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PU: Public, fully open, e.g. web
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Summary

This deliverable presents the findings from Task 1.4 of a Horizon Europe funded project READJUST (Just Transition to a Green and Digital Future for all). The task focuses on the impact of the twin transition—green and digital transformations—on vulnerable groups within the agri-food and mobility sectors. Its primary goal is to synthesise experts' views on vulnerable groups affected by the twin transition in these two sectors. Vulnerable groups are defined as those who face greater challenges to adapt to transitions due to their sensitivity and limited capacity to respond to the changes. The challenges may be caused by pre-existing inequalities, systemic barriers, or limited access to the resources and support needed for better adaptation.

The report employs a multi-level, multi-stakeholder approach, utilising insights from focus group interviews conducted with experts to build a nuanced understanding of vulnerability in the context of the twin transition. The task began with system mapping workshops with READJUST partners to accumulate project group's existing insights and inform the design of focus group discussions. Then four focus group interviews were organised, with 26 participants in total, representing diverse organisations within the quadruple helix framework. The resulting data were analysed using abductive approach to vulnerability assessment.

The findings summarise experts' views on the changes brought along with green and digital transition in the agri-food and mobility sectors; how these changes affect different societal groups; and the groups in which vulnerabilities are likely to arise. Vulnerability issues—sensitivity and limited response capacity—that may cause difficulties for these and other groups are summarised to inform further research and co-creation activities. The document concludes with recommendations for policymakers to engage vulnerable groups in the planning of green and digital transitions. It emphasises the importance of conducting situation-specific assessments of vulnerabilities and summarises a method for conducting such assessment. For READJUST project, the report creates an overview of engagement strategy to ensure that the voices of vulnerable groups in specific contexts of investigation are included in the co-creation processes aiming to contribute to fair and equal policies for facilitating just twin transition.

1 Introduction

The European Green Deal (European Commission 2019) set the objectives for the transformation of Europe's economy and society towards sustainability. The agri-food and mobility sectors are central to this transition path as they account for a remarkable share of the EU's greenhouse gas emissions. Simultaneously they are deeply embedded in the everyday lives of citizens, making them critical arenas for inclusive and equitable transformation. The Green Deal highlights the role of digital technologies as a critical enabler for attaining the sustainability goals and accelerating the impact of policies in different sectors. Digital technologies can be useful, for instance, for distance monitoring of air and water pollution, or for monitoring and optimising the use of energy and natural resources, as well as enablers of circular economy solutions (European Commission 2019, 9). This paradigm, i.e. the simultaneous pursuit of green and digital transformations, and the reinforcing effect that the latter can have on the former, is often named as *twin transition*.

Twin transition can be particularly important in sectors with high environmental impact and systemic importance, such as agri-food and mobility. It is expected to bring about structural changes to these sectors. In agriculture, traditional practices may be replaced or augmented by data-driven and automated systems, altering the nature of farm work and decision making. The sustainability impact may be achieved through improved resource efficiency, including more efficient use of production inputs, such as fertilizers. In mobility, improved services and the shift from private car ownership to shared, electric, and autonomous transport modes will, for example, reshape urban planning, logistics, and commuting patterns. However, these changes also require substantial investment, regulatory adaptation, and behavioural change.

The European Green Deal highlights that the transition needs to be conducted in a fair and inclusive way to be successful. As the transition will lead to significant structural changes in production systems, business models and skill requirements, it will create a strong need for social adaptation. Citizens will be affected in different ways due to their local social and geographical circumstances. Different states, regions and cities are in different positions in relation to the transition and have different capabilities to adapt

to the changes. To support just transition, The European Grean Deal includes mechanism, such as Just transition Fund, directed toward the regions and sectors that are most affected by the transition and to leave no one behind (European Commission 2019, 16).

Similarly, the Task 1.4 of the READJUST project builds on the principle of "leave no one behind". The task aims to identify how systemic shifts within twin transition—such as electrification, digital solutions or data-driven governance practices that promote sustainability—may exacerbate or alleviate existing inequalities in mobility and agri-food systems and who are the groups that need support for adaptation. The analysis is grounded in a multi-level, multi-stakeholder approach, drawing on insights from focus group interviews conducted in February-Mach 2025. Participants of the focus groups were experts representing different groups within the quadruple helix framework (including academia, industry, policymaking and civil society). The findings of Task 1.4 aim to contribute to a more nuanced understanding of vulnerability in the context of green and digital transitions of agri-food and mobility sectors. The outcome lays the groundwork for participatory needs assessments and policy recommendations in subsequent project phases. Ultimately, the goal of the READJUST project is to support a just transition that is not only technologically and environmentally sound but also socially inclusive and responsive to the needs of those most at risk of being left behind. In the next section, we discuss briefly the concept of vulnerable groups to give background for results.

