

Bridging the disconnect between practice and system: the “Just Transition Pathway” as a tool for steering practical solutions towards more systemic impact

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Abstract

Innovation projects targeting complex societal challenges such as climate change, food loss, and digital transformation often struggle to scale their solutions beyond pilot phases. This paper identifies three structural causes of this disconnect between innovation practice and systemic impact—overstated ambition, technological determinism, and contextual isolation. Using the EU Horizon project ZeroW as a case study, we introduce the Just Transition Pathway (JTP) as a practical instrument to bridge this gap. The JTP combines systemic foresight, stakeholder consultation, scenario development, and economic modelling to embed justice, inclusivity, and sustainability at the heart of transition design. Through the co-creation of alternative pathways and the development of seven “Just Pathway Actions,” the ZeroW project demonstrated how technical innovations can be aligned with broader systemic dynamics, while also addressing equity concerns such as the digital divide and disproportionate burdens on vulnerable actors. The findings highlight the JTP’s value as both an analytical and operational framework for linking local solutions to long-term systemic transformations. By reframing ambition, integrating social and behavioural dimensions, and embedding pilots within governance structures, the JTP provides a roadmap for scaling innovations in ways that are both just and impactful.

Keywords

Just Transition Pathway; systemic innovation; food loss and waste; Horizon Europe; sustainability transitions; social justice; innovation scaling; ZeroW project; systemic change; policy integration

Introduction

Challenges to society’s wellbeing abound, such as climate change, geopolitical tensions, and malicious AI. These complex challenges are multidimensional and systemic in nature, which is why there are no simple solutions to face them. In reality, they demand transitions: “[...] a structural change in a societal (sub)system that is the result of a co-evolution of economic, cultural, technological, ecological and institutional developments at different scale levels” (Rotmans et al., 2008).

Numerous innovation projects, such as those supported by the EU Horizon Europe programme, aim to accelerate these transitions necessary to sustain society's wellbeing. While many solutions developed within these projects reach a certain level of maturity, the challenge of

scaling them often persists (e.g., Schut et al., 2020; Van der Weerd et al., 2017). We posit that this can be explained by features often woven into the fabric of these projects from the onset: overstated ambition; technological determinism; and contextual isolation.

Firstly, in order for those working on a promising innovation to become eligible for funding, they are required to pitch an ambitious and compelling story selling the broad impact of their innovation. This is comparable to a job interview, in which it is, presumably, familiar to many that the focus is on positive traits and potential. When the project then progresses, some complicating aspects may surface that previously went unnoticed, such as workers seeing the technology as a potential threat to their position, or the solution assuming a degree of digital literacy that is not ubiquitous. We call this phenomenon *overstated ambition*, where projects begin with bold claims about their potential impact and ambitions that can obscure practical limitations and social complexities.

Secondly, by putting tech-heavy digital innovations centrally within a project from the start, as is often the case, it seems that other crucial elements such as the behavioural changes needed for an innovation to come to full impact, can become compromised. This can be traced back both to the fact that digitalisation is a connecting theme that recurs in many of these innovation projects, and to the fact that the EU is firmly set on the notion that digital advances, such as AI, data spaces, and cybersecurity, contribute to a European Union that can uphold and protect its democratic values of civil participation, safety and security, and sustainability¹. Moreover, in the recently-launched EU Competitive Compass, digitalisation and diffusion of advanced technologies across the European economy are deemed a key ingredient for lifting productivity growth (European Commission, 2025). Some transitions, like the twin Digital and Green transitions, complement each other (Muench et al., 2022). This complementary parallel transition also materialises within European research projects that place digital innovations front and centre as a means to support or accelerate transitional goals. Nevertheless, a technological determinism and strong emphasis on digital technologies as main solution can marginalise the behavioural, cultural, and institutional dimensions of change.

Lastly, whilst a European research project often pursues a holistic path of systemic innovation (also focusing on elements such as mindset change and new regulations), pilots in such projects will by nature focus more on innovating their “product” (e.g. a sensor, an app, or a decision-support systems). They will thus, justifiably, prioritise improving product features, sharpening the business case, and finding potential clients. Often rooted in a relatively isolated context, these solutions run the risk of broader social impacts being left in limbo when they are further developed, which may in fact hinder their adoption, let alone scaling.

In short, a recurring and highly consequential challenge in the domain of innovation for societal transition is that proposed innovations fundamentally fail to adequately address larger systemic realities. The features of potential solutions described above (namely, overstated ambition, technological determinism, and contextual isolation) steer them away from being a true lever for systemic change and ultimately limit their scalability. On the surface, the diagnosis and subsequent medicine to this disconnect seems straightforward; increase awareness of these issues and tweak the solutions to meet them. However, in the chaotic context of a dynamic innovation project with many stakes, activities and partners, this becomes difficult to

¹ Europe's Digital Decade | Shaping Europe's digital future (<https://digital-strategy.ec.europa.eu/en/policies/europes-digital-decade>)

accomplish. A practical instrument is thus needed to, in a comprehensive, useful, and attractive way, bridge the practice of innovators and solution builders with the wider systemic story.

