After presenting the narratives for each imaginary (Chapters 7.1–7.4), we identify key commonalities and tensions across the proposed policy mixes.

4.1 European food systems in the 'Technocracy for the Common Good' Imaginary

4.1.1 Key characteristics of European food systems

In the "Technocracy for the Common Good" Imaginary, food production is localised across rural, peri-urban, and urban areas, eliminating the need for imports. Rural areas prioritise highly productive, automated agriculture, with low-yield left fallow. Food systems are managed by governments and operated by a mix of corporations, cooperatives, and social movements. Consumers adopt healthier diets centred on seasonal foods and alternative proteins, facilitated by targeted marketing and advanced technologies. Industry 4.0 technologies—robotisation, AI, automation, and digitalisation—are fully integrated, particularly in urban "food laboratories" that produce resource-efficient food year-round. Online shopping has become the norm, powered by carbon-free energy systems, with constant monitoring to optimise resource use and minimise inputs like water, energy, and fertilisers. This high-tech food system prioritises affordability while delivering sustainable and efficient food solutions.

4.1.1.1 Food production: "Efficient, automated food systems for localised production and nutritional security"

Rural food production is concentrated in highly productive, intensive, and technology-driven agriculture, requiring minimal labour due to extensive automation, while low-yield land is abandoned. Governments oversee food systems primarily operated by large corporations, complemented by cooperatives and social movements, leveraging centralised efficiency and a carbon-free energy supply. Advanced monitoring systems and continuous improvements in resource efficiency minimise water, energy, and fertilizer use. Technology-driven production methods, including vertical farming and alternative protein sources, enhance food security and ensure the availability of diverse, high-quality foods year-round. Nutritional needs are met through supplements and indoor farming, with technology critical in ensuring food safety and security.

4.1.1.2 Food consumption: "Encouraging sustainable eating: healthier choices in a Digital Age"

Consumers are shifting toward healthier diets, focusing on seasonal products, alternative protein sources such as algae and lab-grown proteins, and supplements. This dietary transformation fosters new habits, traditions, and social and cultural events centred around these foods. The food system reduces the resources required to produce less nutritious products by prioritising health and eliminating nutrient-poor diets. Most food shopping occurs online, with universal digital access available, ensuring affordability for all consumers. This dietary and cultural shift is actively encouraged to make healthier choices more appealing and desirable

4.1.1.3 Food retail, industry, and food services: "Government-supervised, sustainable food systems with a focus on local production"

Governments manage food systems using advanced technology to ensure nutrition, food security, and social and environmental well-being. Food production is concentrated primarily in urban areas, with consumption localised to reduce reliance on extended distribution networks. International food trade is eliminated as local production meets demand. Transport of food products is decarbonised, and marketing focuses on promoting locally produced, seasonal products, including innovative protein sources and supplements.

4.1.2 Strategic areas of intervention

4.1.2.1 Promotion of a digitally monitored, resource-efficient, and urban-centric food production system

This policy mix aims to transform food production by centralising and digitalising production processes across rural, urban and peri-urban areas. Key technologies such as precision farming, vertical farming, and alternative protein sources, like algae and artificial meat, will form the foundation of sustainable food hubs. Emphasis is on leveraging technology to maximise efficiency, minimise resource use, and establish a resilient and self-sustaining system. Digital monitoring powered by AI, blockchain, and automation enables real-time food production and distribution oversight, reducing waste, enhancing transparency, and preventing shortages.

Despite their promise, technological breakthroughs raise concerns about rural economies and traditional agricultural livelihoods. Increased automation, land repurposing, and urban-focused food production may reduce income and employment opportunities in rural areas. Equitable access to high-tech infrastructure, particularly for small producers and low-income populations, also remains a challenge. Public scepticism about alternative proteins and AI-driven monitoring regarding health, privacy, and ethics further complicates adoption.

In the emergence phase, efforts are put into promoting precision farming and monocropping systems using high-performance seeds tailored to local climates to maximise productivity and minimise resource use. Urban food hubs are developed through investments in vertical and indoor farming, supported by R&D on environmental impacts and pilot projects to test viability. R&D, pilot trials, and restaurant testing, emphasising health and environmental benefits drive the development of alternative proteins like algae and artificial meat. Technological innovation begins with R&D and pilot projects for digital tools such as AI and blockchain to prevent food shortages and manage supply chains autonomously.

In the acceleration phase, precision farming and monocropping expand through tax incentives, reoriented subsidies, and updated standards to encourage resource efficiency. Urban food hubs grow through similar financial and regulatory support, while the production of alternative proteins scales up with fiscal incentives, standards, and subsidies. Technological innovations for supply chain management progress to broader implementation.

In the stabilisation phase, these practices are maintained alongside continued R&I investments in food production processes. Strong environmental regulations, comprehensive pricing mechanisms, and sustained R&D ensure the stability of urban production, alternative proteins, and digital monitoring technologies, securing their long-term contribution to sustainable food systems.

Table 1. Policy mixes for the promotion of a digitally monitored, resource-efficient, and urban-centric food production system (Technocracy for Common Good Imaginary)

Key strategic policy intervention areas	Emergence	Acceleration	Stabilisation
Supporting precision farming and intensive monocropping systems	R&I support to urban indoor production systems.	CAP support to the acceleration of precision farming and high-performance seeds suited to local climates. Definition of standards and later, regulations, on efficiency and environmental performance of precision farming. Address financial barriers to upscaling	Maintain (and review) standards and regulations for precision farming and monocropping practices, alongside the use of high-performing seeds with minimal environmental impact. Ongoing R&I investment in innovative food production processes.
Support and accelerate urban food hubs	R&D support to low environment impact urban food hubs. Support piloting of urban food hubs.	Definition of environmental standards for vertical farming systems. CAP support for the acceleration of sustainable vertical farming systems. Taxing excessive resource use in urban hubs Address financial barriers to upscaling	Environmental regulation is well in place and updated as needed. Ongoing investment in R&D focuses on innovative and sustainable food production methods.
Acceleration of market share of alternative proteins for healthier diets and better food security	R&D support and piloting with alternative proteins, including health and environmental aspects.	CAP support for alternative protein acceleration Address financial barriers to upscaling Definition and implementation of standards or regulations on the production of alternative proteins for healthier diets (food safety regulations) and better food security	Environmental regulation is well in place and updated as needed. Regulation of food tariffs and prices are in place.Fiscal measures well in place and accepted. Continual R&DI on alternative protein sources and their environmental impacts.
Deployment of digital monitoring tools for better food security, sustainability and biodiversity	R&D support for technologies to manage supply chains more autonomously Pilot, experimentation and learning	Address financial barriers to upscaling Funding support to the implementation of monitoring tools Implement digital monitoring of food chains	Maintain digital monitoring to address food shortages

Source: Authors own elaboration based on the first and second workshops

4.1.2.2 Integrated policy framework for sustainable diets, rural transition, and decarbonization

This strategic area of intervention seeks to harmonise food, land, and energy policies to encourage sustainable dietary patterns, reduce reliance on animal-based products (while shifting to sustainable animal production systems), and create alternative income streams for rural areas as food production

increasingly transitions to urban and peri-urban settings. Key policy interventions include promoting plant-based diets, personalised nutrition, and locally sourced, seasonal foods, supported by public awareness campaigns and clear food labelling. Simultaneously, rural regions would be repurposed for renewable energy generation and agroforestry, ensuring economic stability while advancing decarbonisation goals.

However, the dietary shift from traditional, processed, off-season, nutrient-poor, or energy-rich products to healthier and more sustainable options, may face significant cultural resistance as it challenges entrenched food habits and social practices. Rural communities may also face economic vulnerabilities as food production and processing become increasingly urban and peri-urban centred. Given the potential economic losses, large agribusinesses are likely to resist the reduced focus on conventional foods and production processes, while consumers could struggle with the higher costs of sustainable products. The transition to alternative protein sources and healthy diets may also create market volatility.

To mitigate these challenges, in the emergence phase, the effort is directed at supporting rural areas affected by shifts to high-productivity land, food hubs, automation, and urban production. This includes alternative income opportunities like agroforestry and renewable energy (e.g., solar farms), alongside R&D and piloting automation in farming. Policy integration frameworks link food, land use, and energy, supported by programs like Horizon and LIFE. Efforts also involve piloting sustainability monitoring systems and advancing technologies like AI and blockchain to promote healthy diets and autonomous supply chain management.

Acceleration provides equitable support for farmers, establishes just transition mechanisms, and plans phaseouts of unsustainable practices. Actions include redirecting subsidies from carbon-intensive practices, implementing carbon taxes, funding agroforestry, and holding the food industry accountable. Monitoring systems expand to track agricultural progress, while markets for sustainable products are developed through certification, informational campaigns, price regulations, and retailer incentives.

Stabilisation integrates food, land use, and energy policies for sustainability and carbon reduction. It prioritises renewable energy R&D, updated environmental regulations, and effective fiscal measures. Stabilisation also ensures regular sustainability monitoring, price controls, ongoing research, and labelling and marketing regulations to support sustainable dietary practices.

Table 2. Policy mixes for sustainable diets, rural transition, and decarbonization (Technocracy for Common Good Imaginary)

Key strategic policy intervention area	Emergence	Acceleration	Stabilisation
Accelerating automation in agriculture production Support for rural areas affected decreased labour needs	R&D and piloting of automation in rural and urban farming	CAP support for automation in agriculture Cohesion policy instruments and just transition mechanisms for rural areas affected by shifts in food production. Major investments on farming education	Just transition mechanisms introduced and continue to assist the most affected farmers and regions.
Integration of food, land use, and energy policies to enhance sustainability.	Integration of policy frameworks linking food, land use, and energy for decarbonisation.	Address financial barriers to upscaling of agroforestry Increase CAP support to agroforestry, redirect	Maintaining R&D programs to advance renewable energy

	R&D support for decarbonisation of food and energy systems Piloting and experimentation of aligned practices, is supported by funding programs like Horizon and LIFE.	subsidies from carbon-intensive practices. Introduce carbon taxes to support decarbonization.	Environmental regulations are updated as needed
Supporting shift towards local, seasonal, and nutrient rich foods	Innovative public procurement Public disclosure of resource intensiveness of production (labels). R&D support to technologies for healthy diets promotion, autonomous supply chain management Piloting AI, blockchain, and automation to influence consumer behaviour effectively.	Research support to understand consumer adoption of new diets European level nutrition recommendations for healthy and sustainable diets Food law strengthened to regulate nutrient content and sustainability of food products Regulations and standards set for food labelling Code of conduct on responsible and marketing practices set Incentives or regulations for retail to include healthy, local, seasonal and sustainable produced goods in their spaces. Added Value Tax on food products changed to support healthy and environmentally friendly products. Regulation on food price and tariffs. Universal school meals programmes introduced across MS with legislative and financial support from the EU Informational campaigns targeted to consumers Support directed to strengthening food education at schools and by the third sector	Fiscal measures well in place and accepted by public Strengthened support to food education Ongoing R&D support Continued labelling, information campaigns, and marketing regulations to support sustainable practices

Source: Authors own elaboration based on the first and second workshops

4.2 European Food Systems in the Unity in Adversity Imaginary

4.2.1 Key characteristics of European food systems

In the Unity in Adversity Imaginary, climate disasters, geopolitical challenges, and financial downturns force the EU to come together, leading to the adoption of a common constitution. The policy focus shifts from GDP growth to prioritising security and resilience. A resilient Europe values its natural resources, land and regional specificities, safeguarding its borders to protect food production. This necessitates a centralised European food policy and governance framework. Food security becomes a cornerstone of agricultural and food policy, complemented by more stringent environmental policies to enhance resilience. These priorities extend to broader societal decision-making, where food security and resilience take precedence. This transition also significantly changes democratic decision-making processes, reflecting the pressing need for coordinated, unified action.

4.2.1.1 Food production: "Farmers are the solution"

Food production is optimised to secure the availability and stability of food supply across the common European agricultural market while supporting the coexistence of diversified farming systems across regions. This diversification fosters harmonious integration of large-scale, small-scale, and family-owned farms, contributing to the sector's resilience. Farmers have regained their bargaining power, and investments in food production have significantly increased, driving major generational renewal in farming. Improved economic conditions and profitability have revitalised the agricultural sector. Resilient agricultural products, plants, and methods resistant to extreme weather events are widely utilised to adapt to climate change and mitigate its impacts. Advances in plant breeding and genetic modification are pivotal in enhancing climate adaptability. Seeds and agricultural inputs are considered strategic assets akin to energy and critical minerals.

Sustainable practices such as organic production, regenerative agriculture and the use of legumes in crop rotation have become fundamental to increasing resilience. Urban and peri-urban farming, including vertical farming and community-based initiatives, have accelerated in response to heightened food security priorities, sparking renewed citizen interest in farming. Rural areas are flourishing, becoming central to a resilient and food-secure society. The transition also reshapes the public image of farmers, positioning them as key contributors to solutions for global challenges. Farmers' Unions have seized this opportunity to strengthen their influence in political decision-making. The Common Agricultural Policy (CAP) has regained prominence, increasing its share in the EU budget to support these essential changes. Investments in resilient farming practices continue to drive innovation, sustainability, and societal appreciation for agriculture's vital role.

4.2.1.2 Food consumption: "Food security entails healthier and sufficient diets"

The paradigm shifts from a focus on consumption to an emphasis on sufficiency. As higher consumption levels become unsustainable, many need to adjust their comfort levels. Food is recognised as a fundamental necessity, and basic needs such as food and nutrition security are prioritised over indulgence and pleasure, both in societal values and in policies guiding food consumption. Food security is redefined to encompass not only availability and stability but also equitable access and effective utilisation (FAO, 2006). Healthy and nutritious diets are emphasised to support environmental sustainability and resilience (Clapp, 2023). However, achieving widespread adoption of healthy diets remains challenging, even by 2050, presenting significant policy hurdles. Managing the transition requires careful planning and attention to ensure equity and acceptance. By 2050, excessive protein, salt, and sugar intake have been moderated, reflecting a societal shift toward balanced consumption. Nevertheless, the proportion of household expenditure allocated to food has risen, highlighting the centrality of food security and nutrition in policy and daily life.