1.1 How to understand vulnerable groups in the context of twin transition?

Vulnerability is a concept that has been used in different disciplinary and practice fields, such as health care (Leight 2003), migration (Gilodi et al. 2024), geography (Paul 2013) or climate change adaptation (Thomas et al. 2018). This has resulted in different definitions and understandings of the concept, which complicate its use as an analytical concept. However, conceptual clarity is important because different concepts of vulnerability are always implicitly connected to different strategies to reduce vulnerability and mitigate the impacts of changes. To navigate the conceptual diversity, we take a systemic perspective as a starting point. In the context of socio-ecological systems, vulnerability is most often understood to constitute of the exposure of the

system to perturbations or external stress, system's sensitivity to perturbation, and its capacity to adapt (Gallopín 2006, Adger 2006, Thomas et al. 2018).

Gilodi et al. (2024), in their review on migration, distinguish three types of vulnerability: innate, situational, and structural vulnerability. Innate vulnerability refers to characteristics inherent to certain individuals or groups—such as gender, age, ethnicity, or medical condition—that may make them vulnerable. Policies addressing this form of vulnerability typically focus on protection, as the condition is considered inherent and unchangeable. Situational vulnerability arises from particular circumstances or experiences affecting certain groups. The systemic perspective mentioned above falls within this category as the exposure to disruptions can be interpreted as a situational factor creating vulnerability. Structural vulnerability considers systemic factors, with emphasis on societal frameworks and inequalities that both create and perpetuate vulnerability among specific social groups. In response, policies based on this understanding aim to change the underlying systems rather than individuals or groups. This view also recognizes the capacity of those identified as vulnerable to participate in actions of resistance and seeking structural change. (Gilodi et al. 2024)

Figure 1 summarises the situational and systemic understanding of vulnerability that is developed from Gallopín's model (2006) and applied to this study. According to the systemic view, **vulnerability is** determined by system's **sensitivity** to stress and its **capacity to respond** to such stress. However, sensitivity and adaptive capacity become meaningful only when the system is **exposed** to external or internal disturbance—such as green and digital transition—that induces a significant (slow or sudden) transformation to the system (affecting the conditions of individuals within the system). The impact of the disturbance depends on the system's (or the individual's or social group's) sensitivity, adaptive capacity and the degree of exposure to disturbance. Systems and individuals are more resilient—meaning that they can either mitigate the impacts or adapt to the changes—if their sensitivity is low and adaptive capacity is high. On the other hand, the higher the sensitivity and lower the adaptive capacity are, the more vulnerable they are, and at higher risk of losing their ability to function.