Hence, to address this quandary, we propose the use of a Just Transition Pathway (JTP) as a means of articulating and navigating the disconnect between the practical solutions and the greater systems that require transition. What JTPs are, and how they can be developed and applied, will now be described by means of a real-life case in which this was materialised: the EU Horizon project ZeroW.

Developing a Just Transition Pathway

CASE: THE ZEROW PROJECT

ZeroW is a multiyear project funded by EU Horizon that aims at supporting a major reduction in Food Loss and Waste (FLW) and defining enabling conditions that allow for near-zero FLW in the EU by 2050. The project, that started in 2023, is not only intent on cutting down the amount of food resources lost, but also on supporting specific actors such as food banks to simultaneously reduce food poverty.

ZeroW identifies a range of so-called “lock-in effects”, structural and behavioural effects of the current food system that underpin the range of factors affecting FLW. Examples of these lock-in effects are consumer preferences for aesthetically pleasing foods; limited capabilities of actors in the food chain to change existing structures and dogmas; lack of adequate and consistent data for decision-making; and information asymmetries between food supply and demand (Fusions 2014; Porter, et al. 2018; Bilska, 2016; and Graham-Rowe, 2014).

Because these challenges touch upon all system layers mentioned above (economic, cultural, technological, ecological and institutional), ZeroW designed its methodological approach to centre nine so-called “systemic innovation living labs” (SILLs). These SILLs serve as the development venue for nine systemic solutions to reduce FLW by addressing the full breadth of factors contributing to FLW (see figure 1).

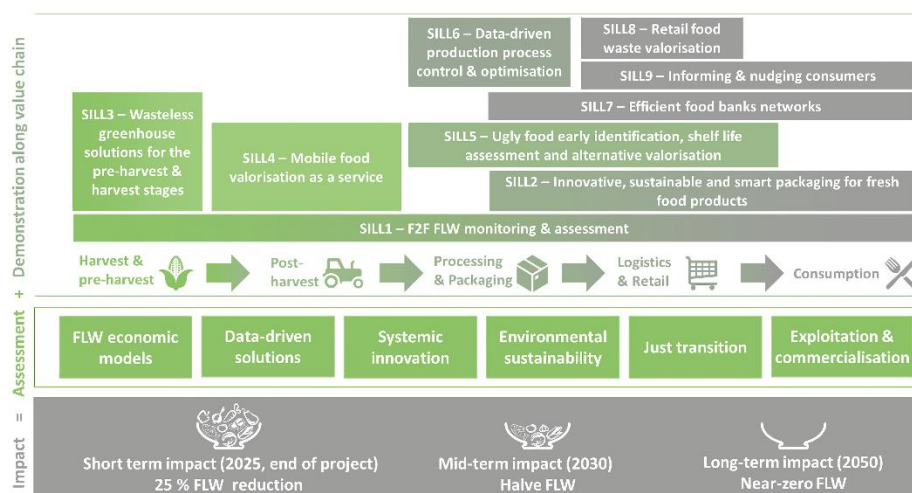


Figure 1 ZeroW value chain and SILLs: this figure summarises how ZeroW develops solutions in the SILLs across a range of impact timelines (from short to long); phases along the value chain (from pre-harvest to consumption); and assessment metrics (from economic to environmental to justice and more). Graphic taken from the ZeroW Grant Agreement (European Commission, 2021)

Inherent to the focus of the ZeroW project, the SILLs each set out to develop a particular solution that addresses the challenges mentioned above, such as a smart packaging label that indicates whether a product is still edible (i.e. replacing a date marking), or the early detection of vegetables that do not fit aesthetic standards but can instead be turned into another food product on time. During the project, efforts were made to ensure alignment with the broader system in which these solutions should be adopted and scaled, for instance via assessing the interplay between the solutions' potential and required behavioural or legal aspects. In the process of further developing the solutions, however, it turned out that more was needed than this indicative assessment score on the fit between systemic aspects and the solution; in fact, the project was in need of an approach to define actual *actions* for a better fit. The ZeroW team put forward the Just Transition Pathway to serve as this approach.

At its core, a transition pathway is a structured, forward-looking roadmap that outlines how complex systems—such as energy, food, or mobility—can shift toward (more) sustainability. Pathways account for the more systemic dimensions of change mentioned earlier, thus going much further than technical blueprints of innovative (digital) solutions (Tomai et al., 2024; Luederitz, 2017). Furthermore, transition pathways that are *just*, are not only about what needs to change, but also about who is affected, who decides, and who benefits. As Morrison (2024) argues, the aspect of justice in the Just Transition Pathway is not an optional add-on, but a foundational principle that must shape how transitions are conceived and governed. While the notion of transition pathways has long existed in sustainability discourse, the integration of justice as a core design element is relatively recent—emerging in response to the growing recognition that transitions failing to address systemic inequities are unlikely to succeed or scale. Embedding justice in transitions, means that environmental sustainability, social equity, and economic viability are all fairly balanced. In other words: they ensure the protection of the environment, the equal treatment of people, and a healthy economy, so that no one is left out or unfairly affected.