4.2.1.3 Food retail, industry, and food services: "Big players lose their power and markets diversify"

The food chain's middle part, including the food industry and retail sector, has diversified significantly. The multinational companies have lost their dominance over market prices, enabling farmers to gain stronger bargaining power. European-wide food regulation now focuses on increasing transparency within the industry and retail sectors. Products available in the market are less processed and richer in nutrients. Citizens increasingly purchase food directly from the farmers and through innovative food co-operatives, fostering closer connections between producers and consumers. The food industry remains a major employer, driven by growth in small and medium-sized enterprises (SMEs). However, Europe's food industry is increasingly compelled to follow innovation trajectories established elsewhere, as societal support for innovation is redirected toward strengthening resilient primary production and ensuring nutrition security. Public food services, such as universal school meal programs, have expanded significantly, reinforcing nutrition security, supporting local food production, and enhancing community resilience. This evolution reflects a broader societal shift toward valuing sustainability, transparency, and equity in the food system.

4.2.2 Strategic areas of intervention

4.2.2.1 Ensuring food security and resilience is a key policy priority

In this Imaginary, the EU is committed to implementing consistent measures to optimize food production, fostering a resilient Europe while acknowledging regional specificities. This necessitates balancing competing priorities, but the increasing geopolitical and climate risks have made Europe and its citizens more accepting of stringent agricultural and environmental policies.

Already in the emergence phase, environmental regulation limits the sustainable use of natural resources and land. Escalating climate risks and the urgent need for adaptation have elevated resilience as a novel focus in environmental policy, highlighting the importance of integrative solutions to biodiversity loss, land degradation and climate change. Trade restrictions and tariffs limit reliance on external inputs in agricultural production. EU-level legislation on emergency stocks bolsters self-sufficiency in times of crises. In the acceleration phase, the restrictions on external inputs spur innovation in agricultural practices, promoting circular and sustainable production. Consequently, food safety laws must be updated to ensure the safe circulation of materials across the food chain while reforming seed policies and patents to enhance food security.

Policy support prioritises farmers who adopt resilient farming methods and innovations. In the emergence phase, support focusses on research and innovation, fostering advancement in resilient crops, farming techniques, plant breeding, digitalization, and more. Pilot projects, experimentation and learning networks (including CSA, urban farming, and regional hubs) are actively supported. In the acceleration phase, CAP is restructured to further incentivise resilient farming practices, technological adoption, and digitalisation. Direct payments in CAP continue, and cohesion policy instruments are expanded to enhance food security and resilience, particularly in regions with pressing needs. Member States align regional development programmes to foster regionally resilient food systems. This also allows more collaborative and deliberative planning processes.

"The resilient Europe" programme coordinates investments in food security and resilience, recognizing farmers as pivotal contributors to Europe's stability. With strengthened Farmer Unions, the program elevates farmers as food security champions. CAP has become more robust, with significant increases in direct payments. In the stabilisation phase, comprehensive EU regulations are introduced to optimise food production across the EU. These regulations stabilise the European food market, leveraging a full spectrum of policy measures, including subsidies, fiscal incentives, and informational campaigns. Investments are also directed towards farming and food education in schools to cultivate long-term awareness and expertise.

Table 3. Policy mixes for ensuring food security and resilience (Unity in Adversity Imaginary)

Key strategic policy intervention area	Emergence	Acceleration	Stabilisation
Ensuring food security by optimising food production and regulating food prices across Europe	Trade rules and tariffs introduced to safeguard food security within EU, including bans or quality criteria for imported inputs and goods Eu level legislation on emergency stocks put in place accompanied with collaboration around food security between the MSs	"Resilient Europe" programme launched together with updated targets and directing major investments to food security and resilience Regulation on food price and tariffs Major increases introduced to CAP direct payments	Regulation to optimise food production across the EU CAP is stronger than ever and its social acceptability is high
Accelerating shift towards environmentally resilient farming methods and crops "farmers as solution"	Environmental regulation set limits to the sustainable use of natural resources and land RDI support to resilient crops, farming methods, plant breeding, digitalization etc. Support to pilots, experimentation and learning (including CSA, urban farming, regional hubs)	Environmental regulation strengthens in setting limits to resilient use of natural resources and land CAP support directed to adoption of resilient farming practices, regenerative farming, adoption of novel resilient crops, legumes, nature-based solutions, digitalization etc. Updating of food safety laws to support circular solutions in agriculture Seed policies and patents reformulated to support food security. Insurance mechanisms developed to deal with climate risks Cohesion policy instruments and just transition mechanisms directed to enhance rural development and resilience in regions with major increase in the budget Extension programmes targeted to farmers. Major investments on farming education	Environmental regulation is well in place and updated as needed. Just transition mechanisms continue to assist the most affected farmers and regions Strengthened support to professional education in farming

4.2.2.2 Policies are utilised to diversify food markets and to enhance sustainable and healthy diets

A holistic understanding of food security, emphasising access, utilisation, and environmental impacts, has gained momentum in this Imaginary. This shift highlights the need for stronger control over the middle part of the food chain and the need to guide the whole food system towards healthier and sufficient diets. While policy measures mainly target primary production, stricter trade regulations are affecting industry operations, prompting a refocus on European markets (see Table 3 above). Legislation on emergency stocks also influence market dynamics, and the industry starts to focus its operations on European markets. To increase resilience, policies aim to diversify the consolidated structure of the food retail industry. Member States provide targeted support for SMEs to strengthen the resilience of food value chains.

In acceleration phase, regulations are introduced to enhance the transparency in food industry and retail operations, promoting sustainable and healthy food production and consumption. Agreed-upon standards for food labelling are implemented and the industry pilots a responsible code of conduct. The EU collects insights from Member States to further innovative public procurement, which receives increased support as a tool to pilot and promote resilient local production. Consequently, a mandatory code of conduct for responsible and resilient food businesses is established. Fiscal policies are redesigned, including a value-added tax reform that imposes higher taxes on unhealthy and unsustainable food products. The changes in the European constitution also give the EU the power to decide upon fiscal measures. In liaison with the tax reform, members states introduced contextually tailored social policy measures to support food security amongst the most vulnerable ones.

The EU is actively educating the public about a new reality of food as a necessity, encouraging citizens to consider what constitutes healthy, nutritious, and resilient food for themselves and for Europe. Management the transition requires careful attention socioeconomic impacts and social acceptance. The EU introduces its own nutrition recommendations, which inform revisions to food laws regulating nutrient content and sustainability standards for food products. Universal school meal programmes are legislated and financially supported across Member States, serving as a key strategy to promote healthy diets and nutrition security among younger generations. Public informational campaigns further engage consumers, and additional resources are allocated to strengthen food education in schools. In stabilisation phase the fiscal tools are well in place as well as the renewed curricula in schools.

Table 4. Policy mixes for diversifying food markets and enhancing sustainable and healthy diets (Unity in Adversity Imaginary)

Key strategic policy intervention area	Emergence	Acceleration	Stabilisation
Diversifying food markets for better food security Supporting shift towards healthy, sustainable and affordable diets	Piloting and experimenting responsible code of conduct Innovative public procurement	European level nutrition recommendations for healthy and sustainable diets Food law strengthened to regulate nutrient content and sustainability of food products Regulations and standards set for food labelling Code of conduct on responsible and marketing practices set compulsory Added Value Tax on food products changed to support healthy and environmentally friendly products. Social policy measures introduced (by MSs) to support food security (EU facilitates learning across MSs) Universal school meals programmes introduced across MS with legislative and financial support from the EU Informational campaigns targeted to consumers Support directed to strengthening food education at schools and by the third sector	Fiscal measures well in place and accepted by public Strengthened support to food education

4.3 European Food Systems in the Great Decoupling Imaginary

4.3.1 Key characteristics of European food systems

In the "Great Decoupling" Imaginary, a liberalised global market economy dominates, driven by technological breakthroughs spearheaded by multinational corporations (MNCs). Governance structures fragment as EU influence wanes, with state intervention giving way to market-driven approaches. Economic growth becomes decoupled from environmental impacts, and it is heavily reliant on advancements in biotechnology, precision agriculture, and digital innovations.

A duality of opportunities and challenges marks European food systems. On the one hand, technological innovation revolutionises food production, retail, and consumption, achieving significant gains in efficiency and sustainability. On the other, disparities emerge as smallholders and low-income populations struggle to adapt to the rapid pace of transformation. These dynamics highlight tensions between innovation and

equity, highlighting the need for targeted policies that balance market efficiency with social and environmental resilience.

4.3.1.1 Food production

In this imaginary, food production is transformed by cutting-edge technologies and circular economy principles. MNCs dominate the agri-food and biotech sectors, driving unprecedented improvements in crop yields and resource efficiency. Key advancements include the widespread adoption of genetically modified organisms (GMOs), cellular agriculture, and precision farming techniques.

Lab-grown meats and algae-based proteins have become mainstream, significantly reducing reliance on traditional livestock farming and lowering associated environmental costs. Urban vertical farming and controlled environment agriculture (CEA) address land scarcity and climate variability, enabling year-round production in dense urban areas.

However, these transformations create significant challenges. Proprietary technologies controlled by MNCs often exclude smaller producers, creating inequities in resource access. Smallholder farmers face significant hurdles competing in this high-tech landscape, relying on cooperatives and local initiatives for survival. Policies aimed at integrating smallholders into global supply chains are critical to addressing these disparities.

4.3.1.2 Food consumption

Technological innovations in personalised nutrition profoundly shape consumer behaviour in the "Great Decoupling" Imaginary. Digital platforms utilise AI and individual health data to create tailored dietary recommendations, promoting nutrient-rich and environmentally sustainable consumption.

While personalised diets enhance convenience and health outcomes for many, affordability remains a barrier for economically disadvantaged groups. High-tech food options, such as lab-grown meats and insect-based proteins, primarily cater to wealthier demographics, exacerbating inequality in dietary access. Public subsidies and educational initiatives are introduced to democratise access to these innovations.

Cultural resistance to novel food types, such as insect proteins, persists in some segments of society. Policymakers face the dual challenge of fostering acceptance of sustainable food alternatives while respecting cultural traditions. Targeted awareness campaigns and incentives aim to bridge this gap and encourage broader adoption of sustainable consumption patterns.

4.3.1.3 Food retail, industry, and food services

The food retail sector is dominated by MNCs that leverage AI and blockchain technologies to optimise supply chains, reduce waste, and improve transparency. Digital marketplaces flourish, offering consumers direct access to innovative food products tailored to their needs.

Automation transforms food services by streamlining production, distribution, and delivery. However, these efficiencies exacerbate employment disparities and concentrate market power among a few corporate actors. Small-scale producers and local retailers face significant barriers to entry, necessitating targeted policies to level the playing field.

The circular economy underpins industry operations, strictly adhering to recycling and resource recovery practices. While these practices significantly reduce environmental impacts, widespread adoption requires comprehensive regulatory support to ensure inclusivity and fairness.

4.3.2 Strategic areas of intervention

4.3.2.1 Ensuring food security and resilience through technological innovation

In the "Great Decoupling" Imaginary, food security is intrinsically linked to technological advancements. Policies prioritise R&D in biotechnologies, cellular agriculture, and climate-resilient crops, with public-private partnerships playing a pivotal role in driving innovation during the emergence phase. Pilot projects test the scalability of these innovations, providing insights that inform broader implementation strategies.

Technological solutions are scaled through market incentives and public education campaigns during the acceleration phase to foster acceptance and adoption. Efforts to integrate circular economy principles into food production gain momentum, ensuring sustainability remains a core objective. Regulatory frameworks are introduced to safeguard accessibility and equity, particularly for marginalised groups, while addressing potential disparities.

In the stabilisation phase, technological innovations are fully embedded within robust regulatory compliance frameworks, securing long-term food security. Policies aim to mitigate risks associated with MNC dominance, promote equitable access, and address environmental trade-offs. Comprehensive education programs for farmers and consumers are critical in consolidating these advancements and ensuring inclusive and sustainable food systems.

Table 5: Policy Mixes for Ensuring Food Security and Resilience through Technological Innovation (Great Decoupling Imaginary)

Key strategic policy intervention areas	Emergence	Acceleration / destabilisation	Stabilisation
Promoting Biotechnological Innovation	Public and private funding allocated to R&D for GMOs, cellular agriculture, and climate-resilient crops. Pilot projects to test the viability of new technologies.	Market incentives to scale adoption of advanced technologies. Public awareness campaigns and subsidies to foster adoption among consumers and producers.	Regulatory frameworks ensure equitable access and affordability of innovations. Long-term funding mechanisms to support continuous innovation.
Integrating Circular Economy Practices	Pilots for circular agriculture systems (e.g., waste-to-resource and regenerative farming). Incentives for the development of resource-efficient farming methods.	Subsidies and standards to encourage industry-wide adoption of circular practices. Insurance schemes were introduced to manage risks associated with climate variability.	Circular systems become mandatory under updated EU regulations. Compliance frameworks enforce sustainability measures across all production systems.

Supporting Equitable Access	Financial aid and training programs for smallholder farmers to adopt new technologies. Collaboration networks for smallholder cooperatives to share resources and knowledge.	Expansion of capacity-building programs for marginalised producers to integrate them into global supply chains. Stronger public-private partnerships to support inclusive innovation.	Comprehensive market access guarantees ensure the participation of smallholders. National and EU-level legislation ensures long-term support for vulnerable groups.