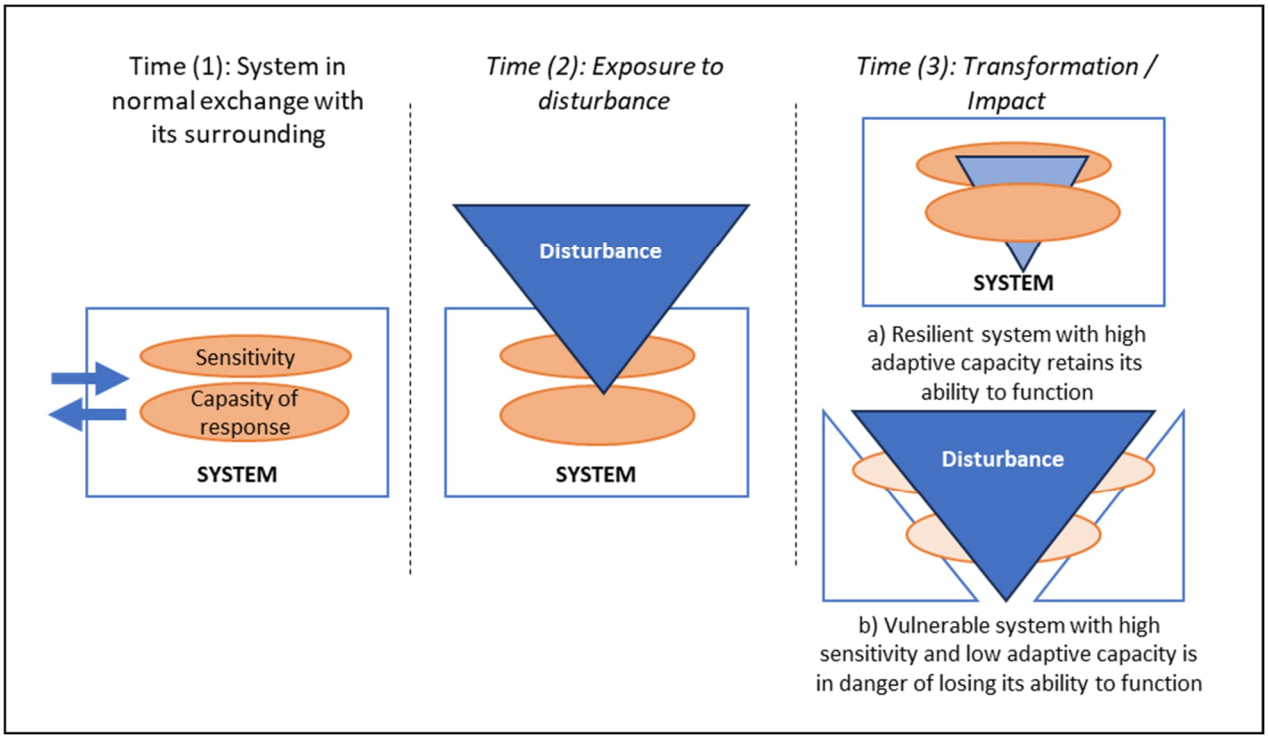

Figure 1. The vulnerability of a system is a function of system sensitivity, capacity of response and exposure to disturbances. Resilient systems are adaptive, while vulnerable systems are in danger of losing its ability to function. Own illustration based on Gallopín (2006).

How is the model illustrated in Figure 1 useful in the analysis of vulnerability? Gallopín (2006) illustrates the different concepts of the model with the following example on the effects of flood in a community:

> "The most precarious homes are hit harder by a flood than the solid ones (sensitivity). Oftentimes, the poorest homes are located in the places most susceptible to flooding (exposure). The families with the greatest resources have a greater availability of means to repair water damage (response capacity). The magnitude of the final impact will also depend on the intensity, magnitude, and permanence of the flood (attributes of the perturbation)." (Gallopín 2006, 297).

Contrary to the previous example, our approach in the READJUST project focuses on the social system meaning that **we approach vulnerability from the perspective of social groups and individuals and possible inequalities related to twin transition.** We focus on the vulnerabilities unintentionally created or aggravated by policies and societal change processes that advance green and digital transitions within societies. Although we consider social and ecological systems to be interconnected, our analysis primarily excludes the impacts of natural disasters on societies, as well as the impacts of policies on ecological systems. We agree that vulnerability affects people's livelihood and

general well-being and possibilities to live a good life, and thus it involves economic and social dimensions (Alwang et al., 2001; Moret, 2014; Mah, 2023). In this respect, sensitivity may be caused by person's employment in a field that is negatively affected by policies while education or training might improve the person's ability to employ in a different field.

We do not consider vulnerabilities as innate characteristics but a consequence of situational and systemic factors. This means that reducing vulnerabilities require changes in societal or structural levels, for instance better targeted education. Our focus is on creating understanding of the **factors that affect vulnerability of different societal groups, i.e., exposure, sensitivity and the capacity to respond to changes originating from twin transition**. The systemic approach to vulnerability is necessary to identify the combined effect of different vulnerability factors on the social groups. Vulnerability does not arise from individual characteristics of certain groups, but from the combined effects of different vulnerability factors. In order to identify vulnerable groups, it is necessary to examine the simultaneous occurrence of different vulnerability factors in a certain group of people and their situational conditions.

1.2 Aims and scope of the study

This report summarises key outcomes of READJUST task 1.4. Results were produced in four focus group interviews, which gathered experts representing different organisations within the quadruple helix framework—including academia, industry, policymaking and civil society—to evaluate the impacts of twin transition on agri-food and mobility sectors and to identify potential vulnerable groups. The information box below summarises the goals of the task and definitions that we adopt in this study.

Information box 1. Summary of the study

Goals and definitions of the study
1. Our goal is to identify and synthetise experts' views on **vulnerable groups in the context of twin transition** in agri-food and mobility sectors. 2. **We define vulnerable groups** as people who face greater challenges to adapt to transitions due to their sensitivity and limited capacity to respond to the

changes. The challenges may be caused by pre-existing inequalities, systemic barriers, or limited access to the resources and support needed for better adaptation.

3. We evaluate vulnerabilities in the two sectors from the perspectives of livelihood (e.g. transport companies, workers, food producers) and the wellbeing of citizens/households (e.g. transport users, consumers).
4. We view **twin transition** as changes which combine green transition goals with digital transition as a means to achieve these goals. However, we also examine the green and digital transitions separately where it facilitates the identification of vulnerable groups.
5. We aim to identify factors and mechanisms that create vulnerability of some groups in the context of twin transition in the target sectors and thus establish basis for vulnerability assessment.
6. The task feeds to other tasks of the READJUST project (in WP3 and WP4) that aim to identify and co-create means to reduce vulnerabilities.