Building on this understanding, the steps for creating a just transition pathway for the ZeroW project outlined below (in figure 2) operationalise these principles by ensuring their systemic, inclusive, and justice-oriented nature:

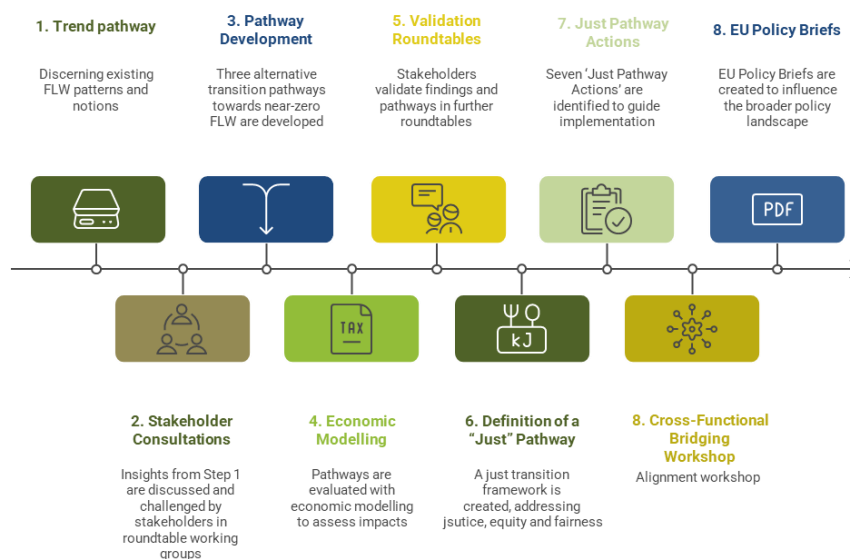


Figure 2 ZeroW JTP process sequence: this figure outlines the sequence of steps ZeroW employed to create the ZeroW Just Transition Pathways

The main elements of these steps are explained here. A more elaborated version, including details on how each step was executed, is given in the Appendix.

In their role to create cohesion between a changing system and potential solutions, JTPs need to originate from understanding the existing structures and dogmas of a system. The first step thus served to discern patterns and dominant notions around FLW, assuming the quantity of FLW stays as it is.

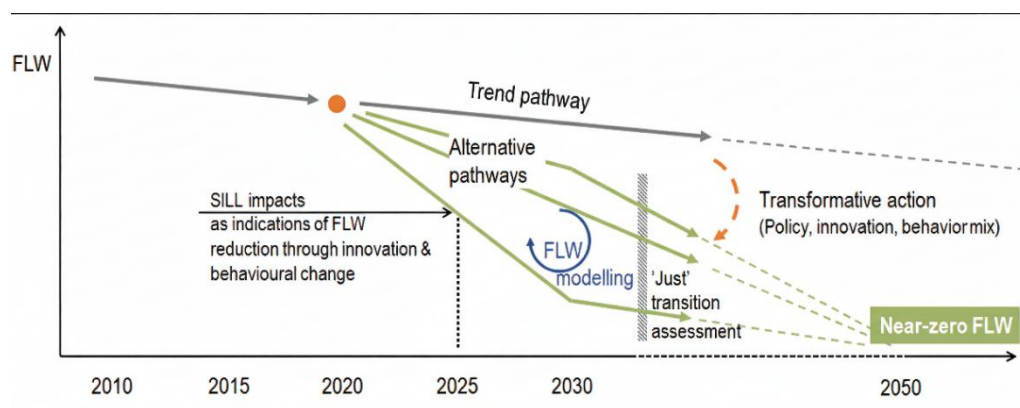


Figure 3 ZeroW (alternative) pathways timeline: this figure graphically depicts the ZeroW approach to establishing Just Transition Pathways for reducing FLW: alternative pathways are proposed as deviations from the status quo (trend pathway), for going towards near-zero FLW by 2050. Transformative actions, as suggested in step 7, then ensure these pathways can actually materialise. Graphic taken from the ZeroW Grant Agreement (European Commission, 2021)

In order then to change these patterns and notions to pathways for reducing FLW instead, the insights of step 1 were discussed and challenged by stakeholders in step 2. In the case of ZeroW, these stakeholder consultations were given extra depth by revolving them around three main systemic themes: potential innovations to reduce FLW; policy making and FLW; and consumer behaviour as a means to reduce FLW.

As visualised in Figure 3, from the outputs of the the consultations in step 2, combined with the result of step 1, three alternative transitions pathways towards near-zero FLW reduction could be developed: a “Green Growth Pathway” that emphasises market-driven innovation and voluntary measures; a “Changing the Rules Pathway” that advocates governance reform, with strict regulatory enforcement of FLW reduction through taxation; and an “Innovation First Pathway that promotes collaborative, cross-sector innovation with flexible, stakeholder-driven targets and strong consumer involvement in co-developing circular solutions. Proposing three pathways (instead of already committing to one) ensures later choices are made that are balanced and weighted (see the Appendix for more details on these JTPs and the related weights). In fact, each pathway reflects a distinct configuration of ambition, governance structures, and societal engagement, enabling the examination of trade-offs and synergies inherent in different approaches to FLW reduction, while reflecting the diversity of plausible responses to systemic barriers. They are not forecasts or predictions of the future; rather, each pathway illustrates how a different constellation of changes in policy, technological innovation, and consumer behaviour could bring us to near-zero FLW.