4.3.2.2 Diversifying food markets and enhancing sustainable and healthy diets

Diversifying food markets and promoting sustainable diets are essential strategies to address socio-economic and environmental challenges. During the emergence phase, significant R&D funding is directed towards alternative proteins, such as lab-grown meats and insect-based foods, with pilot projects developed through partnerships between MNCs and SMEs.

The acceleration phase focuses on scaling these innovations, supported by targeted tax incentives and subsidies and the establishment of clear regulatory standards. Consumer education campaigns focus on the health of alternative proteins' health and environmental benefits, fostering acceptance and reducing resistance. Innovative public procurement practices create demand for sustainable products, encouraging industry participation.

These policies are institutionalised in the stabilisation phase. Public nutrition guidelines incorporate sustainable dietary practices, while universal programs, such as school meal initiatives, ensure equitable access to healthy and sustainable food options. Circular economy principles are standardised across food retail and services, embedding waste reduction and resource recovery practices into industry operations, reinforcing long-term sustainability.

Table 6: Policy Mixes for Diversifying Food Markets and Promoting Sustainable and Healthy Diets (Great Decoupling Imaginary)

Key strategic policy intervention areas	Emergence	Acceleration / destabilisation	Stabilisation
Diversifying Protein Sources	R&D investments in lab-grown meat, algae-based proteins, and insect farming. Public-private partnerships pilot innovative food products in targeted communities.	Tax incentives and subsidies for alternative protein producers to expand market presence. Consumer campaigns highlight the nutritional and environmental benefits of alternative proteins.	Integration of alternative proteins into public dietary guidelines and national education programs. Mandatory labelling and certification ensure transparency and trust in new products.
Encouraging Circular Retail Models	Digital platforms and marketplaces pilot zero-waste retail systems. Policies target resource recovery practices at regional levels to foster collaboration.	Tax breaks for retail systems adhering to circular economy practices. Scaling digital marketplaces to underserved areas to ensure equitable food access.	Circular economy compliance becomes a legal requirement for food retailers and services. Incentives for industries achieving zero-waste and carbon-neutral operations.

Promoting Access to Healthy Diets	Universal school meal programs piloted in select EU regions to test their scalability. Informational campaigns focus on educating the public about the importance of sustainable diets.	Programs expand EU-wide, supported by nutrition education and awareness campaigns targeting families. VAT reforms tax unhealthy, unsustainable food products while subsidising healthy alternatives.	The institutionalisation of healthy dietary practices through EU legislation and funding. Public food procurement aligns with new dietary standards, supporting local and sustainable producers.
Strengthening Public Procurement	Innovative public procurement experiments support local, resilient food production.	National governments align public procurement policies with sustainability goals.	EU harmonises procurement standards, ensuring uniformity across Member States.

4.4 European Food Systems in the Ecotopia Imaginary

4.4.1 Key characteristics of European food systems

In the "Ecotopia" Imaginary, local communities reconnect with nature, using technology sparingly to promote sustainable lifestyles. Consumption and resource use are significantly reduced, shifting the socio-economic paradigm from profit and consumerism to sufficiency and frugality. Nature is intrinsically valued, and reduced resource use and economic activity have alleviated ecological pressures, though they have also diminished governmental resources. Power resides predominantly in local communities and civil society organisations, which take on essential roles in fulfilling collective needs like health and social care. Many have transitioned from urban living to ecovillages, leading to a more dispersed population. Economic activity is fragmented and localised, with sectors like energy and agriculture often managed by small-scale cooperatives. Europe has become more insular and less integrated into global economic networks.

4.4.1.1 Food production

Agriculture is small-scale, diverse, and centred around locality and seasonality. Many Europeans have become "prosumers," growing their food, and food chains shorten with a strong preference for local products. Organic farming and agroecology are standard practices supported by digital innovations such as precision farming and agro-drones. Abandoned agricultural regions are reinhabited, with resources managed to boost biodiversity and ecosystem health.

4.4.1.2 Food Consumption

Diets are primarily plant-based, with protein sources like legumes and soy replacing animal products. Agrobiodiversity and cultural diversity thrive through place-based food production. The sharp decline in consumption of animal-based products reduces environmental impacts, while genetic crop diversity supports climate adaptation. Nutrition focuses on raw, whole foods rather than supplements, resulting in healthier diets and lower obesity rates.

4.4.1.3 Food retail, industry, and food services

Food policy prioritises short supply chains and strong producer-consumer relationships. While the fragmented food supply chains raise food safety concerns, robust protocols mitigate risks. Retail becomes decentralised, no longer monopolised by large entities, with community-supported agriculture (CSA) and local markets thriving. Food prices are higher due to sustainable practices, necessitating measures to ensure equitable access, such as recognising the "right to food" and establishing innovative models enabling those with low incomes to obtain food non-monetarily.

4.4.2 Key Strategic Policy Intervention Areas

4.4.2.1 Managing and enabling the decentralisation: Revitalising rural communities – keeping cities alive

A decentralised and localised approach to food production and consumption can revitalise rural communities while maintaining the vibrancy and connection of cities to their local food systems. Central to this vision in the **emergence phase** is facilitating access to agricultural land for regional and local food production and empowering society to self-organise around sustainable food practices.

To enable access to agricultural land, policies must prioritise land redistribution to small-scale farmers and cooperatives, encouraging diverse and regenerative farming practices. This can be achieved through land reform measures, such as providing incentives for large landowners to sell or lease portions of their land to smaller producers. Additionally, establishing community land trusts can ensure that agricultural land remains affordable and accessible for local food production.

Simultaneously, urban planning policies should promote the integration of agriculture into cities through initiatives like community gardens, rooftop farms, and vertical farming. These urban agricultural spaces provide fresh, local produce and serve as hubs for community engagement and education around sustainable food practices. This decentralised model strengthens regional food systems and reduces dependence on long-distance food transportation by fostering a symbiotic relationship between urban and rural areas.

Empowering society to self-organise around sustainable food practices is crucial for the success of this decentralised approach. This can be achieved by promoting food policy councils, which bring together diverse stakeholders to develop and implement local food policies. These councils can serve as platforms for knowledge sharing, capacity building, and collective decision-making, ensuring that the needs and perspectives of both rural and urban communities are considered.

Furthermore, investing in education and training programs can equip individuals and communities with the skills and knowledge to engage in sustainable food production and consumption practices. This includes promoting agroecological farming techniques, food preservation methods, and culinary skills that prioritise local and seasonal ingredients.

In **the acceleration phase,** innovative financing mechanisms, such as community-supported agriculture (CSA) schemes and local food hubs, are introduced to support the financial viability of small-scale producers and local food enterprises. These models enable consumers to directly invest in local food production, providing farmers with a stable income and reducing their vulnerability to market fluctuations.

As highlighted in the Ecotopia imaginary, community brokers facilitate knowledge exchange and trade between regions. These brokers can help connect producers and consumers, fostering a culture of cooperation and solidarity. Community brokers can ensure that even those with limited financial resources can access healthy and sustainably produced food by promoting bartering and non-monetary exchanges.

To stabilise the decentralised and localised food practises prepared in the preceding phases, mass meat production and large-scale intensive industrialised farming practises need to be prevented from being reintroduced. This could only be achieved by limiting efficiency-oriented market forces. Here, regulation (in terms of limits or caps) might be needed, along with a “protection mechanism” for small-scale landowners. Fair access and fair price mechanisms might be facilitated either by self-organism or with support from local and regional governments.

Table 7. Policy mixes for revitalising rural communities and keeping cities alive (Ecotopia Imaginary)

Key strategic policy intervention area	Emergence	Acceleration	Stabilisation
Facilitating access to agricultural land for regional and local food production	Subsidise living on land and regional production.	Support local food production systems that are predominantly smaller in scale, diverse, and organised around locality, place, and season.	Ban intensive livestock production systems (and intensive and super-intensive farming)
Enable and empower society. Support self-organisation.	Support deliberative democracy, support/promote dialogue between the actors Enable knowledge sharing and capacity building Support producer organisations and cooperatives	Support community-led initiatives Foster youth engagement	Foster rural-urban connections Ensure fair value distribution

4.4.2.2 Managing the decentralisation: Securing food safety and security and establishing good practice of ecological agriculture

The decentralisation approach focusing on local, small-scale, and diverse agricultural practices might present challenges in ensuring food safety, consistent supply, and food security across diverse regions. The prioritisation of sustainability, seasonality, and connection to nature makes agricultural production fluctuate, following natural cycles. In the worst case, any catastrophe or extreme weather endangers food provision.

In the **emergence phase**, robust protocols and redistribution networks must be established to address potential supply chain disruptions and maintain food safety standards. Community brokers play a crucial role in facilitating knowledge exchange and trade between regions, often through bartering and non-monetary transactions that emphasise the value of goods and services beyond their financial worth.

Sharing good agricultural practices and strengthening resilience are key aspects of the Ecotopia food system. Organic farming and agroecology are the predominant food production methods, supported by digital innovations such as local precision farming and agri-drones. These practices reduce reliance on pesticides and fertilisers and contribute to soil health, biodiversity conservation, and ecosystem resilience. Such digital systems support primarily nature-based solutions. Access to knowledge and good practices needs to be facilitated. This can be achieved by funding pilot projects and developing guidelines with local actors.

Seed policy and regional autonomy are also central to the Ecotopia vision. Genetic diversity of plants and seeds is actively promoted as a means of adaptation to changing climatic conditions. Legumes play a dual role, serving as a dietary staple and a natural alternative to synthetic fertilisers. The emphasis on regional autonomy has led to a resurgence of place-based food production and agricultural cultural diversity.

Ecotopia has greatly reduced the consumption of animal-based products by regulating mass meat production. Animal husbandry is carried out according to strict ecological and ethical requirements,

focusing on animal welfare. The shift towards plant-based diets and alternative protein sources like legumes and soy has significantly reduced the food system's environmental impact.

Decentralised mechanisms to secure food safety are critical to the Ecotopia food system. While the fragmented nature of food supply chains presents challenges, a strong system of food safety protocols, controls, and early warning systems has been implemented. Community-supported agriculture models and a diversified retail system further contribute to food safety by fostering close relationships between producers and consumers.

In the **acceleration phase**, the pilot projects need to be scaled up by expanding the funding scheme away from experimentation and moving towards more regional approaches that consider adaptation mechanisms to climate change. Education and training programs are expanded to mainstream climate-resilient and sustainable practices. Based on the experiences in the experimentation phase, regulations support the transition, e.g. away from mass meat production practises.

In the **stabilisation phase, a** monitoring system needs to be established to supervise good practices and be able to adapt to changing conditions due to climate change. Quality mechanisms and supervising mechanisms have to be established to guarantee the quality of seed materials in the long term and to prevent monopolisation.

Table 8. Policy mixes for securing food safety and security and establishing good practices of ecological agriculture (Ecotopia Imaginary)

Key strategic policy intervention area	Emergence	Acceleration	Stabilisation
Sharing good ecological agriculture practices, strengthening resilience	Establish knowledge-sharing networks between farmers, researchers, and policymakers. Provide funding for pilot projects demonstrating climate-resilient farming practices. Develop guidelines and standards for climate-resilient agriculture	Scale up successful pilot projects through targeted subsidies and incentives Incorporate climate resilience into agricultural education and training programs Mandate adoption of climate-resilient practices for receiving agricultural subsidies	Continuously update guidelines based on new research and best practices Monitor and report on adoption rates of climate-resilient practices Provide ongoing support to maintain knowledge-sharing networks
Seed policy and supporting regional autonomy	Develop and reform harmonised regional seed regulations Set up benchmarking systems for seed quality and sustainability Protect Indigenous communities' seed rights Create knowledge exchange networks for seed preservation	Strengthen farmers' position in seed value chains Support free seed trading practices Invest in seed storage facilities Improve seed testing capabilities	Strengthening the institutional setting to establish long-term seed monitoring systems. Ensure fair value distribution in seed systems Create stable seed market frameworks.
Regulating mass meat production	Create a comprehensive methodology for accounting for GHG emissions in the livestock sector. (Further) develop animal welfare legislation and standards Support education, training and good practices on sustainable livestock practices Providing independent advisory services	Implement an EU-wide animal welfare labelling scheme. Provide information and education on meat alternatives.	Establish long-term monitoring systems. Animal production emissions are fully included in ETS.
Install decentralised mechanisms to secure food safety	Support education and training on food safety practices Provide independent advisory services Support food safety awareness	Invest in food safety testing facilities Develop traceability systems Improve monitoring capabilities	

4.5 Reflection on the policy mixes across the imaginaries

Each imaginary emphasises sustainable and healthy diets as a cornerstone of sustainable food systems, with a shared consensus on reducing meat consumption and promoting plant-based diets. Notably, while this agreement is consistent across the Imaginaries, their approaches to addressing barriers to dietary shifts vary. Some advocate for softer informational or stronger fiscal measures, while others call for a combination of educational and economic policies to reshape socio-cultural and economic incentives and food environments. All Imaginaries highlight the role of technological advancements, such as novel foods and plant-based alternatives, to support dietary shifts. However, the Ecotopia Imaginary strongly questions the trend toward highly processed foods, envisioning a transformative shift toward fresh and raw plant-based diets supported by production-focused policies and measures targeting rural communities. Policy interventions emphasised during the acceleration and stabilisation phases are price adjustments, capacity building, and reshaping food environments, with public procurement playing a pivotal role during the emergence phase.