The study is conducted as a collaborative effort between the partners of READJUST project. Anna Leinonen and Tiina Tuominen from VTT Technical Research Centre of Finland were responsible for designing and conducting Task 1.4, analysing the outcomes and writing this report. The partners that contributed to the task by identifying and inviting experts and/or by contributing to the focus group events include Mónica Castañeda and Jehan Bhikoo (EIT Urban Mobility); Mario Roccaro and Milena Marzano (EIT Food); Linda Widdel, Nof Afghani and Maria Stadler (Fraunhofer ISI); Tristan de Wildt and Elena Sertore (Yaghma B.V.); Lavinia Mazzei (Solidar); Maaike Happel (University of Amsterdam) and Anu Tuominen and Anton Sigfrids (VTT). The entire READJUST consortium supported the task by joining the internal system mapping workshops and other planning events that helped defining the scope of the task.

The methods employed in this study are described in Section 2. Then, the results of the focus groups related to the transitions and vulnerabilities are described for the agri-food and mobility sectors separately in Section 3. Finally, we evaluate the implications of the results for situated vulnerability assessments and for the engagement of vulnerable groups in READJUST and in the design of fair policies in general in Section 4.

2 Description of Activities

The research process comprised three phases, summarised in Figure 2. At the core of the process is the engagement of experts who have relevant previous experience and expertise on transitions in mobility and agri-food sectors, and who are therefore well-positioned to identify potential vulnerable groups. Prior to their engagement, it was necessary to define the scope and themes addressed in the focus groups. Therefore, the process begun with **a system mapping exercise** with READJUST project partners in order to gather the project groups' current understanding of relevant transitions to be discussed with the experts (see Chapter 2.1). The outcomes of this exercise informed the planning of **focus group interviews** (See Chapter 2.2), including the mapping of relevant experts to be involved (see Chapter 2.2.1) and preparation of focus group themes. Four focus groups were organised. Finally, the vulnerability assessment was conducted by analysing materials created in the focus groups to specify relevant transitions, identify potential vulnerable groups, and formulate engagement strategies related to READJUST activities in agri-food and mobility sectors (see Chapter 2.3).

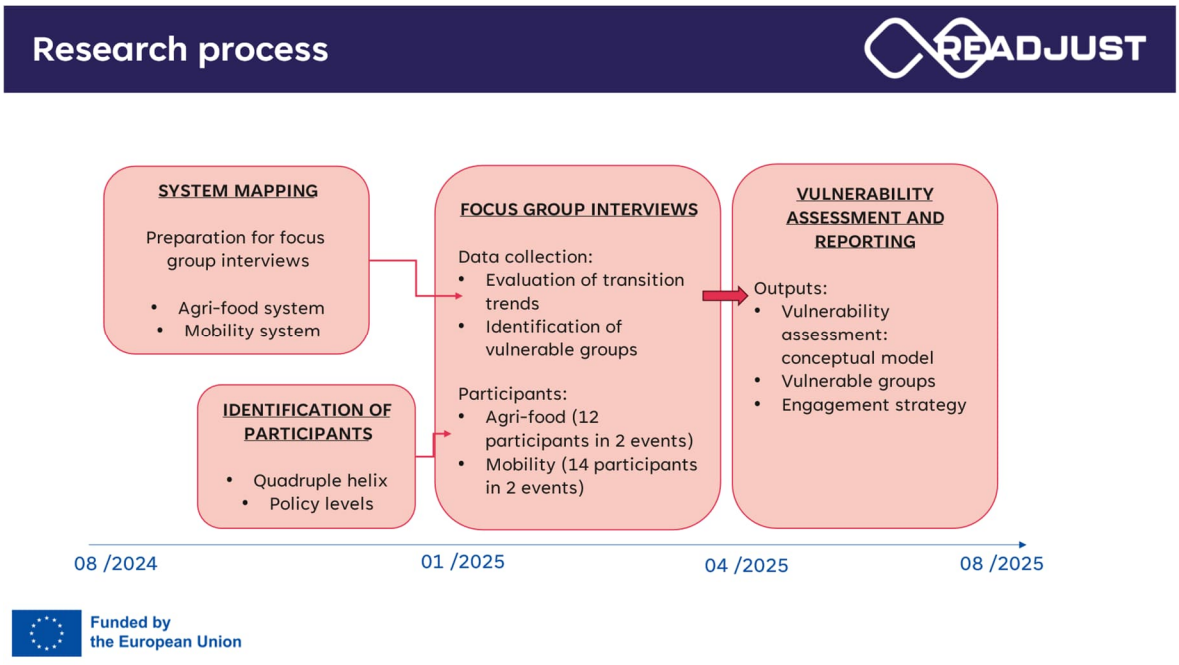

Figure 2. Activities of the READJUST task 1.4.

Next, each of these activities are described in turn.