To then operationalise a *just* transition (again, one that balances environmental sustainability, social equity, and economic viability), while at the same time proposing realistic food loss and waste (FLW) reduction targets, an economic modelling exercise was conducted in step 4 that substantiated the potential of each pathway with quantitative figures. The outcome of this modelling exercise pointed to a detrimental effect of relying solely on mandatory FLW reduction targets (the required taxation would be too high) and the need for context-sensitive policies as certain household reduction measures could hit vulnerable consumers disproportionately hard.

Then once more, building on the three alternative transition pathways developed and modelled, the ZeroW team reconnected with stakeholders from the initial working group sessions on policy, innovation, and consumer behaviour, and invited additional participants to two roundtables designed to validate the findings so far (step 5).

Subsequently in step 6, the ZeroW project could advance a conceptual framework for a just transition in the food system. This framework aimed to define what constitutes “justice” in the context of FLW reduction and how it can be operationalised. Recognising the food system as a complex, multi-level network shaped by socio-economic, political, and ecological forces, the framework identified systemic vulnerabilities and power asymmetries that may disproportionately affect certain groups. By then examining the implications of different policy combinations, ZeroW uncovered how various FLW reduction strategies might shift burdens across the food value chain, potentially exacerbating social inequalities, especially regarding access to food. These insights guided a fresh review of the three alternative pathways which culminated in the creation of one balanced and just transition pathway: a hybrid strategy that combines moderate taxation, targeted incentives, and voluntary agreements.

Step 7 then focused on the identification of seven overarching actionable interventions - termed ‘Just Pathway Actions’ – that would both steer the technological innovations developed within the ZeroW project towards a fit with actual systemic issues; and serve as a roadmap for policymakers seeking to implement just and effective FLW reduction strategies in line with EU goals (mainly the newly adopted mandatory food waste reduction targets by the European Commission (2025)). In short, these actions are (also depicted in figure 4 below):

- Action 1: Differentiated FLW reduction targets – Tailoring reduction targets to country context, supply chain actors, and commodity types. Progressive taxation models, exemptions for small actors, and incentives for verified reductions ensure fairness and effectiveness.
- Action 2: Standardised measurement and monitoring – Developing consistent definitions across Member States, strengthening data infrastructure, and promoting transparency through non-punitive reporting.
- Action 3: Support for small-scale producers – Improving access to climate-resilient technologies, storage, and transport, supported by cooperative models and peer-learning mechanisms to ensure vulnerable actors benefit from innovations.
- Action 4: Scaling innovations through subsidies and training – Reducing barriers to technology adoption through targeted subsidies, grants, and vocational training, especially for SMEs and low-income actors.

- Action 5: Consumer incentives for household waste reduction – Introducing subsidies for smart appliances, composting services, and behavioural nudges such as personalised guidance, to address the fact that households are the largest contributors to FLW.
- Action 6: Legal reform – Updating fragmented or outdated frameworks, clarifying responsibilities, simplifying compliance procedures, and enabling scaling of new FLW reduction innovations.
- Action 7: Empowering grassroots and community actors – Strengthening municipalities, NGOs, food banks, and cooperatives as intermediaries that engage vulnerable groups, redistribute surplus food, and foster cross-sector collaboration.

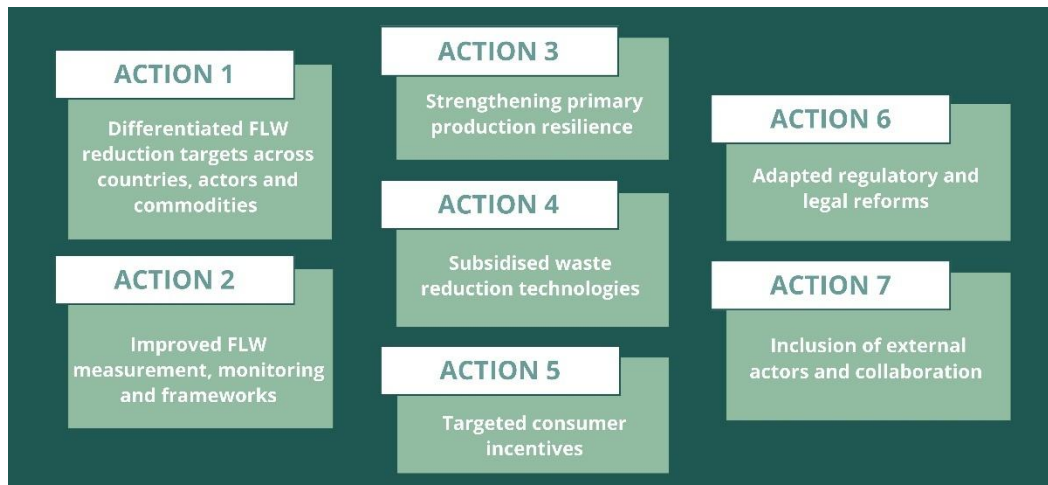


Figure 4 ZeroW Just Pathway Actions: this figure presents an overview of the Just Pathway Actions, stemming from the Just Transition Pathway

To put the JTP into practice, an important next step was to the in-depth, cross-functional workshop, designed to foster mutual learning and alignment. This workshop brought together members of the ZeroW team (with expertise on policy making, technology development and behaviour change), with representatives of the SILLs, in a structured, dialogic setting. These participants collaboratively examined how the distinctive features of each SILL—whether related to their innovation, required behaviour changes, or their policy context, reflecting the origins of the JTP—could inform or reinforce the seven Just Pathway Actions. Also, the workshop participants identified where the SILLs already contributed to just outcomes, and where policy support would be essential to scale impact equitably.