The imaginaries offer diverse and often contrasting views on the role of technological innovation in advancing sustainable food production and consumption. For example, the Great Decoupling emphasises technological innovations to boost production efficiency, while Ecotopia advocates for locally-based solutions and social innovations, including opening seed policies and patents. The Unity in Adversity Imaginary prioritises environmental and food safety regulations to ensure the sustainable use of natural resources and accelerate circular solutions in agriculture. At the same time, Technocracy for the Common Good highlights the need for strong measures to mitigate the impacts of technological advancements on rural areas. The reorientation of CAP is seen as vital in the acceleration phase to give farmers the right incentives and support structures. Across these imaginaries, R&D funding is identified as critical during the emergence phase, while the acceleration phase calls for a mix of taxes, subsidy reorientation, standards, and capacity-building initiatives.

The role of the state, governance and regulation diverges significantly across the Imaginaries. Unity in Adversity advocates for strong European policy frameworks, whereas the Great Decoupling relies on market self-regulation. Technocracy for Common Good combines a strong focus on technological development and innovation with measures to mitigate the socio-economic impacts on the vulnerable, aligning with approaches seen in the European Green Deal, which includes green investment financing mechanisms and just-transition mechanisms targeted to the most vulnerable regions, communities, and economic sectors. Ecotopia, by contrast, champions locally driven governance and policies that integrate rural areas into broader societal frameworks. Additionally, the imaginaries differ in their allocation of regulatory authority among the EU, Member States, and regional bodies, ranging from strong EU-level regulation (Unity in Adversity) to local governance autonomy (Ecotopia). Whilst in the Technocracy for Common Good, markets are regulated with the help of taxes and incentives, the Great Decoupling aims to dismantle all unnecessary regulation to stimulate innovation and market growth.

Different governance forms and structures are reflected in the Imaginaries for sustainable farming and food systems. Except for Great Decoupling, all the Imaginaries prioritise localised food systems, such as urban and peri-urban farming or community-supported agriculture, to enhance resilience and reduce reliance on imports. These approaches often prioritise regional and local governance and diverse food systems that foster vibrant rural areas. Interestingly, the University in Adversity Imaginary supports regional differentiation of production systems to build resilience. In contrast, the Great Decoupling envisions a unified European food system with minimal state regulation geared toward global market competitiveness. Technocracy for the Common Good represents a middle ground, resembling current governance models, where the state aims to address environmental and socio-economic impacts.

The imaginaries also tackle critical challenges related to resilience and security. For instance, the Unity in Adversity imaginary underscores Europe's increasing risk and instability, while Ecotopia emphasises integrated approaches to climate adaptation and biodiversity protection. In contrast, the Great Decoupling focuses on technological solutions to address sustainability challenges.

All the imaginaries, apart from the Great Decoupling, address the consolidation of the food retail and industry sectors as a central issue. Both imaginaries, Ecotopia and Unity in Adversity, emphasise developing locally based market structures or robust European-wide governance models to counterbalance these trends. The need for just and equitable food value chains emerged as a key theme and was also highlighted in discussions during the two workshops that contributed to the development of this work.

5 Morphological analysis

The following sections present four policy mixes developed using morphological analysis (see Chapter 2.5). This systematic approach facilitated the exploration of multiple dimensions within the problem space and their potential consistent combinations.

Based on the insight gained from exploring the Imaginaries, ten key dimensions of food system governance were identified and used in the morphological analysis:

1. Management of climate change
2. Direct income support for farmers and market stability
3. Rural development sustainable agricultural practices
4. Seed policy
5. Food processing and distribution
6. Support for sustainable and healthy diets
7. Market design of the future Common Agricultural Policy
8. Role of technology and digitalisation
9. Research and innovation
10. Role of the state

For each dimension, a range of policy options were identified and systematically combined to create coherent policy mixes. A detailed description of the morphological box can be found in the Annex. This process enabled four consistent policy pathways: Nature First, High Tech, Top-down, and Mixed Approaches. Each pathway represents a unique combination of policy choices across these dimensions, ensuring internal consistency while addressing the complex challenges of European food systems. While additional combinations and variations are possible, the selected mixed are distinct and serve to 'open up' the spectrum of possible solutions.

These policy mixes represent diverse philosophical and practical approaches to food system governance. The combinations were selected based on internal consistency and evaluated through further participant voting (see **Error! Reference source not found.**).

The '**Nature First**' pathway prioritises ecological sustainability and local autonomy, focusing on agroecological farming practices and community-based solutions. In contrast, the '**High Tech**' mix emphasises market-oriented technological advancement and industrial-scale agriculture, positioning innovation and efficiency at its core. The '**Top-down**' pathway blends technological sophistication with robust governmental oversight, centralising decision-making and regulation, whilst the '**Mixed Approaches**' pathway balances ecological sustainability and economic viability, advocating for collaborative governance and integration of diverse strategies.

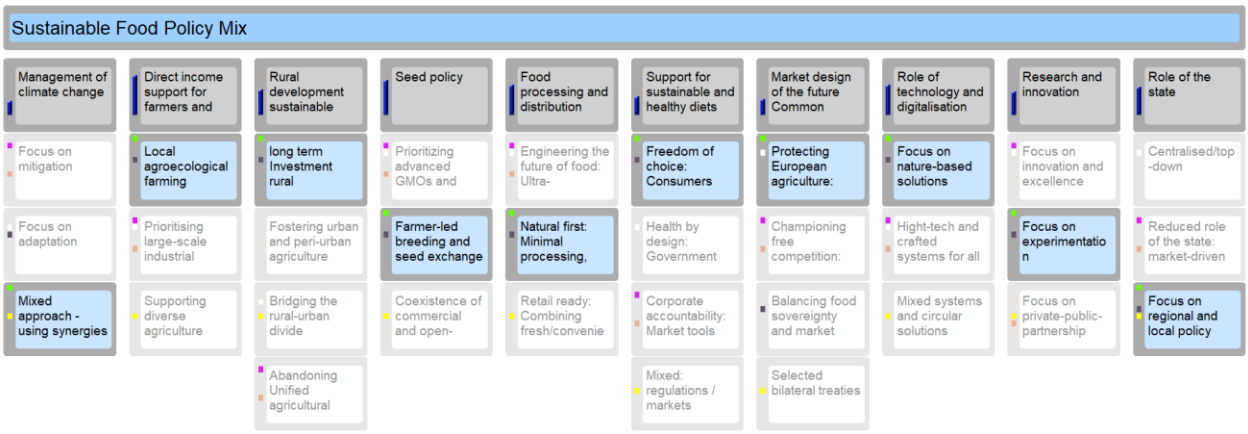
The following sections delve deeper into these policy mixes, analysing their defining characteristics, potential impacts, and implications for European food systems. This comprehensive framework offers valuable insights into the diverse pathways available for food system transformation and their associated trade-offs and opportunities.

5.1 Nature first

The "Nature First" pathway envisions a transformative food system for Europe, centred on ecological sustainability and local autonomy at its core. This policy mix prioritises environmental stewardship while

addressing human needs, fostering a balance between sustainable practices and consumer freedom within an ecologically conscious framework. It emphasises climate change adaptation and mitigation strategies, leveraging carefully designed synergies to harmonise agricultural practices with ecological goals. For a detailed overview of the policy options included in this pathway, see Figure 8.

Figure 8: Nature First-pathway in the Morphological Box



Note: This figure shows a morphological box of policy options for a sustainable food system following the Nature First pathway. In boxes in blue, mark the consistent combination of policy options.

Reference: Screenshot taken from Parmenides Eidos™, 28.10.2024.

The Nature First pathway is rooted in local agroecological farming, prioritising small-scale, sustainable practices that enhance biodiversity, minimise chemical inputs, and strengthen resilient local food networks. It calls for substantial investment in revitalising rural communities, preserving traditional knowledge, and fostering vibrant rural economies to benefit future generations. Central to this pathway is farmer autonomy in seeds and breeding, championing farmer-led initiatives, open seed exchange, and traditional seed varieties. This community-driven model safeguards genetic diversity, enhances local adaptability, and reduces dependency on corporate control. Food processing focuses on minimal intervention, preserving nutritional value and flavour while prioritising seasonal and regional production to limit the use of preservatives and the need for long-distance transportation needs.

While upholding consumer choice, this pathway protects European agriculture from external market pressures, ensuring the viability of local food systems and long-term food security. Nature-based solutions are emphasised over technological interventions, encouraging collaboration with natural processes. Communities are supported in experimenting with locally adapted solutions through dedicated funding and knowledge-sharing initiatives.

Governance with the Nature-first pathway emphasises regional and local decision-making, tailoring solutions to specific cultural and ecological contexts. This decentralised model nurtures diverse, resilient food systems, shifting from industrial agriculture toward a more harmonious relationship with nature.

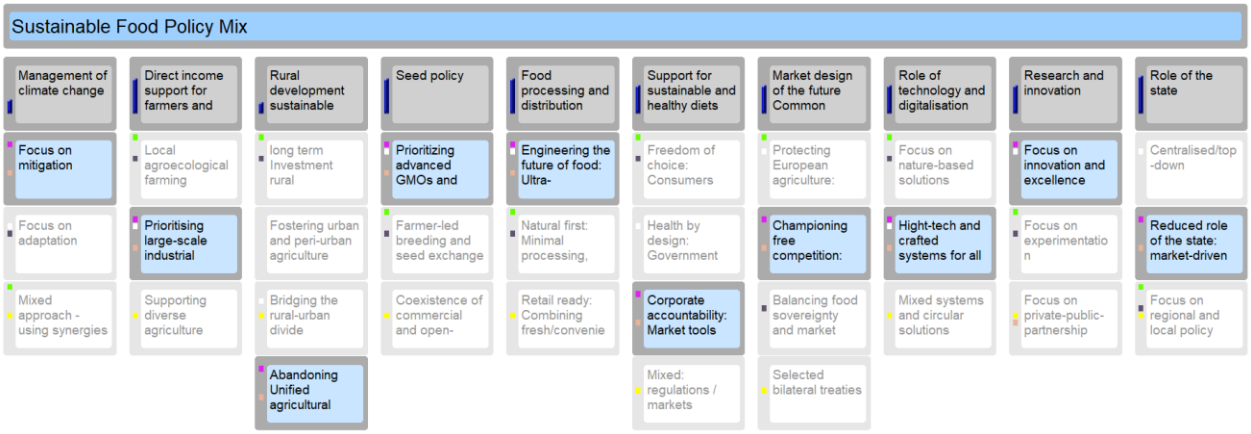
Nature First offers a transformative pathway to a sustainable and equitable food system by prioritising ecological sustainability, rural community empowerment, and consumer choice. It preserves biodiversity, ensures food security, and leverages local knowledge and natural processes to guide the future of European agriculture.

5.2 High Tech

This policy mix represents a technologically advanced, market-oriented approach to European food systems, prioritising efficiency, innovation, and global competitiveness. It emphasises industrial-scale agriculture and cutting-edge technologies while reducing state intervention and favouring market-driven mechanisms (see Figure 9).

Climate change mitigation is central to this pathway, driven by technological solutions in large-scale agriculture. Advanced machinery, precision farming, and integrated food systems replace traditional urban-rural distinctions, optimising resource use and sustainability. A defining feature of this pathway is the adoption of advanced biotechnology, including genetically modified organisms and patented climate-resilient crops, enabling high yields with minimal resource input.

Figure 9: High Tech-pathway in the Morphological Box



Note: This figure shows a morphological box of policy options for a sustainable food system following the High Tech pathway. In boxes in blue, mark the consistent combination of policy options.

Reference: Screenshot taken from Parmenides Eidos™, 28.10.2024.

The approach also emphasises ultra-processed food production tailored to modern lifestyles, with corporate accountability mechanisms ensuring adherence to food standards and quality. Market tools influence pricing, while business-led solutions drive innovation and ensure food quality and safety. Free competition is championed, opening EU agricultural markets to global players and fostering a level playing field for competitive farming across Europe.

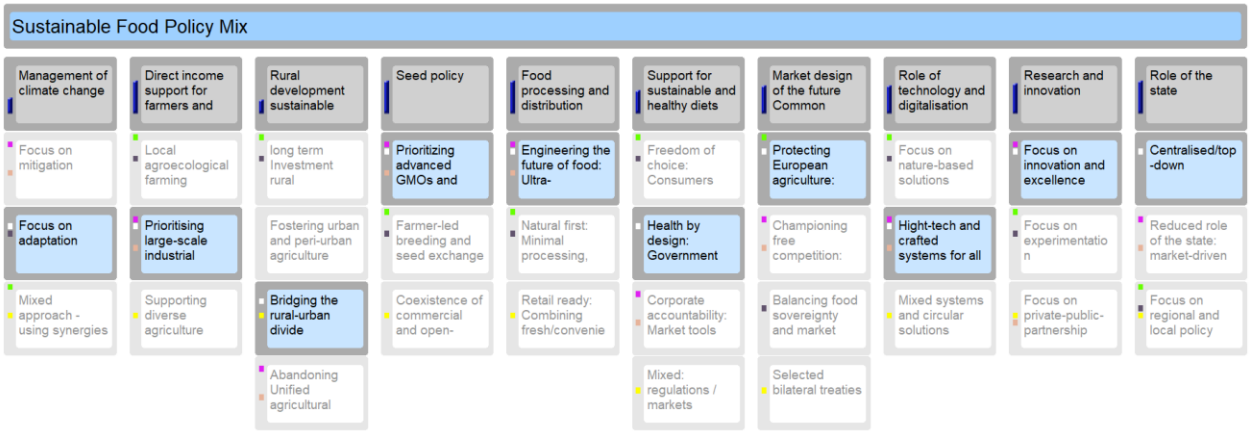
Technology is the backbone of this system, permeating every aspect, from digital automation and real-time monitoring to research and development. Private-sector investment drives these innovations, with minimal government intervention beyond regulatory oversight. Consumer demand and market dynamics are pivotal in shaping the system, reflecting a departure from state-led governance models. This industrialised, technology-driven pathway proposes a globally integrated food system optimised for efficiency, corporate-led innovation, and market dynamics. It represents a significant shift away from traditional agricultural practices, redefining the role of governance in European food systems.