2.1 System mapping

The system mapping workshop was designed as a participatory method to support knowledge integration within the READJUST project group. The primary goals were to accumulate project group's existing insights, identify knowledge gaps and inform the design of focus group discussions. A key issue was to specify the transition themes that affect agri-food and mobility systems and consequently were most relevant to be discussed with the experts. Therefore, the system mapping exercise aimed to generate a baseline understanding of the factors relevant for the agri-food and mobility system transitions and to connect twin transition policies with potential inequalities emerging in these sectors, and this way identify potential vulnerable groups.

System mapping was carried out for the two sectors separately. Shared Miro boards[3] were used to collaboratively map observations, conceptions and questions. Figure 3. Layout of the system mapping board. 3 presents an exemplary layout of such Miro board. The workshop was supported by facilitated stepwise procedure with guiding questions (see Appendix 1). The workshop method combined elements of various system mapping approaches, including participatory system mapping method that emphasises collective approach (Barbrook-Johnson and Penn 2022, p. 61-77) and cognitive mapping approach that captures participants' cognitions (i.e. mental models) to understand complex problems, and helps to visualise causalities using nodes and arrows (Eden 2004).

[3] Miro is a collaborative online workspace, see https://miro.com/index/

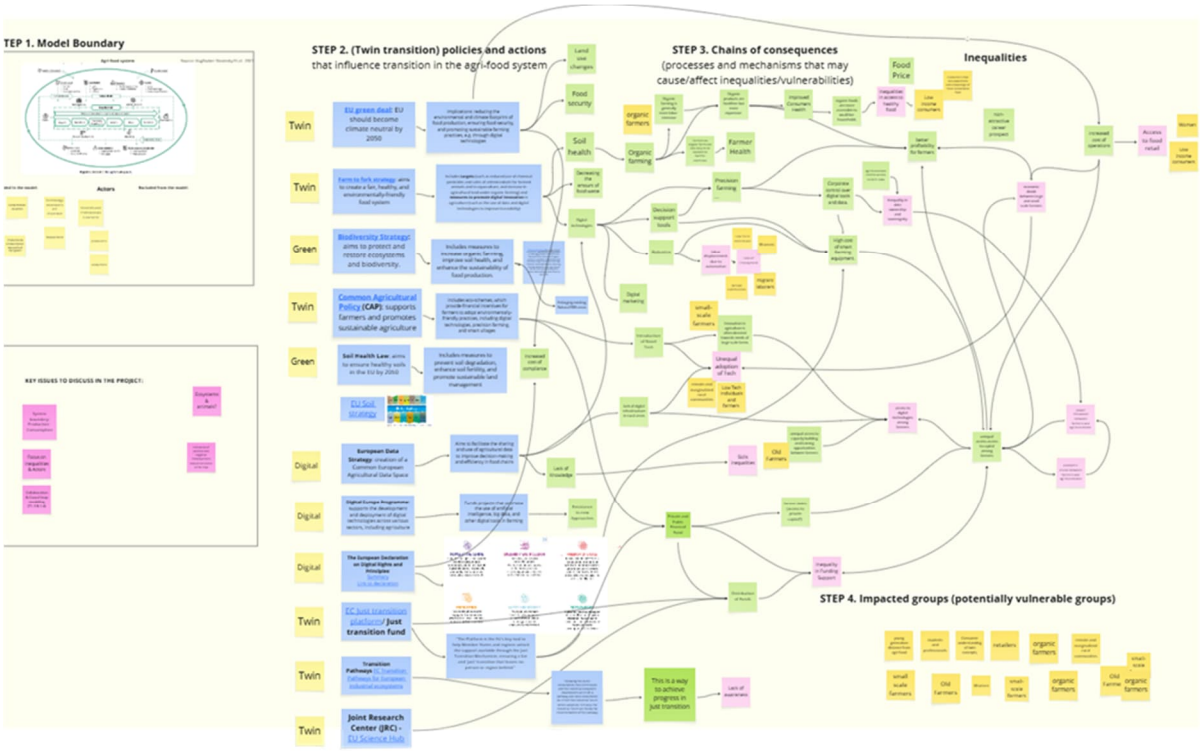

Figure 3. Layout of the system mapping board.

The following sections summarise the outcomes of system mapping for both sectors. We present the results using a layered structure (inspired by Auvinen and Tuominen 2014) that delineates three levels: 1) The key changes in each sector that are driven by the twin transitions policies (Level A). These changes were selected for the design of focus group interviews. 2) The main elements, functions or activities of the system (Level B) and technologies and solutions that are relevant for the system (Level C). Identifying these elements supported the overall understanding of the system and its boundaries.