The final step in the process (step 9) focused on informing and shaping the broader policy landscape through the creation of corresponding EU Policy Briefs. These serve as advocacy tools, aiming to influence EU and Member State policies that support the of linking of pilot-level innovations to systemic, long-term transitions inspired by the Just Transition Pathway.

Revisiting the 3 features of the disconnect between practice and system

Despite the growing maturity of many innovations developed within EU research projects, the persistent challenge of scaling them remains due, in large part, to structural features embedded in project design—namely, overstated ambition, technological determinism, and contextual isolation. The process of developing a Just Transition Pathway in ZeroW helped us understand,

navigate, and bridge this disconnect between ambition and implementation, between technological innovation and systemic change, and between specificity and broader systemic thinking by embedding innovation within a broader systemic and justice-oriented framework.

Firstly, overstated ambition is frequently incentivised by funding structures that reward bold, transformative visions. While this can drive creativity and urgency, it also risks setting unrealistic expectations that overlook the complexity of real-world implementation. As projects progress, the gap between projected impact and practical feasibility can widen, especially when social, institutional, or behavioural barriers emerge. The ZeroW project confronted these challenges by embedding a justice-oriented lens into its methodology, recognising that scaling is not merely a technical or economic ambition, but a deeply social and political one. Furthermore, ZeroW grounded its vision in evidence-based transition pathways developed through trend analysis, literature reviews, and multi-stakeholder validation. This ensured that FLW reduction goals were translated into realistic, context-sensitive strategies. And finally, the use of economic modelling and scenario analysis helped anticipate impacts and align innovation with both short- and long-term policy goals.

ZeroW's deliberate integration of social, behavioural, and policy dimensions into every stage of the JTP design process also helped to counteract the overemphasis on technological innovation within projects. As such, technological solutions were evaluated not just for their efficiency, but for their inclusiveness, accessibility, and potential social consequences. Particular attention was given to mitigating risks such as the digital divide (the gap between individuals, communities, or regions that have access to digital technologies and those that do not, often resulting in unequal opportunities for education, employment, and social participation) and labour displacement (e.g. when workers lose their job because of automation), which are often overlooked in innovation-led projects.

Lastly, pilot projects often remain confined to narrow contexts, limiting their broader impact. ZeroW addressed this by establishing nine Systemic Innovation Living Labs (SILLs) where diverse actors co-created, tested, and refined solutions in real-world settings. These labs were complemented by participatory working groups and EU policy briefs, ensuring local experimentation was linked to systemic change mechanisms. Nevertheless, in the process of vigorously pursuing the goals set out at the beginning of a project, safeguarding a fit between the solution and the broader system dynamics is sometimes overlooked. ZeroW's JTP innovation process, including the workshop at the end to align the SILLs with the JTPs, has served to put this connection back on the centre stage.

Discussion

ZeroW's bridging exercise with JTPs yielded several key insights. The first one is to integrate social and behavioural aspects from the outset; these should not be secondary to technological development. For instance, increasing digital literacy emerged as a priority, both to ensure equitable access to technological benefits and to address the growing digital divide. Secondly, make sure to secure funding for scaling of the potential solutions early during the project, as to ensure their continuity and impact after the project concludes; Finally, we recommend to foster cross-sectoral collaboration; innovation thrives at the intersections of disciplines, industries, and governance levels. And recurring stakeholder engagement helps to ensure that innovations remain relevant and grounded in real-world needs.

The effectiveness of this approach can be attributed to several interrelated factors. The Just Transition Pathway and Actions encouraged grounded thinking through realistic as well as

thought-provoking scenario planning, while also acknowledging the multidimensional nature of innovation—including social, economic, and environmental forces. The process brought together diverse stakeholders with complementary perspectives and facilitated structured yet flexible dialogues that surfaced tensions and opportunities. Perhaps most importantly, the Just Transition Pathway and Actions provided a shared vocabulary and collaborative workspace - a kind of sandbox - where actors could co-create transition strategies using robust tools such as modelling and backcasting. This demonstrated the value of the Transition Pathway not only as analytical framework but also as a practical instrument for guiding inclusive, systemic innovation.

The iterative exchange in the bridging workshop in turn allowed conceptual actions to be reflected upon in operational realities. Choosing this workshop format also encouraged critical interrogation of assumptions, surfaced context-specific barriers, and helped articulate the kinds of enabling conditions—legal, financial, behavioural, infrastructural—needed to move from isolated innovation to systemic transformation. In doing so, this process itself became a model for participatory governance and co-creation, reinforcing the principle that justice must be embedded not only in what we do, but also in how we do it.