5.3 Top-down

This policy mix represents a highly technologised and tightly regulated approach to European food systems, combining industrial-scale production with robust government oversight to ensure food security, public health and environmental resilience. It emphasises climate change adaptation through technological innovation while maintaining strong European protectionism. See Figure 10 for the detailed policy options within this pathway.

Central to this model is the development and deployment of climate-resilient crop varieties and livestock breeds designed to withstand environmental stressors. Large-scale industrial agriculture is prioritised, leveraging advanced machinery, precision farming and data-driven management to maximise efficiency and output. Urban food production is integrated through ecodomes and vertical farming near cities, connected to rural systems via efficient transportation and digital networks.

Figure 10: Top-down-pathway in the Morphological Box



Note: This figure shows a morphological box of policy options for a sustainable food system following the Top-down pathway. In boxes in blue, mark the consistent combination of policy options.

Reference: Screenshot taken from Parmenides Eidos™, 28.10.2024.

Biotechnology and genetic engineering are pivotal, with advanced GMOs and patented climate-resilient crops ensuring high yields and resource efficiency. Food processing focuses on ultra-processed, nutritionally tailored foods designed to meet modern lifestyles, supported by innovative preservation techniques. Government regulations enforce healthy consumption patterns, including strict controls on food composition, sustainability reporting, and corporate practices to align with public health and environmental goals.

European agriculture is safeguarded through **trade rules and tariffs**, reinforcing food sovereignty and driving internal market growth. Technology underpins all aspects, from precision agriculture and AI-driven robotics to blockchain for supply chain transparency. Research priorities include cultured meat production and nanotechnology to enhance food safety and quality.

Governance is centralised, with EU and national governments exercising significant control over food systems. Large corporations operate under stringent regulatory frameworks to deliver healthy, sustainable and ethically produced options that align with social welfare goals.

5.4 Mixed approaches

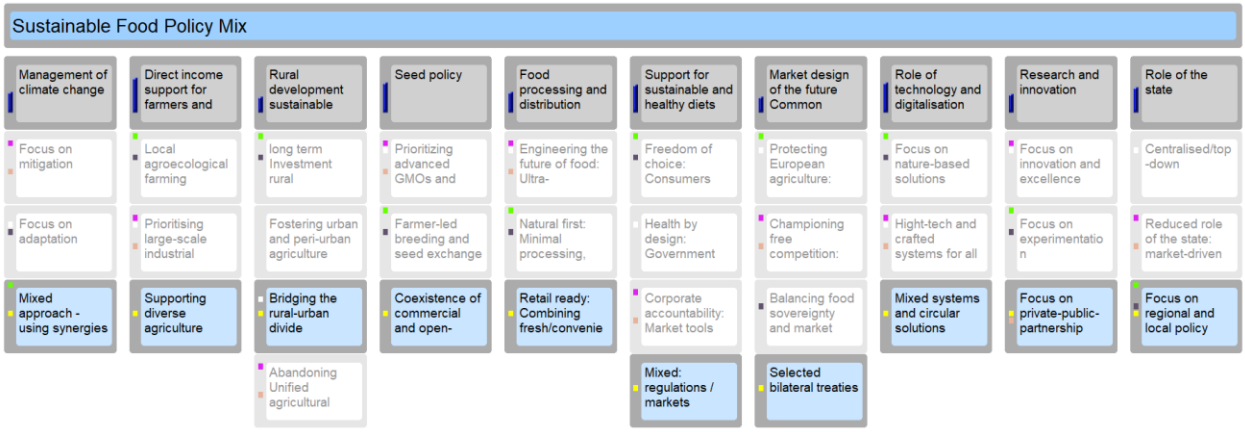
This policy mix embodies a balanced approach to European food systems, integrating ecological sustainability, economic viability, and collaborative governance. It emphasises local adaptation, public-private cooperation, and diverse farming practices to tackle climate change while ensuring food security. See Figure 11 for the policy options underpinning this pathway.

At its core, the policy harnesses synergies between climate adaptation and mitigation, promoting circular food system principles. Agricultural practices focus on reducing greenhouse gas emissions, enhancing carbon sequestration, and implementing nature-based solutions. A diversity of farming methods across Europe builds resilience, optimises food production, and supports the common agricultural market. Farm advisory services support transitions to sustainable intensification and climate-smart agriculture, leveraging high-tech solutions where appropriate.

This approach bridges the rural-urban divide by fostering regional food systems that connect rural supply with urban consumers. This connection is supported by efficient transportation networks and digital technology, ensuring equitable resource distribution and mutual benefits for rural and urban communities. Seed policy seeks to balance innovation and tradition, supporting commercial and open-source systems.

It preserves intellectual property rights while allowing farmers to save and exchange seeds, enhancing biodiversity and resilience.

Figure 11: "Mixed Approaches"-pathway in the Morphological Box



Note: This figure shows a morphological box of policy options for a sustainable food system following the Mixed approaches pathway. In boxes in blue, mark the consistent combination of policy options.

Reference: Screenshot taken from Parmenides Eidos™, 28.10.2024.

The food processing strategy combines fresh, minimally processed foods with convenient, sustainable options tailored to modern lifestyles. It prioritises health, regional and seasonal offerings, and consumer needs, ensuring a balance between tradition and modernity. Market regulation incorporates market mechanisms alongside targeted policies, fostering international cooperation through selected treaties while safeguarding domestic interests.

The policy emphasises circular solutions tailored to local contexts, integrating nature-based and technological approaches to achieve sustainability goals. Public-private partnerships are central to driving innovation and accelerating sustainable practices, combining private-sector creativity with public oversight. Regional and local policymaking ensures solutions are adapted to specific cultural and environmental contexts, aligning with broader European objectives. This empowers communities, strengthens resilience, and fosters a sustainable and equitable food system across Europe.

5.5 Policy mixes based on workshop participants' voting

During the workshop, participants voted on the policy mix elements they considered the 'most desired,' 'most feasible,' and 'closest to today. These votes were used to create corresponding policy mixes. However, it is important to note that the voting results were often ambiguous. This ambiguity highlights two key points: first, participants' preferences were influenced by their individual lifestyles and professional contexts; second, the framing of the alternatives may have lacked precision. The implications of these observations are further explored in section 8.6.

The 'most feasible' policy mix, in particular, exhibited significant ambiguity. While the resulting policy mix leans toward large-scale, industrial agricultural production, it also delegates considerable responsibility to the private sector, albeit under strong state regulation. This combination reflects a market-oriented approach with state oversight, balancing private-sector innovation with public accountability.

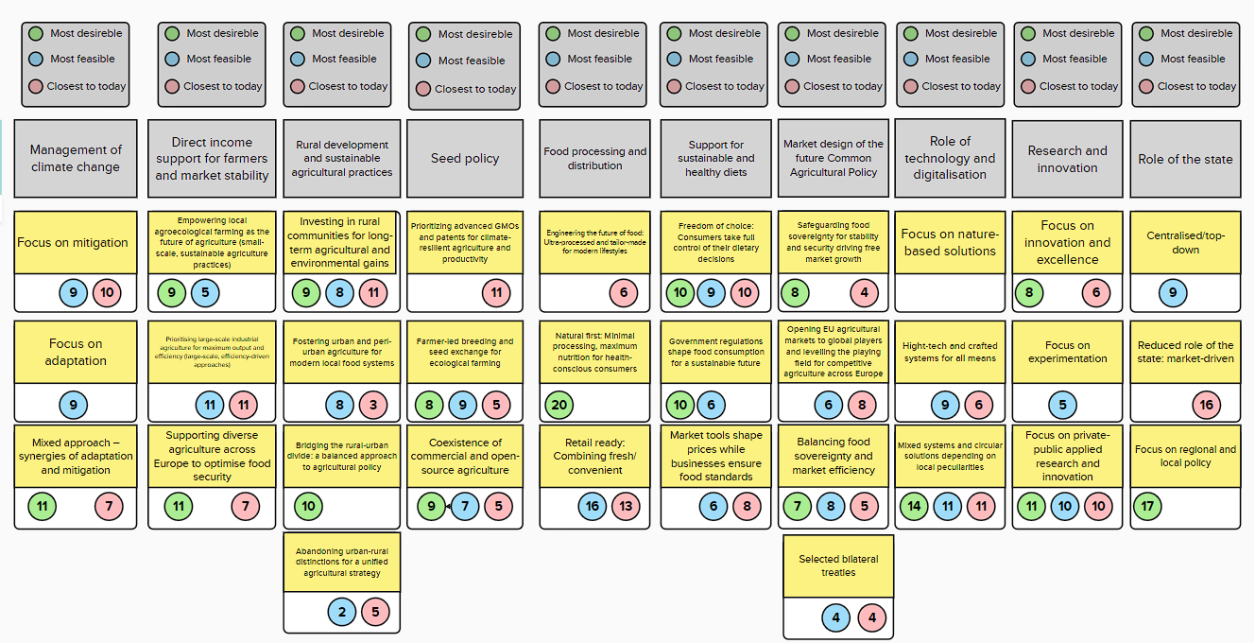
Similarly, the 'closest to today' policy mix was also marked by ambiguity. However, constructing the policy mix based on simple majority preferences produced a relatively consistent combination that aligns with the 'high tech' and 'mixed approaches' policy frameworks. This policy mix emphasises market-driven,

large-scale, industrial, and agricultural production, resonating with the status quo of European food systems.

In contrast, the 'most desirable' policy mix closely aligns with the 'mixed approach' described in section 8.4. However, there are notable deviations in areas such as 'food processing and distribution,' 'support for sustainable and healthy diets,' and 'market design.' These deviations result in a lower degree of internal consistency compared to the other policy mixes presented.

In summary, the voting exercise underscores the diversity of preferences and perspectives among the workshop participants, reflecting the complexity of designing coherent and widely acceptable policy mixes for European food systems.

Figure 12: Votings in the morphological box (workshop), identical to figure 5



Note: The screenshot displays the morphological box, with grey boxes representing the dimensions for the political options (yellow boxes). The grey boxes in the first row act as a legend, clarifying the meaning of the three colours: green signifies the most 'desirable option', blue represents the 'most feasible option', and red denotes the 'closest to today'. The numbers within the yellow boxes indicate the corresponding votes.

Reference: Screenshot from a Miro-board used at the EIONET Workshop shop of the food experts, 3/10/2024. Screenshot taken on the 27/10/2024.

5.6 Reflection on the four policy mixes pathways

The four policy mixes represent distinct philosophies or discourses for European food systems, reflecting different aspects of current policy debates and future aspirations.

Nature First: This approach partly aligns with the EU's Farm to Fork Strategy (EC, 2020a) and Biodiversity Strategy 2030 (EC, 2020b), particularly in its emphasis on agroecological practices and local food systems. Its innovative elements strongly focus on farmer-led breeding and seed sovereignty, challenging existing agricultural intellectual property frameworks. However, it has conservative aspects, such as preserving traditional farming methods and local knowledge systems.

While this pathway resonates with the European Green Deal (EC, 2019) it proposes a more radical transformation through decentralised governance and a stronger reliance on nature-based solutions. Although current EU policy increasingly recognises the importance of agroecology, the Nature First pathway envisions a more fundamental overhaul of food systems than is currently mainstream.

High Tech: This mix reflects trends visible in the EU's Digital Strategy (EC, 2024a) and Horizon Europe programme (EC, 2024b), particularly regarding precision agriculture and biotechnology. Its innovative aspects include the comprehensive integration of digital technologies and a focus on ultra-processed foods engineered for efficiency. This pathway aligns closely with industrial food and agriculture lobbying positions and represents a continuation of market-liberal agricultural policies.

Conservative elements include preserving industrial-scale agriculture and corporate-led innovation, though its approach to biotechnology and market liberalisation extends beyond the scope of current EU regulatory frameworks. Emerging developments in cellular agriculture and vertical farming (EEA, 2022b) align with this vision, though EU policies currently emphasise stricter regulatory oversight.

Top-Down: This approach combines existing EU regulatory frameworks with enhanced centralised control. It innovates through its comprehensive integration of technological solutions with strong governmental oversight, particularly in areas like ecodomes and vertical farming. While aligning with aspects of the European Food Safety Authority (EFSA, 2021), it advocates for more stringent controls than current policies.

The conservative aspects include maintaining centralised authority and state intervention. However, it pushes boundaries in areas like GMO regulation and corporate accountability. Although this approach reflects some EU food safety and security policy trends, it suggests more intensive governmental involvement than existing frameworks.

Mixed Approaches: This mix resembles current EU policy directions, particularly the multi-actor approach emphasised in the Farm to Fork Strategy and Common Agricultural Policy post-2020 (EC, 2021). Its innovation is systematically integrating diverse governance models balancing public-private partnerships with environmental and economic goals.

While aligned with the EU's efforts to balance sustainability and economic viability, this pathway proposes enhanced mechanisms for regional adaptation and circular economy integration. It builds on existing frameworks while exploring more refined solutions for food system resilience. The workshop voting results paint a somewhat ambiguous picture. Participants voted on the ‘most desired,’ ‘most feasible,’ and ‘closest to today’ elements of the policy mixes. Surprisingly, the voting results were not straightforward, especially when reflecting current policies. While many participants supported the ‘most desired’ elements, likely reflecting a shared vision, these often did not align with the ‘most feasible’ or ‘closest to today’ elements.