2.1.1 Agri-food system

The agri-food system forms a rather linear supply chain, in which raw materials from agriculture are processed by food industries into food products that are distributed for consumption. These activities are embedded in and interact with the broader societal context and natural environment. On one hand, social and environmental context affect the food chain through policies, laws, regulations, socio-cultural norms, and environmental conditions. On the other hand, food system has environmental, economic and social impacts, such as effects on biodiversity, employment or health and nutrition of people. (Ericksen 2008; FAO 2018, Voglhuber-Slavinsky et al. 2021)

Our system model (see Figure 4) identifies three main phases in the supply chain: agricultural production, food processing (including packaging and logistics), and consumption (including retail, marketing and consumption). Each phase has its own technological system, which enables the activities and transferring materials and products and interactions across system phases. As a result of the system mapping, we decided to focus on the first and last phases, leaving food processing outside the scope.

The agri-food sector is a central part of the European Green Deal (European Commission 2019) due to its significant greenhouse gas emissions. The Farm to Fork strategy (European Commission 2020a) defines the sector specific goals for EU agri-food sector to reduce the environmental and climate footprint of the food system, strengthen its resilience, ensure food security in the face of climate change and biodiversity loss, and lead a global transition towards sustainability. The Farm to Fork strategy identifies also means enabling the transition through research, innovation, technology development and innovations, as well as the development of advisory services, data and knowledge sharing and skills. In line with these goals and proposed means, the project group decided to include the following changes in the scope of the focus group interviews:

1) **The increase of organic farming and focus on soil health**: The Farm to Fork strategy sets the objective of at least 25% of the EU's agricultural land under organic farming by 2030 (European Commission 2020a, 8-9).
2) **Precision farming**: Precision farming refers to the optimisation of farming practices to specific field and crop conditions by integrating data produced with advanced technologies, such as GPS, sensors, and drones. Precision farming is central to twin transition in the field of agriculture, as it enables the optimisation of the input materials, such as fertilizers, pesticides or water, without compromising yields. This way digital technologies enable more sustainable farming. Access to broadband internet is a key enabler for precision farming, and therefore it is included in the Farm to Fork strategy's selection of means (European Commission 2020a, 15).
3) **Data insensitivity and traceability**: The Farm to Fork strategy includes actions related to the development of data networks and facilitating the use of data for decision making. For example, the common European agriculture data space aims

to allow precise and tailored application of production approaches at the farm level, and the monitoring of performance of the entire sector through the processing and analysis of production, land use, environmental, and other data (European Commission 2020a, 16).

4) **Automation and robotics**: Even if automation is not directly connected to the Farm to Fork strategy, we included it as one of the changes to be discussed in the project. Digital technologies are enablers of automation and robotics, which may have a profound effect on agricultural practices. Automation is an interesting topic also from the perspective of potential social impacts. Previous studies have drawn attention to the different possibilities of farmers, for example in terms of farm size, in the adoption of technology (Giagnocavo et al. 2025, 9).