In the end, by engaging with the JTP and Just Pathway Actions, ZeroW was able to reframe the three systemic challenges as opportunities: 1) overstated ambition became a driver of evidence-based, context-sensitive planning; 2) technological determinism gave way to a holistic perspective integrating behavioural and policy dimensions; and 3) contextual isolation was countered by embedding pilots within systemic governance frameworks.

Limitations

While ZeroW's approach to bridging practical solutions to systemic dynamics through a Just Transition Pathway demonstrated the potential of inclusive, scalable innovations, several limitations must be acknowledged to ensure realistic application in other projects revolving around innovations with an envisioned systemic impact. First, the integration of social and behavioural aspects from the outset requires significant resource allocation—not only financial, but also in terms of time, effort, and expertise. Bringing together diverse stakeholders, especially pilots and policy actors, demands sustained coordination and facilitation, which can be challenging without dedicated support structures. Moreover, fostering the right mindset across sectors—particularly where systemic thinking is relatively new, or undervalued—can slow progress. Lastly, approach also assumes that systemic embedding is always the most effective strategy, yet in some contexts, a more targeted focus on the economic value chain or technological deployment may be more appropriate.

All in all, the authors can recommend using this method to address challenges of connecting systemic features to practical solutions in innovative, multi-faceted, ambitious projects. Yet we propose these key recommendations for doing so successfully:

1. Ground innovation in evidence-based, inclusive strategies. And use tools like scenario planning, economic modelling, and stakeholder validation to ensure that ambitious goals are translated into realistic, context-sensitive actions that consider social, environmental, and economic dimensions.
2. Integrate social and behavioural aspects throughout: Avoid overreliance on technology by evaluating solutions for their accessibility, inclusiveness, and potential social impacts—such as the digital divide or labour displacement—while embedding pilots within broader systems thinking.

3. Foster collaboration and alignment: Engage diverse stakeholders early and continuously, connect local pilots to systemic change mechanisms, and align interventions with funding and innovation cycles to maintain relevance, momentum, and long-term impact.

Conclusion

As evidenced by the ZeroW project, we argue that use of the Just Transition Pathway and Actions can not only help to articulate and navigate the disconnect, but ultimately also support the development of pilots that are better suited to systemic challenges, better equipped to be scaled up and commercialised, and better designed to address societal inequities through inclusion of a justice lens.

The combination of the Just Transition Pathway and the Just Pathway Actions offered a structured yet adaptive framework that allowed us to translate high-level systemic goals into actionable strategies. This was particularly effective in addressing three core tensions identified at the outset of the project: the gap between project ambition and implementation; the overemphasis on technological solutions at the expense of human and social dimensions; and the need to move from narrow specificity of solutions to systemic thinking. By engaging with the Just Transition Pathway and the Just Transition Actions, we were able to reframe these tensions as opportunities for integration and alignment. Ultimately, we encourage people working on innovations and launching pilots within larger systemic projects to consider using ZeroW's methodology to foster a stronger connection between solution development and systemic impact—bridging the gap in ways that support effective scaling and boost impact.

Declarations

Acknowledgement

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Ethical Approval

This study did not require formal ethical approval as it did not human-centred data. The work was based on qualitative insights from expert stakeholders, collected in a professional capacity, and did not involve sensitive personal data or interventions. All procedures adhered to the principles of the Declaration of Helsinki.

Informed Consent

Verbal informed consent was obtained from all stakeholders prior to participation. As participants were experts acting in their professional capacity, their contributions were anonymised and involved no sensitive personal information. For this reason, written informed consent was not deemed necessary.

Data Availability

No datasets were generated or analysed for the purpose of this paper.

Extended Data

All supporting materials, including notes from stakeholder consultations and resulting policy briefs, are publicly available via “Deliverable 8.2: ‘Just’ transition pathway & intermediate targets” (ZeroW project, 2025) can be accessed at: <https://www.zerow-project.eu/publications> and will be made available on Zenodo after the project review (Q1 2026).

Ethical approval and consent were not required to obtain the data.

Competing Interests

The authors declare no competing interests.

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Author’s Note on AI Usage

The “Create” module of Microsoft Copilot 365 was used to sketch figure 2. Copilot was used to enhance the readability of the manuscript. No new content was produced by AI.

Appendix: the steps towards the creation of ZeroW’s Just Transition Pathways

Step 1: Trend pathway

The process began by developing a “trend pathway” that projected the future based on historical patterns and assuming no major changes in current policies, innovations, or consumer behaviour. The conceptualisation of the trend pathway was done through an extensive literature review that looked at the entire EU policy and political landscape surrounding the topic of FLW reduction.

Step 2: Stakeholder consultations

Next, stakeholder input was gathered via 14 Working Group meetings. In order to make the outcomes more rich and targeted, the Working Group meetings all had a specific focus, either on Innovation, Policy, or Consumer Behaviour—selected for their measurable impact and complementary roles in FLW reduction. The Innovation Working Group meetings explored forward-looking solutions across the food supply chain, highlighting technologies such as modified atmosphere packaging, edible coatings, and data-driven logistics to reduce spoilage and improve efficiency. The Policy Working Group meetings focused on creating an enabling regulatory environment, such as mandatory FLW reduction targets, incentives for innovation, and policy tools like public procurement criteria and educational campaigns to drive systemic change. Lastly, the Consumer Behaviour Working Group meetings addressed household-level waste by

promoting mindful purchasing, better storage practices, acceptance of imperfect produce, and food donation, while also calling for evidence-based behavioural toolkits for broader implementation.