This divergence highlights a few challenges. First, the small sample size and ambiguous votes limit the robustness of any conclusions. Second, participants’ interpretations of the brief descriptions in the morphological box likely varied. Individual associations shaped by prior knowledge, experience, and personal preferences could have introduced bias.

Additionally, the subsidiarity principle underpinning EU policies, which allows member states flexibility in implementing legislation, may contribute to these ambiguities. The varied preferences may reflect the broader Imaginaries (EEA, 2023b) underpinning the policy mixes, which suggest four overarching discourses: a nature-based discourse, a technology-oriented discourse, a market-based discourse, and a strong-state discourse.

While the material gathered during this project offers insight into these discourses, it does not provide sufficient statistical evidence or a research design robust enough to draw definitive conclusions. Nonetheless, the diversity in voting highlights the complexity of balancing competing priorities and visions for the future of European food systems.

6 A future-oriented sustainable food policy mix – Gap analysis

The EU must transition from the emergence to the acceleration phase toward more sustainable food systems. This imperative becomes evident from analysing the future Imaginaries and their associated policy mixes. Achieving this transition requires deliberate and strategic decisions about the direction of change--a direction that currently lacks clarity. Exploring the Imaginaries and their related policy mixes provides valuable insights into the policy choices.

In the following, we highlight six strategic intervention points available to the EU. These strategic intervention points are based on analysing shared and divergent elements in the evaluated policy mixes. We also reflect on how these intervention points relate to the current EU food policy mix (Asquith et al., 2022) and the priorities identified in the Strategic Dialogue on the Future of EU Agriculture (EC, 2024). The Strategic Dialogue on the Future of EU Agriculture convened 29 major stakeholders from the European agri-food sectors, civil society, rural communities and academia to foster a shared understanding of the further development of a core area of European life and economy in a new format of political discourse. This initiative introduced a new format of political discourse, establishing guiding principles and concrete policy options for transitioning to more sustainable food systems. Much like the Farm to Fork Strategy, it adopts a food systems approach to policy development.

Based on our analysis, we identify the following key strategic intervention points as priorities for shaping future EU food and agricultural policy:

1. Accelerate healthy and sustainable diets

Our previous analysis in 2022 concluded that current EU food policies address consumers and other key actors unevenly and in ways that are likely to lead to little change (Asquith et al., 2022). The same conclusion is reinforced by the present analysis of Imaginaries and associated policy mixes, which underscores the need for greater focus on the demand side in future EU food policies. According to the policy mix analysis, the policy options available to the EU include introducing (1) Market-based tools, such as voluntary initiatives and fiscal measures, to encourage healthier and more sustainable consumption patterns or (2) Stronger governmental policies, including stricter controls on food composition and corporate practices, such as reducing unhealthy ingredients, promoting plant-based alternatives, and requiring companies to report sustainability progress. Fostering public procurement to create demand for sustainable and healthy foods also falls under this category.

The Strategic Dialogue on the Future of EU Agriculture emphasises enabling healthy and sustainable choices by fostering food environments where balanced, less resource-intensive, healthy diets are available, accessible, affordable, and attractive (see also, SAPEA, 2023). The dialogue calls for a full review of EU food labelling legislation and an evaluation of current marketing measures, particularly those targeting children. Moreover, fiscal measures, such as consumer tax reductions, are recommended to provide coherent price signals. Member States should implement complementary social and fiscal policies to ensure affordability for lower-income consumers.

Our analysis of policy mixes highlights the importance of policies targeted at the acceleration phase of the transition, which are critical to supporting dietary shifts. This would include fiscal measures, labelling standards, marketing restrictions, other regulatory measures, and informational measures, such as nutrition recommendations and food education. For the EU to encourage the transition towards plant-based options and help consumers adopt sustainable and healthy diets, it is vital to holistically develop policy mixes that address these areas, supporting social and fiscal policies. However, the voting results on policy preferences revealed a significant divide. Votes for the ‘most desirable’ policy options were split between those advocating a market-based approach based on freedom of choice and those favouring stricter government regulation (Figure 12). The feasible options also spanned across the whole spectrum of policy instruments. Finding effective and widely acceptable policy mixes to accelerate the adoption of healthy and sustainable diets requires robust societal dialogue and thoughtful policy deliberation. Policymakers must navigate these divergent views to design interventions that balance public support, feasibility, and transformative impact.

2. Develop climate change mitigation and adaptation strategies by fostering just transition and resilience

Addressing greenhouse gas (GHG) emissions in agriculture is crucial, as the sector lags behind others in achieving EU-level emission reductions. This is acknowledged by the Strategic Dialogue on the Future of EU Agriculture, which recognises that the European Commission and Member States should work on a coherent mix of policies that combine incentives with regulatory measures, including (1) the establishment of a comprehensive methodology to set a GHG emissions accounting system and specified goals for the different types of agriculture and its structural conditions; (2) a general pathway to boost the implementation of appropriate measures and promote access to investment across agriculture and territories to advance towards the established emissions reduction goals. The Strategic Dialogue also emphasise that ambitious actions in the most challenging areas would need to be implemented by territorial strategies and financed through mechanisms such as an Agrifood Just Transition Fund (see also EESC, 2024) similar to the Just Transition Mechanism in the European Green Deal.

Findings from the policy mix analysis underscore the need to design strategies that harness synergies between climate change mitigation**,** adaptation, and biodiversity protection**.** Insights from workshops and the policy mix analysis reveal that integrating these goals is essential. In the first workshop, participants highlighted the importance of combining mitigation and adaptation efforts with circular solutions in the revised food imaginaries. This mixed approach, seeking synergies between adaptation and mitigation, emerged as the most desirable policy option (Figure 12). This aligns well with the Strategic Dialogue goal of “enhancing sustainable farming practices", guaranteeing that agriculture production contributes to protecting and restoring the climate, ecosystems, and biodiversity. Reducing external inputs, such as mineral fertilisers and pesticides, and improving nutrient management are critical steps in increasing the resilience of and circularity in European farming systems. In contrast, high-tech solutions were perceived as less desirable for achieving these goals (Figure 13).

The policy acknowledges such a strategy and calls for regional and contextualised governance strategies. When developing ambitious policies to mitigate and adapt to climate change at the EU level, it is hence important to set clear standards and monitoring rules at the EU level and direct support to national and regional levels to implement abatement strategies similarly as emphasised by the territorial strategy supported by the Just Transitions Fund, and beyond for stronger rural development strategies. Nature restoration law should be implemented to find co-benefits between climate mitigation, adaptation, and biodiversity. Also, the Strategic Dialogue calls for establishing a well-resourced nature restoration fund (outside of the CAP) to support farmers and other land managers to restore and manage natural habitats at the landscape level.

The legally binding objective of 'no net land take by 2050,' proposed by the Strategic Dialogue, is a key step toward achieving synergy between climate and biodiversity goals. Policies that integrate restoration, mitigation, and adaptation measures while promoting circularity will ensure that agriculture contributes to a sustainable, resilient future for Europe’s food systems. By focusing on comprehensive, well-resourced policies that bridge EU-wide and regional efforts, the EU can make significant progress in reducing GHG emissions while protecting biodiversity and enhancing the resilience of farming systems.

3. Reorientate CAP for delivering environmental, social and animal welfare outcomes

The current structure of the Common Agricultural Policy acts as a major barrier to advancing sustainable farming practices (Asquith et al., 2022). This is also acknowledged by the Strategic Dialogue, which argues that the future CAP should focus on (1) providing socio-economic support targeted to the farmers who need it most; (2) promoting positive environmental, social, and animal welfare outcomes for society; and (3) invigorating enabling conditions for rural areas. Based on farmers’ economic viability, the CAP should deliver income support for those most in need. The CAP should reward and incentivise farmers to establish and continue providing ecosystem services; environmental payments should go beyond what EU legislation requires and aim at the highest ambition in a system to be linked to quantifiable results using robust indicators. Financial support to environmental and climate actions will need to substantially

increase annually throughout the following two CAP periods, starting from the current budget share for eco-schemes and agri-environmental and climate instruments.

The findings of the policy mix analysis strongly support this vision. Public incentives need to be structured to support sustainable farming practices. This was emphasised across all the Imaginaries. The analysis of Imaginaries also reveals that emphasising global competition and trade, rural development, or agricultural support will lead to markedly different policy outcomes. In the morphological analysis of policy mixes, the support for diverse European agriculture to optimise food security and empower local agro-ecological farming was ranked as the most desirable policy option (figure 13). In contrast, prioritising large-scale industrial agriculture was deemed closest to current practices but the least desirable option. Investing in rural communities for long-term gains and bridging the rural-urban divide were also ranked as highly desirable policy directions.

The policy mix analysis underscores the importance of setting clear, coherent incentives for farmers and food system actors. A results-based model, where payments are tied to measurable environmental outcomes, provides the most straightforward pathway for scaling up sustainable practices. Reorienting the CAP is essential to accelerate this transition, offering farmers the right incentives and support structures.

4. Accelerate responsible research and innovation

Innovation, technology and knowledge play a key role in the transition of the European food systems. All Imaginaries recognise this, albeit with differing emphases on which technologies are most desirable. Key areas include biotechnology, precision agriculture, digital tools, and innovative food production and distribution systems. The morphological policy mix analysis revealed limited support for purely high-tech solutions (Figure 13). Instead, the mixed systems and circular solutions were seen as the most desirable, feasible, and closest to today. Notably, the findings also revealed that options such as prioritising advanced GMOs and patents for climate-resilient agriculture (in the context of seed policy) reflect current practices but were not viewed as the most desirable policy option.

The importance of R&I funding during the emergence phase is well acknowledged across the Imaginaries. The policy choice of which technologies to support is a key question for the acceleration phase and the choice of instruments therein. More targeted policy efforts are required to accelerate sustainable innovations. This was also the key message in our earlier analysis of EU food policy mixes (Asquith et al., 2022). Although the EU has provided substantial and growing funding for food and agriculture-related innovation under successive Horizon framework programmes and partnerships, there remains a significant gap in support for scaling up and commercialising radical innovations. The legislation on novel foods has slowed down the acceleration of many novel food innovations.

To support the acceleration phase, the EU must employ a combination of measures, including taxes, reoriented subsidies, standards, and capacity building. Enhanced risk-financing mechanisms, innovation schemes, and public-private partnerships are crucial for driving progress. The **Strategic Dialogue** also emphasises these measures, calling for more public-private partnerships, effective bank lending frameworks, and increased investments in innovation and research. Finally, technology choices in the acceleration phase must be guided by their ecological, economic, and social sustainability implications (Kaljonen et al., 2024). Expanding support for social innovations is essential to diversify the range of sustainable solutions and ensure widespread adoption.

5. Strengthen the position of farmers in the food value chain

The consolidated structure of the food industry and retail sectors weakens farmers' positions, as highlighted in the analysis of the Imaginaries. The first workshop and policy mix analysis emphasised the need to address this imbalance, with participants identifying empowering local agroecological farming and supporting diverse European agriculture as priority policy options (Figure 12). While shifting away from the dominance of large-scale industrial agriculture is acknowledged as a significant challenge (e.g., Eurostat 2022), concrete measures to break market consolidation remain difficult to envision.

The same difficulty is clearly detectable in the measures suggested by the Strategic Dialogue, which argues for "Strengthening farmers' position in the food value chain by encouraging them to better cooperate, reduce costs, increase efficiency, and improve prices and decent income from the market. This would imply proactive steps at the European and national levels to strengthen the competitiveness of farmers and the chain, increase transparency in the food chain, support cooperation and capacity building, better address unfair trading practices, and better work together along the chain to deliver on sustainability." In this respect, the European Commission should ensure greater coherence between its trade and sustainability policy.

The steps to be taken are multiple. The Imaginaries and the policy mixes scrutinised here also proposed a different alternative to global food markets, that of local food systems. Morphological policy mix analysis identified empowering local agroecological farming (small-scale farming) or, at a minimum, promoting diverse agricultural systems (encompassing small, medium, and large-scale farming) as the most desirable options (Figure 13). Farmer-led breeding and seed exchange, or at least mixed approaches where these coexist with other formats, were seen as the most desirable and feasible policy options. It is important to take note of these Imaginaries when developing the competitiveness and market structure across Europe. Alternative ways of farming and trading should be made viable for farmers and SMEs. This is necessary to build an attractive, diverse sector and keep rural areas viable. As emphasised by the Strategic Dialogue, boosting generational renewal in the agri-food sectors is key to creating momentum for transition. Again, here, social innovations require more attention from the policy mix (see also Asquith et al., 2022).

6. Support directionality and phase-out

The imaginaries explored in this analysis highlight diverse and often competing trajectories for European food systems. Notably, the concept of a single, unified European food system may prove detrimental to sustainability. Instead, the EU should focus on diversifying food systems and supporting multiple value chains and local food systems. As the EU enters the acceleration phase, the emphasis must shift from merely supporting innovation to actively phasing out unsustainable production, consumption, and market practices. Creating space for multiple sustainable food systems to flourish requires dismantling dominant, unsustainable models. For instance, accelerating plant-based protein value chains will not succeed unless agricultural subsidy systems and food environments are restructured (Kaljonen et al., 2021). Similarly, organic production will remain uncompetitive unless market incentives are redesigned. Phase-out also requires attention to transition measures, as the Strategic Dialogue emphasises. Just transition measures on their part can also assist in revitalising rural areas. When planned and deliberated in an anticipatory manner, they can provide means for empowerment and, eventually, stabilisation of transition (Kaljonen et al., 2024).

7 Reflection and lessons learnt methodology-wise

Current food systems, encompassing the entire value chain, from production, processing, and distribution to consumption and waste, are unsustainable. Addressing this complexity requires a combination of creative and analytical methods to identify alternative approaches and ex-ante explore potential systemic changes. Environmental and sustainability policies are inherently systemic, involving intricate interactions between ecosystems, economies, and societies. Their complexity demands innovative approaches to governance and decision-making (EEA, 2024b).