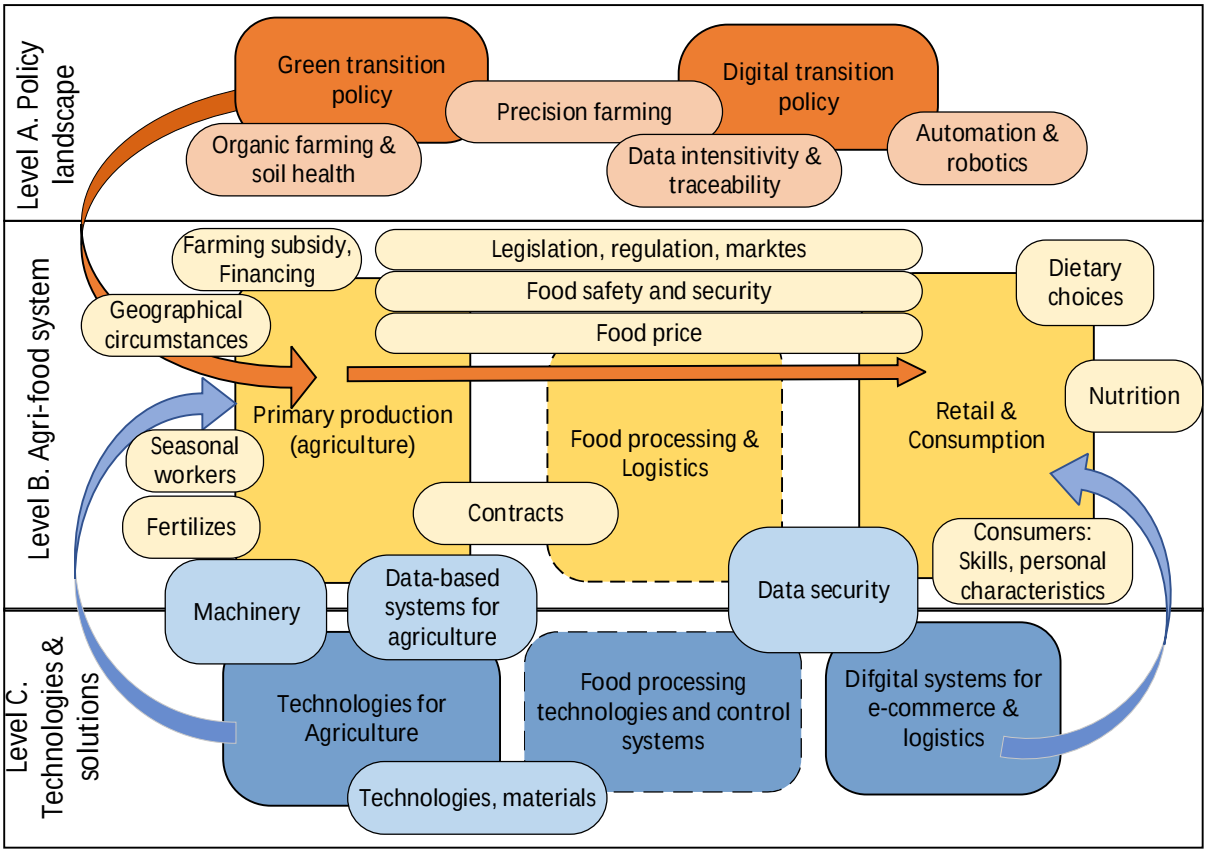

Figure 4. The agri-food system based on the results of system mapping workshop. Arrows indicate the impact chains of twin transition in the system. The project group decided to focus on the beginning and end of the chain (production and consumption phases).

2.1.2 Mobility system

Mobility system differs from the agri-food system as it does not produce concrete outputs but enables immaterial service operations – travels from one place to another.

This requires transport infrastructure, such as roads, rails or terminals, but also mobility services like public transport, taxi companies or car sharing operators. Travels do not happen without travellers, people who need to get from one place to another. Therefore, transport users are central elements of mobility system – their needs, habits and choices motivate activities within the system. The system requires also governance including regulation and decisions on mobility services and infrastructures, but also regulation of behaviours, e.g. in relation to traffic rules or safety. Furthermore, in addition to transport infrastructure, a multitude of other technological solutions are needed, including vehicles and energy systems, and due to digitalisation also data systems.