While economic factors were not directly included in the WG discussions, they were addressed through economic modelling by Wageningen University (described in step 5).

Step 3: Pathway development

The ZeroW project could subsequently develop three Alternative Transition Pathways to explore trajectories toward near-zero food loss and waste (FLW) by 2050, grounded in the earlier trend analysis, literature review and stakeholder consultation. These pathways were not intended as predictive models but as conceptual tools to provoke dialogue, challenge prevailing assumptions, and support systemic thinking within agrifood and/or FLW research and innovation communities. These pathways are:

- **Green Growth Pathway:** this pathway emphasises market-driven innovation and voluntary measures, with moderate mandatory targets (10–30% by 2030) and a focus on scalable technologies and consumer education.
- **Changing the Rules Pathway:** this pathway advocates for systemic governance reform, with uniform mandatory 50% reduction targets by 2030 and strict regulatory enforcement across all stages of the food chain.
- **Innovation First Pathway:** this pathway promotes collaborative, cross-sector innovation with flexible, stakeholder-driven targets and strong consumer involvement in co-developing circular solutions.

Their relevance lies in their ability to illustrate multiple avenues for action while also serving as a basis for discussing what constitutes a “just” transition in step 6 (one that accounts for the complex interplay between environmental sustainability, social equity, and economic viability).

The pathways also incorporated practical elements drawn from current policy trends and recent publications from EU institutions. Specifically, they were designed in response to ongoing discussions about introducing new mandatory food waste reduction targets for EU Member States (Council of the European Union, 2025).

Step 4: Economic modelling

The ZeroW project employed a dual economic modelling approach, consisting of both a partial equilibrium model² and the MAGNET model³ (Pijpers & Drabik, 2025). These models each offer complementary insights. The partial equilibrium model provided commodity-specific analysis across the food supply chain, while the MAGNET model offered macroeconomic perspectives on policy interventions, such as disposal taxes for foods and waste and voluntary reduction measures (i.e., measures not based on taxes, fines, or obligations). The models assessed the effects of disposal restrictions across various FLW end-of-life routes (e.g., landfill, donation,

² A partial equilibrium model is an economic modelling approach that analyses the equilibrium condition of a single market or sector in isolation, holding all other markets constant (*ceteris paribus*), hence not accounting for feedback effects from the broader economy (Hallren, R., & Riker, D. 2017).

³ The MAGNET model (Modular Applied GeNeral Equilibrium Tool) is a global, multi-sectoral computable general equilibrium (CGE) model developed to assess economic, environmental, and social impacts of policy interventions across interconnected sectors and regions (Wageningen Economic Research. (n.d.))

sewage) and quantified related systemic outcomes, such as their impact on FLW levels, GDP, and employment in agriculture and food processing.

The modelling results (Pijpers, F., & Drabik, D. (2025) informed the definition of a *just* transition pathway by identifying achievable short- and medium-term targets and highlighting sectoral interdependencies. For instance, commodity-specific taxes could reduce waste, but may also disproportionately affect vulnerable consumers, raising equity concerns. These findings stress the need for nuanced, context-sensitive policy design that balances environmental goals with social fairness. At the macro level, the MAGNET model revealed that FLW reduction policies could have significant ripple effects across the economy. For instance, taxing specific supply chain stages may shift waste to the untaxed sectors. Also other potential unintended consequences were identified, such as the paradoxical effect of lower food prices due to efficiency gains from FLW reduction, encouraging higher consumption that would need to be met by greater agricultural output. Consequently, a cascade effect is that the FLW measures would actually lead to more intensified land use and rising labour demand, particularly for unskilled workers. These insights again underscore the importance of designing FLW reduction strategies that are not only effective but also socially and environmentally sustainable.

Step 5: Validation Roundtables

The ZeroW team re-engaged stakeholders from the initial WG sessions on policy, innovation, and consumer behaviour, and invited additional participants to two roundtables aimed at validating the findings from Steps 2 through 4. The first roundtable focused on validating the feasibility of the reduction targets presented in each of the three alternative pathways. The second roundtable explored effective policy designs and strategies, emphasising social impacts and collaboration needs.

Step 6: Definition of a “Just” Pathway

To address the potential vulnerabilities and injustices in a system when following FLW reduction pathways, three core dimensions of justice were analysed: distributional justice, which concerns the fair allocation of benefits and burdens across different actors; procedural justice, which focuses on inclusive and transparent decision-making processes; and recognition justice, which ensures that the voices, identities, and knowledge of marginalised groups are acknowledged and respected. These dimensions provided a structured lens for evaluating whether FLW reduction strategies promote equity, not only in terms of outcomes but also in terms of the processes that shape the strategies. Special attention was given to structural barriers such as the digital divide, which risks excluding vulnerable actors from innovation and decision-making processes.