The human brain excels at recognising and interpreting complex patterns, but this strength also introduces weaknesses through cognitive biases. While the orientation of the content is based on the context and experience of the persons, the mechanisms of cognitive biases are universal in human thinking, influencing our judgements and decisions. Participatory approaches emerge as powerful tools to mitigate these biases and enhance the quality of decision-making. In the face of complex and systemic challenges of food systems, EU institutions, governments, businesses, and civil society organisations are increasingly using foresight.

In this study, we applied several methods from the foresight toolbox, namely, the futures wheel, X-curve analysis, and morphological analysis.

The **X-Curve framework** is particularly useful in visualising the interplay between the build-up of new sustainable practices and the breakdown of unsustainable systems. Adding the different phases of transitions, emergence, acceleration, and stabilisation adds another layer of information to the policy design analysis. Often, it appears that the sequence of policy measures and a sort of “staging” of different instruments is not applied systematically. The x-curve approach provides a framework to at least define three stages. However, while there is a logical sequence for one specific key strategic intervention point, two of these intervention points might already be competing or not synergistic. In this regard, more systemic approaches that focus on the interplay of different measures come into play.

Therefore, the Futures Wheel and, later in the process, the morphological analysis were applied.

The **futures wheel** opened the scene to familiarise the participants in the first workshop with forward thinking. Adding missing aspects allowed participants to engage and “modify their” idea of the future, creating engagement and identification with the respective Imaginary. Once entered into the virtual world of that Imaginary, participants could think through what activities needed to be created and phased out. The workshop's silent writing phases alternated with discussions that captured diverse worldviews. However, these outputs were snapshots, limited by participant knowledge and viewpoints.

The **morphological analysis** complemented the subsequent approach. In this analysis, the focus is on checking consistencies between different key interventions safeguarding the coherence of the policy measures. At best, policy coherence creates synergies between different public policies; it leverages the capacity to realise a common policy goal. At a minimum, it ensures that different policies do not undermine one another or cancel each other out (Pike and Muscat, 2012).

However, morphological analysis was originally a systematic creativity tool for identifying new combinations (see section 2.5.). This still holds true as the morphological analysis helps to collect and visualise current public discourses based on preferences and world views and to identify alternative options. This approach can help facilitate debates as opposing viewpoints might often be subject to (political) bargaining or “power games”. Different policy options can be captured and assessed later in a morphological box. The method includes a consistency check to ensure that individual preferences or biases do not unduly influence policy options. In this regard, the morphological analysis complements more heuristic approaches like the x-curve analysis.

Furthermore, using multiple expert evaluations helps validate the robustness of the proposed policy mixes, reducing the risk of skewed assessments based on personal or institutional biases. This became apparent in the voting when no entirely consistent picture emerged. The human brain's capacity is limited to analysis and understanding no more than four factors at a time (Halford et al., 2005), the pairwise consistency

check helps the brain come to robust evaluations. The authors have themselves participated in the evaluation. The assessments by the authors already differed substantially from each other. This points to the fact that linguistically, the concepts had not fully been clarified content-wise. This can be explained by the condensed and non-participatory process of compiling the morphological box in the present study.

Combining the X-Curve framework with morphological analysis proved challenging but yielded valuable insights:

- The X-Curve provides a temporal perspective, adding a dynamic, temporal layer to the morphological analysis, linking policy options to phases such as emergence, acceleration, stabilisation, and phase-out. In contrast, the morphological box is more static, presenting different policy options. Combining these tools was challenging, but meaningful insights emerged.
- Using the X-Curve, the team developed narratives and identified policy levers. From these levers, instruments were created to support emergence, acceleration, phase-out, and stabilisation. These policy instruments informed the development of the morphological analysis. The analysis highlights the pivotal role of the acceleration phase, including phase-out, for the future policy mix of sustainable EU food systems. The policy measures for the stabilisation phase require further attention in the future analysis of policy mixes.
- Policy options gained sequential context by integrating the X-Curve with the morphological analysis, clarifying the instruments needed at each phase of the transition, from emergence to acceleration and stabilisation.

In the morphological analysis, the voting (on the most preferable, most feasible and closest to today's options) was simplified and realised quickly. While the questions focused on expert opinions regarding the most preferable, feasible, and current options, participants lacked sufficient time to fully grasp the linguistic and conceptual nuances of the policy mix. These likely triggered cognitive biases, as participants relied on familiar patterns to make quick decisions. To enhance robustness, a broader survey, potentially involving the Food Systems EIONET group, could provide more diverse perspectives and better reflect realities across Member States. This approach would also allow participants to study background information, fostering a shared understanding of the policy options.

However, an extended analysis would further improve the results of this study. Considering the coherence identified in the morphological analysis more systematically, the sequence of policy measures and related instruments might be analysed. Here, approaches like a visual roadmap (Hussain et al., 2017; Kind et al., 2011; Phaal and Muller, 2009) could be applied, considering that specific measures create the condition to apply a second measure. Based on such a comprehensive analysis realised in this project, one integrated roadmap would illustrate logical sequences and timings connecting today’s conditions with a future vision.

One general conclusion is that the x-curve approach alone does not guarantee policy coherence, and the morphological analysis falls too short when defining temporal sequence considering the phases of transition management.

Recommendations for future workshops:

To improve the methodological process and outcomes, we recommend the following:

- Participant selection: Ensure a critical mass of participants with diverse expertise.
- Participatory processes for developing the morphological box: Conduct workshops to refine dimensions and policy options collaboratively, identifying missing elements or redundancies.
- Enhanced surveys: Develop comprehensive surveys and ensure participants have adequate time and resources to understand the morphological box.

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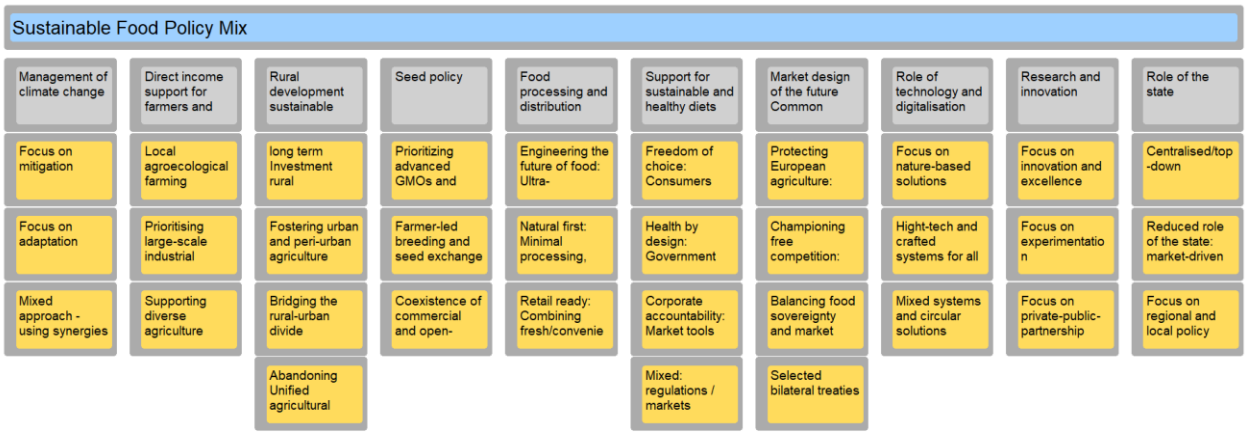
Annex 1: Description of the policy options in the morphological box

The morphological box



This description was prepared as a support material to encourage participants of the hybrid online workshop "Exploring Multiple Pathways for Transforming European Food Systems", to engage in critical thinking and dialogue during the session scheduled for October 3rd, 1:45 pm – 3.15pm CET.

Management of climate change

Focus on mitigation

In the realm of agricultural production, management strategies centred on mitigating greenhouse gas emissions and enhancing carbon sequestration. Farmers are turning to conservation tillage and cover cropping to maintain soil health and capture carbon. At the same time, integrating agroforestry systems serves to store carbon and diversify income streams. Precision farming techniques are being harnessed to apply water and fertilisers more efficiently, minimising runoff and the release of nitrous oxide. Renewable energy installations on farms, such as solar panels and wind turbines, replace fossil fuel-based energy sources, further cutting emissions.

Focus on adaptation

An agricultural practice focused solely on climate change adaptation would prioritise strategies that enhance the resilience of farming systems to the impacts of climate variability and extremes. This would involve the cultivation of climate-resilient crop varieties and livestock breeds that can withstand drought, heat, and other stressors. Efficient water management techniques, such as micro-irrigation, rainwater harvesting, and deficit irrigation, would be essential to cope with water scarcity and ensure optimal water use. Soil management practices, including conservation tillage, cover cropping, and biochar, would be implemented to improve soil structure, enhance moisture retention, and reduce erosion. Diversification of crops and intercropping would be employed to spread risk and improve ecosystem resilience. Additionally, using agro-advisories and precision agriculture technologies would enable farmers to make informed decisions based on real-time weather data and local conditions, thereby reducing vulnerability to climate shocks.

Mixed approach – synergies of adaptation and mitigation

Food production strategies that harness the synergies of reducing greenhouse gas (GHG) emissions, increasing carbon sequestration, and adapting to climate change are multifaceted and integrative. One effective approach is adopting circular food system principles, which involve optimising diets, cropping patterns, and animal husbandry to significantly reduce land use and GHG emissions. Shifting the protein intake ratio from animal-sourced to plant-sourced proteins (40:60) can further enhance these reductions.

Implementing nature-based solutions such as agroforestry, improved pasture and crop management, and the application of biochar to soils can sequester substantial amounts of carbon.

Direct income support for farmers and market stability

Empowering local agroecological farming as the future of agriculture (small-scale, sustainable agriculture practices)

The goal is to support local and regional small-scale production. The agricultural practice includes permaculture practices, including agroforestry systems. This approach assures a variety of agricultural and horticultural techniques, which might be less productive and, respectively, require more land. As the ecological quality is high, there are positive biodiversity effects and no pure wilderness areas.

Prioritising large-scale industrial agriculture for maximum output and efficiency (large-scale, efficiency-driven approaches)

The aim is to have highly productive areas that are managed intensively with machinery. This puts pressure on the natural system, and as a balance, more wilderness areas and protected areas are created. In urban or near urban centers “ecodomes” (Greenhouses with closed systems, like vertical farming or aquaponics) support urban agricultural needs.

Supporting diverse agriculture across Europe to optimise food security

Food production is optimised to secure availability and stability of food production across European common agricultural market. Different kind of farming practices across Europe are embraced and developed to enhance resilience of farming systems.

Farm advisory services and market access facilitate the shift from conventional farming practices to sustainable intensification and climate-smart agriculture via high-tech solutions such as biological input substitution, new breeding techniques, and climate-resilient seed varieties optimised and adapted to a changing climate.

Unproductive and inefficient areas might be dropped.

EU-level legislation on emergency stocks safeguards self-sufficiency in times of crises.

Rural development and sustainable agricultural practices

Investing in rural communities for long-term agricultural and environmental gains

The idea is to revitalise the rural areas and bring life back to the countryside. This requires investment in rural infrastructure for digitalisation and transportation. Access to fast broadband internet in rural areas enables the mainstreaming of precision farming and the use of artificial intelligence. However, the privatisation of data services raises concerns about equity and access. Policy interventions ensure these digital platforms remain accessible to all, particularly to medium and small-scale farms in rural areas.

Fostering urban and peri-urban agriculture for modern local food systems

A policy centred on urban and peri-urban agriculture (UPA) would integrate farming within and around cities, aiming to bolster urban food security and sustainability. It would involve creating a regulatory framework for UPA, promoting sustainable resource management, fostering local food markets, and ensuring community engagement and training. Such a policy would necessitate urban planning to accommodate agricultural spaces and encourage circular economy practices. However, a UPA-focused policy could potentially divert resources from rural areas, risking widened economic disparities and neglect of rural development. To counteract this, the policy would need to maintain strong urban-rural linkages, enabling rural producers to access urban markets and benefit from urban waste resources. While UPA could alleviate pressure on rural land, careful management is required to prevent resource depletion.

Bridging the rural-urban divide: a balanced approach to agricultural policy

A food and agricultural policy designed to bridge the rural-urban divide would adopt a balanced approach, ensuring equitable resource distribution and mutual benefits for both rural producers and urban consumers. Such a policy would likely include investment in rural infrastructure to improve productivity and market access, alongside support for urban agriculture initiatives that contribute to city food security and create green spaces. It would encourage the development of regional food systems that connect urban demand with rural supply, facilitated by technology and transportation networks that streamline the farm-to-fork process. Training and education programmes would be implemented to transfer knowledge between rural and urban areas, fostering innovation and sustainable practices across the board. The policy would also promote collaborative platforms for rural and urban stakeholders to co-create solutions to shared challenges, such as climate change and food waste. By fostering these synergies, the policy would aim to create a resilient food system that leverages the strengths of both rural and urban areas, supports local economies, and ensures access to nutritious food for all communities.

Abandoning urban-rural distinctions for a unified agricultural strategy

In crafting a unified agricultural strategy within the European Union (EU), the focus would be on creating an integrated framework that dissolves the traditional urban-rural divide, fostering a seamless agricultural continuum. This strategy would aim to harmonise the diverse agricultural landscapes across the EU, ensuring that policies are inclusive and beneficial to all member states, whether urban or rural.

This approach would be central to the development of robust urban-rural linkages, enhancing connectivity and cooperation across the EU. This would involve improving infrastructure and logistics to facilitate the efficient movement of produce, services, and knowledge between regions. Economic policies would be unified, supporting diverse agricultural activities and markets, thus promoting a resilient pan-European economy.

The strategy would also be grounded in evidence-based policymaking, utilising data and research to tailor interventions that address the specific needs of different regions within the EU. Participation from a broad range of stakeholders would be crucial, ensuring that the voices of all communities are represented and that policies reflect the collective European interest.

Seed policy

Securing the future: Prioritizing advanced GMOs and patents for climate-resilient agriculture and productivity

All means are applied in agricultural practice to have high intensity, adapted to local climates (including drought resistant and robust) and low resource intensive species (including low nutrient intake). This includes genetically modified organisms including patents on certain techniques, but not only. In addition, classical breeding and selection techniques are applied to find optimal species also for indoor cultivation.

Climate-smart agriculture and associated technical solutions such as precision agriculture, new breeding techniques, and GMOs face the challenge of locating the environmental sustainability and resilience of food systems and the risk of reinforcing rather than challenging the large-scale monoculture production model at the expense of natural ecosystems.

Championing open sharing: Farmer-led breeding and seed exchange for ecological farming

There are no patents on GMO. “Old” species can be shared and cultivated to assure robust species. Farmers and gardeners can produce own seeds, exchange and sell. Quality is controlled voluntarily. High-quality seed material can still be bought, contributing to food security in primary production.

Balancing innovation and freedom: Coexistence of commercial and open-source agriculture

In a European seed policy where commercial patenting and trading of genetically modified organisms (GMOs) coexist with natural breeding and the open exchange of seeds, a nuanced regulatory framework would be paramount. Such a policy would carefully balance innovation with tradition, allowing for the

protection of intellectual property rights inherent in GMO development while also preserving the rights of farmers and breeders to save, use, and exchange naturally bred seeds.

The policy would delineate clear GMO cultivation and labelling guidelines, ensuring transparency and consumer choice. It would also establish a robust approval process for GMOs, focusing on safety and environmental impact, alongside measures to prevent cross-contamination with non-GMO crops.

Simultaneously, the policy would support the conservation of agricultural biodiversity by encouraging the use of a variety of plant species, including heirloom and locally adapted varieties. This would be facilitated through incentives for the maintenance and exchange of traditional seeds within community seed banks and networks, fostering resilience and adaptability in the food system.

Food processing and distribution

Engineering the future of food: Ultra-processed and tailor-made for modern lifestyles

In Europe, the food system is being re-engineered to meet the demands of modern lifestyles through the development of ultra-processed and tailor-made foods. This initiative is at the forefront of food processing and distribution, ensuring that products are not only convenient but also aligned with health and environmental sustainability. The design of these foods incorporates advanced nutritional formulations, reducing reliance on additives and prioritising plant-based, insect, or biotechnologically produced components. This approach addresses key health issues, such as obesity, by providing nutrient-rich options suitable for fast-paced European lives.

The distribution of these foods is equally innovative, with a strong emphasis on local sourcing to diminish carbon emissions and streamline logistics. Packaging solutions are eco-friendly, supporting the EU's commitment to a circular economy by prioritising biodegradable materials and the efficient use of resources. Energy and water conservation are integral to the production process, and food waste is minimised through creative repurposing.

Natural first: Minimal processing, maximum nutrition for health-conscious consumers

A natural food system in Europe with minimal processing would prioritise health, food safety, and food security by focusing on sustainable and regenerative agricultural practices. This system would focus on seasonal and regional production. The system would reduce exposure to chemical residues and contaminants by minimising processing and treatments for transport. The principles of sufficiency and regeneration would guide food production, ensuring it aligns with the natural rhythms of ecosystems and supports long-term ecological balance. Furthermore, the system would embrace the concept of food as a commons, promoting equitable distribution and access.

Retail ready: Combining fresh, lightly processed foods with convenient solutions for big markets

The European food system is a hybrid, striving to balance the convenience of processed foods and the global variety of transported goods with the sustainability and health benefits of regional, seasonal offerings.

On the one hand, the market is saturated with convenience foods catering to the urban populace's fast-paced lifestyle, offering ready-to-eat options that significantly cut down meal preparation time. These products, often ultra-processed, are a testament to the technological advancements in food science and preservation. Concurrently, the system is heavily reliant on importing and exporting foodstuffs, enabling a diverse year-round availability of items that are not native or off-season in Europe. This aspect of the food system underscores global interconnectedness and trade reliance, but it also raises concerns about the carbon footprint associated with long-distance food transportation. In addition, regional and seasonal products are gaining traction as consumers become more environmentally conscious and health-oriented. This system segment supports local agriculture and tends to have a lower environmental impact due to reduced transport distances and the absence of energy-intensive storage. It also fosters food security by encouraging self-sufficiency and resilience within local economies.

Support for sustainable and healthy diets

Freedom of choice: Consumers take full control of their dietary decisions

Consumers in Europe are increasingly encouraged to make informed dietary choices that align with their health and sustainability goals. Information and labels are used to educate people on sustainable and healthy foods. Measures such as labelling and certificates, informational campaigns, nutrition recommendations, digital apps and education are used. Support is directed at strengthening food education at schools and by the third sector. Food education and information are provided exclusively by governmental entities.

Health by design: Government regulations shape food consumption for a sustainable future

Government regulations are pivotal in shaping food consumption patterns to ensure a sustainable food system. Strict regulations and controls influence **food composition**, such as reducing unhealthy fats, sugars, and salts and increasing plant-based alternatives. Companies are obliged to report on their sustainability advances. Corporate promotions on potentially unhealthy foods are no longer allowed.

Corporate accountability: Market tools shape prices while businesses ensure food standards

Fiscal instruments are used to promote sustainable and healthy food choices. The added value tax on food products has been changed to support healthy and environmentally friendly products.

Financial support mechanisms address disparities exacerbated by market liberalisation. Subsidies are provided to low-income populations to ensure equitable access to healthy, affordable food, alongside social protection measures to counterbalance the regressive effects of taxation.

Market design of the future Common Agricultural Policy (CAP)

Protecting European agriculture: Safeguarding food sovereignty for stability and security driving free market growth

Agricultural land and production are seen as essential assets that must be safeguarded to ensure food security within the EU, especially in times of crisis. To achieve this, trade rules and tariffs are strictly enforced to protect the internal market from external dependencies, ensuring the EU maintains control over its food supply. Support is directly channelled to farmers, mainly through the Common Agricultural Policy (CAP), which is adapted to prioritise resilience and sustainability. This approach also includes establishing EU-level legislation on emergency food stocks and collaboration among member states to enhance food security and preparedness across the region.

Championing free competition: Opening EU agricultural markets to global players and levelling the playing field for competitive agriculture across Europe

This option advocates for free competition within the Common Agricultural Markets, driven by the belief that open markets and competition will lead to the most efficient allocation of resources. The focus is on minimising government intervention, allowing market forces to dictate production and distribution patterns. This approach encourages innovation and technological advancements, as farmers and agribusinesses compete on a level playing field, leading to increased efficiency and lower costs for consumers. The EU's role is primarily to ensure that markets operate smoothly, with regulations focused on maintaining competition and preventing monopolistic practices.

Balancing food sovereignty and market efficiency: Ensuring fair competition while protecting European agriculture

In Europe, a food market that harmonises food sovereignty with market efficiency is one where local agricultural practices are safeguarded, yet fair competition is maintained. This equilibrium allows European farmers to thrive, preserving traditional agricultural methods and ensuring that imported goods do not overshadow local produce. The Common Agricultural Policy (CAP) plays a pivotal role in this,

offering subsidies to farmers and incentivising sustainable practices, while also imposing tariffs and quotas on certain imports to prevent market saturation from non-European producers.

Simultaneously, the market operates within the framework of the World Trade Organization (WTO) rules, which promote fair competition and discourage protectionist measures that could distort global trade. This ensures that European consumers have access to a diverse range of food products, fostering a competitive environment where quality and price are optimised.

The European food market also integrates digital platforms to enhance market efficiency, connecting producers directly with consumers and reducing the need for intermediaries. This improves transparency in pricing and sourcing and supports small-scale farmers by providing them with a broader market reach.

Selected bilateral treaties

The European Union (EU) actively pursues bilateral treaties with various countries to enhance food security and cooperation. These treaties aim to harmonise regulations, reduce transaction costs, and facilitate trade and investment in the food sector. For instance, the High-Level Regulatory Cooperation Council between Mexico and the United States serves as a model, focusing on regulatory compatibility, simplification, and transparency to boost competitiveness and development.

Role of technology and digitalisation

Focus on nature-based solutions

Nature-based solutions (NBS) are integral to enhancing ecosystem services in agricultural practices. Agroforestry, for instance, merges tree cultivation with farming, increasing biodiversity and providing alternative income. In livestock management, NBS foster habitats for pollinators and pest predators, reducing chemical use. Horticultural techniques like companion planting and organic composting or applying Biochar and legumes improve soil health and crop resilience, contributing to carbon sequestration and climate mitigation.

These practices include creating flood plains for water management, windbreaks to combat soil erosion, and landscape designs to mitigate heat accumulation. The adoption of NBS underpins a shift towards agroecology and permaculture, prioritising natural processes over synthetic inputs and reducing the reliance on heavy machinery.

Hight-tech and crafted systems for all means

The EU champions advanced, intensive food production methods such as precision agriculture, single-crop farming, and state-of-the-art vertical farming alongside cutting-edge greenhouses and Biolabs. These systems are constantly monitored to ensure efficiency and sustainability. Digital technology is at the forefront of personalising nutrition, focusing on health benefits rather than traditional taste and culinary heritage. Governments are guiding these food systems towards eco-friendly practices using digital innovations. The digital transformation across the continent is streamlining food production, ensuring that European agriculture remains sustainable and productive.

Mixed systems and circular solutions depending on local peculiarities

The EU is fostering a blend of mixed agricultural systems and circular approaches, tailored to the unique characteristics of each locality. This includes backing for robust crop varieties, innovative farming techniques, advanced plant breeding, and comprehensive circular strategies that span the entire food supply chain. These strategies integrate both nature-based solutions and sophisticated technology. Where suitable, greenhouses, 'Ecodomes', and aquaculture systems are employed. Meanwhile, areas unsuitable for intensive farming—such as arid regions or flood-prone zones—are designated for ecological restoration and conservation, or are utilised minimally, for example, as grazing lands. This nuanced approach ensures that agri-cultural practices are both sustainable and adapted to the environmental context.

Research and innovation

Focus on innovation and excellence

This option prioritises technological excellence and cutting-edge research to drive the future of Europe's food systems. Precision agriculture utilises drones and IoT sensors to monitor crop health, optimise resource use, and reduce waste. Vertical farming, employing controlled environments and hydroponics, is expanding the possibilities of urban agriculture. In food processing, AI-driven robotics are streamlining operations, while blockchain technology enhances traceability and transparency in the supply chain. Innovations include cultured meat production, which involves growing meat from cells in a lab, potentially reducing the environmental impact of livestock farming. Nanotechnology is poised to revolutionise food safety and shelf-life extension with smart packaging that detect spoilage. Gene editing techniques like CRISPR are also being explored to create crops with improved yields.

Focus on experimentation

This option prioritises experimentation with sustainable, community-driven, and ecologically sound practices optimised locally. Such experiments and local optimizations are funded systematically, as is the exchange of good practices.

It emphasises developing and scaling up agroecological methods, circular economy models, and regenerative agricultural practices through collaborative and locally rooted experimentation.

Local innovation hubs are established where farmers, researchers, and communities work together to test and refine environmentally sustainable and socially equitable practices. The focus is on low-impact, nature-based solutions that enhance biodiversity, restore ecosystems, and build resilience within the food system.

Focus on private-public applied research and innovation

Private-public partnerships in applied research can play a big role in advancing food production technologies. These collaborations combine the innovation-driven nature of private enterprises with public entities' regulatory and financial support. Together, they focus on addressing critical challenges such as enhancing crop yields, developing sustainable farming practices, and improving food security. By combining resources, expertise, and infrastructure, these partnerships expedite developing and deploying new technologies, such as drought-resistant crop varieties or precision agriculture tools. They also facilitate the transfer of knowledge from research labs to the field, ensuring that scientific breakthroughs translate into tangible benefits for farmers, the food industry, and consumers. Such synergies drive agricultural innovation and support policy objectives related to environmental sustainability and economic development.

Role of the state

Centralised/top-down

Large businesses dominate the economy, but their activities are heavily regulated to serve the common good, National governments hold significant power over food systems. European Union takes a stronger role in regulating not only primary production and food markets. Food companies are regulated to provide healthy and sustainable foods to citizens.

Reduced role of the state: market-driven (current policy)

The food retail and industry sectors are dominated by Multinational Companies (MNC), which control the essential data infrastructure for precision farming, home delivery services, and personalised nutrition plans. The privatisation of digital services has concentrated power within a few large corporations, sparking concerns over equity, access, and the decline of local food networks. This corporate dominance has led to a fragmented food market, as the weakening of the EU single market has prompted national and regional policies diverge in response to global trade pressures and local production demands.

Focus on regional and local policy

The breakdown of the Eurozone has further exacerbated this fragmentation, with regional economies struggling to compete against international trade pressures and foreign direct investment (FDI) from outside the EU. Deregulated food markets have allowed MNCs to expand their influence, but this has come at the cost of lower food standards in certain European regions. Combined with the decline of small farming, this has deepened social and economic disparities across Europe. Nevertheless, new business models are emerging to challenge this corporate dominance. Circular economy practices have become well-established in the food industry, with companies integrating sustainability into their core strategies. These models prioritise optimising food production and distribution, focusing on waste reduction and resource efficiency. As these practices scale up, they offer a pathway to a more resilient and sustainable food system, though one that remains heavily influenced by corporate vested interest and global market dynamics.