The project also identified four transformative pillars essential for a fair and sustainable transition: 1) rethinking food as a public good (e.g., regarding food beyond market value, and considering nutritional value); 2) addressing unfair trading practices (e.g., power imbalances between retailers and farmers); 3) shortening supply chains (e.g., to create a better position for farmers); and 4) bridging the digital divide (e.g., ensuring that digital solutions to support FLW reduction are widely accessible). These pillars were evaluated through the lens of distributional, procedural, and recognition justice—ensuring that benefits and burdens are fairly allocated, that decision-making processes are inclusive and transparent, and that the identities and needs of vulnerable groups are acknowledged.

Streamlined Just Alternative Pathway

Analysis of the modelling results demonstrated that neither the most ambitious pathway nor a laissez-faire approach would meet the criteria for a just and feasible transition by 2030. Instead, the ZeroW policy team proposed a calibrated set of intermediate targets that reflect an equilibrium between ambition and practicality. These targets, which correspond to the EC targets, were selected as an indicative choice to address macroeconomic effects, stakeholder concerns, and the feasibility of technological advancements. These targets are proposed as follows (figure 5):

Food waste reduction target on	Mandatory 2030 FW reduction target	Voluntary 2030 FW reduction target
Primary production	n/a	10%
Processing & Manufacturing	10% (absolute amount in mass units)	For higher target levels
Retail & Consumption	30% (per capita)	For higher target levels

Figure 5 FLW reduction targets: this figure depicts our final proposal for just and realistic intermediate FLW reduction targets

Step 7: Just Pathway Actions

The methodological approach employed in the previous steps led to the identification of seven overarching actionable interventions, termed ‘Just Pathway Actions’. These Just Pathway Actions serve two notable functions. First, they allow for the effective operationalisation and implementation of the technological innovations developed within the project. Second, they serve as a roadmap for policymakers seeking to implement just and effective FLW reduction strategies in line with EU goals, while increasing the likelihood of meeting the newly adopted mandatory food waste reduction targets.

The seven Just Pathway Actions are deemed critical to achieving a fair and effective reduction of FLW across the EU and to enacting the Just Transition Pathway. These actions are therefore essential complementary components to the Just Transition Pathway, helping to mitigate potential negative consequences while still enabling meaningful FLW reduction. They were designed to address the complex trade-offs and systemic barriers identified in the modelling results and the conceptual framework, while aligning with the EU’s new mandatory FLW reduction targets. These actions offer insights into the limitations of technological advancement and the financial viability of scaling up, thereby paving the way for more specific policy interventions. Rather than presenting a one-size-fits-all solution, the actions were designed to account for the diversity of Member States, agricultural systems, and consumer behaviours. As such, the Just Pathway Actions are critical to bridging the persistent disconnect between systemic barriers and practical, implementable solutions in FLW reduction. The specifics of the Actions are outlined in the paragraph above on “Developing a Just Transition Pathway”.

Step 8: Cross-Functional Bridging Workshop

The “bridging” workshop was a key moment in the development process, where the ambitions and intended outputs of each solution were revisited in light of the Just Transition Actions that had been formulated. This workshop brought together solution developers—such as pilot leads and product owners—and experts in Just Transition Pathways for a day-long, preferably in-person, collaborative session. During the workshop, the Pathways and Actions were presented along with the reasoning behind them, and each solution (in this case, SILL) was examined to assess its alignment with the broader transition goals.

The purpose of this confrontation was not only to propose new additions to the solution but also to prioritize or amplify elements that were already planned. The outcome was a set of tailored recommendations for scaling each solution in a way that fit the system and supported the transition framework. By matching the developed Actions to each solution, the workshop helped refine their direction and ensured that scaling efforts were both strategic and context-sensitive.

Step 9: EU Policy Briefs

The policy briefs are grounded in evidence and insights generated throughout the ZeroW project, including the challenges and opportunities observed across the nine SILLs. The briefs address key areas identified as bottlenecks or leverage points during this process: (1) transforming the structure of the food chain, (2) enhancing governance mechanisms, (3) empowering farmers, (4) enabling informed and fair consumer choices, and (5) fostering inclusive urban food governance. In doing so, they reflect the very tensions the Just Transition Pathway aimed to reframe from isolated, tech-driven fixes to integrated, just, and systemic solutions. The briefs were made available both in short formats (for high-level policymakers) and in detailed versions (for practitioners and researchers). These policy briefs are not merely end-of-project outputs; they are advocacy tools designed to influence ongoing EU- and Member State-level policy processes. By connecting pilot-level learnings with structural policy needs, they seek to ensure that the innovations developed in ZeroW, whether technical, behavioural, or institutional, can be embedded within a regulatory environment that supports long-term, just, and scalable transitions. This final step reinforces the value of using the Just Transition Pathway and Actions, not only as a planning tool, but also as a bridge between experimentation and systemic change.

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List of figures

Figure 1 ZeroW value chain and SILLs	3
Figure 2 ZeroW JTP process sequence	4
Figure 3 ZeroW (alternative) pathways timeline	5
Figure 4 ZeroW Just Pathway Actions	7
Figure 5 FLW reduction targets	14