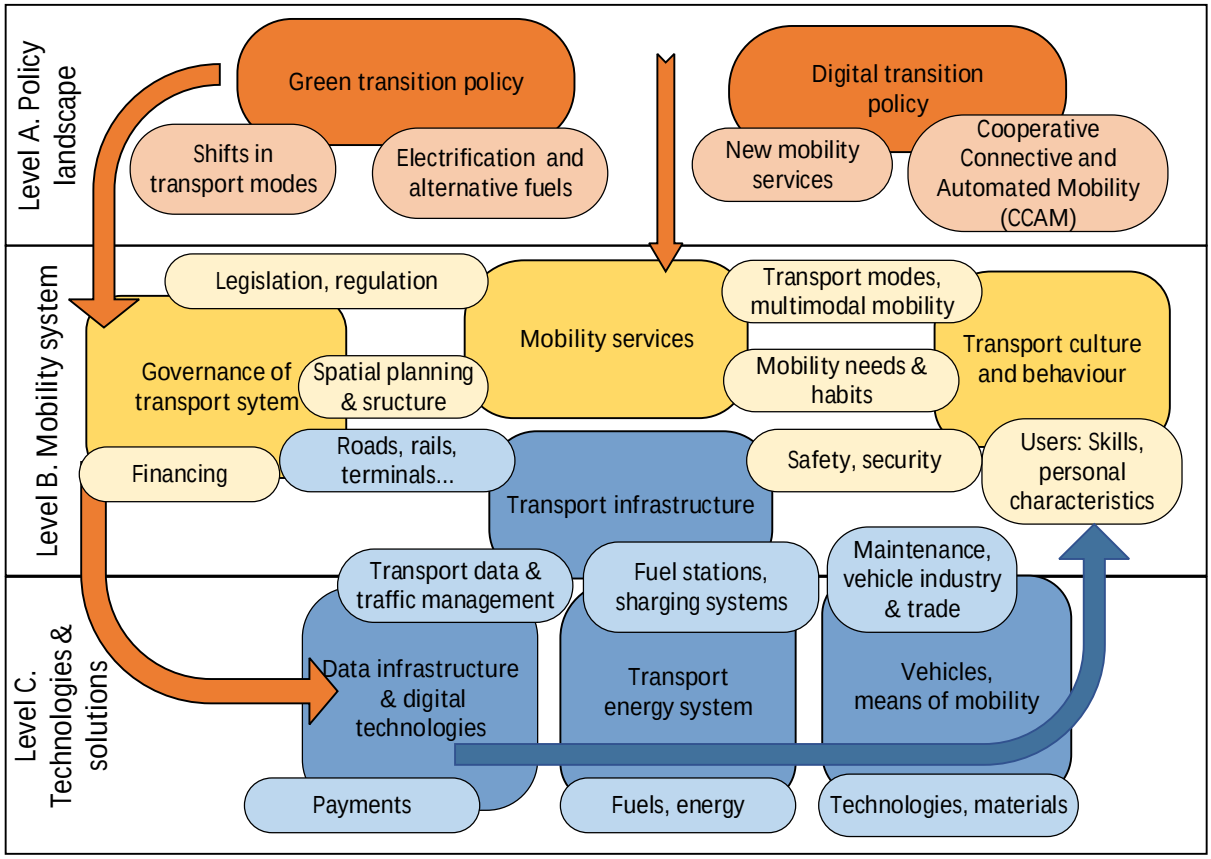

Figure 5. Mobility system based on the results of the system mapping. Arrows indicate the impact chains of twin transition in the system.

Figure 5 shows the visualisation of mobility system developed based on the system mapping exercise. It is important to note that this is an aggregate version of the mobility system and consequently a simplification of the complexity inherent in mobility systems. More accurately, mobility system can be viewed as a system of systems. For example, Kirpes et al. (2019) have developed a three-dimensional systems architecture model for

the e-mobility sector that identifies 5x4x5 elements to be able to analyse the complexity and interoperability needs of different systems. On the other hand, many models cover only some aspect of the entire mobility system. For instance, Ketter et al. (2023) uses a framework that distinguishes digital and physical layers for managing mobility tasks and fulfil mobility needs to analyse the role of information systems in smart mobility. Galanakis et al. (2025), in turn, develop a framework for identifying different types of policy measures for sustainable urban mobility, which separates three types of measures: avoid measures that diminish the need for mobility, shift measures that changes the system away from car-centred structures and improve measures that support the transition to zero or low-emission vehicles.

The European Green Deal (European Commission 2019, 10) sets a goal to reduce 90% of greenhouse gas emissions from transport by 2050, as transport accounts for a quarter of EU's greenhouse gas emissions. A central means to achieve this reduction, according to the Green Deal, is to provide transport users with more affordable, accessible, healthier and cleaner alternatives for mobility. This entails boosting multimodal transport, including automated and connected multimodal mobility systems, and the development of pricing and taxation schemes reflecting the impacts on the environment and on health. The shift to low-emission fuels is also a central goal in the sustainability transition. Sustainable and Smart Mobility Strategy (European Commission 2020b) defines the sector-specific visions and flagship programmes to realise the goals of the EU Green Deal in the mobility sector. The vision is built on the principle of twin transition; it aspires the creation of sustainable mobility system based on an efficient and interconnected multimodal transport system and relies on digitalisation as an important driver for the change. In addition, the strategy highlights just transition outlining that mobility should be available and affordable for all, including the residents or remote regions and persons with reduced mobility or disabilities.

In line with the goals and strategies discussed above, we decided to focus on the following changes in the mobility sector:

1) **Electrification of transport and alternative fuels:** We focus on the electrification of transport, as battery-electric vehicles are already available in the market and

their take-up is growing both in private use and in urban transport. Efficient electrification requires the creation of a comprehensive network of recharging infrastructure, which is included in the European strategies.

2) **Shifts in transport modes:** The development of multimodal mobility system is an important goal of the European mobility strategy. Eventually, sustainability of transport is dependent on the modal choices that mobility users make. Therefore, shifts to active modes or low-emission alternatives are important aspects of the mobility system transition.
3) **New mobility services (e.g. MaaS):** On the provision side, multimodality require a versatile selection of various mobility services and a seamless access to different alternatives enabled by digital solutions. Mobility as a Service (MaaS) is a concept describing this kind of solutions. Another example of new type of mobility services is intermediary platforms facilitating shared and collaborative mobility services, such as shared cars, bikes, ride-hailing.
4) **Cooperative Connective and Automated Mobility (CCAM):** CCAM systems represents longer-term development in mobility, as the solution is currently still in the stage of research and innovation. According to the Sustainable and Smart Mobility Strategy, CCAM has high potential to improve the functioning of the transport system, and it can contribute to the sustainability and safety goals (European Commission 2020b, 13).

2.2 Focus group interviews

The outcomes of the system mapping exercise were used to specify the focus group methods, scope, and the experts to be invited. Because many policies and transitions were sector-specific, and because many experts had sector-specific focus, we planned the focus group interviews for the agri-food and mobility sectors separately. Four events were organised, two for each sector. The structure of the events is summarised in Figure 6. The contents of the two sector-specific focus groups were similar, but the latter events built on the former where possible. This design enabled discussing transitions affecting each sector deeply and evaluating the transitions at different levels within each event. Furthermore, the design aimed to maximise the number of participants, as each expert could choose suitable date from two options.

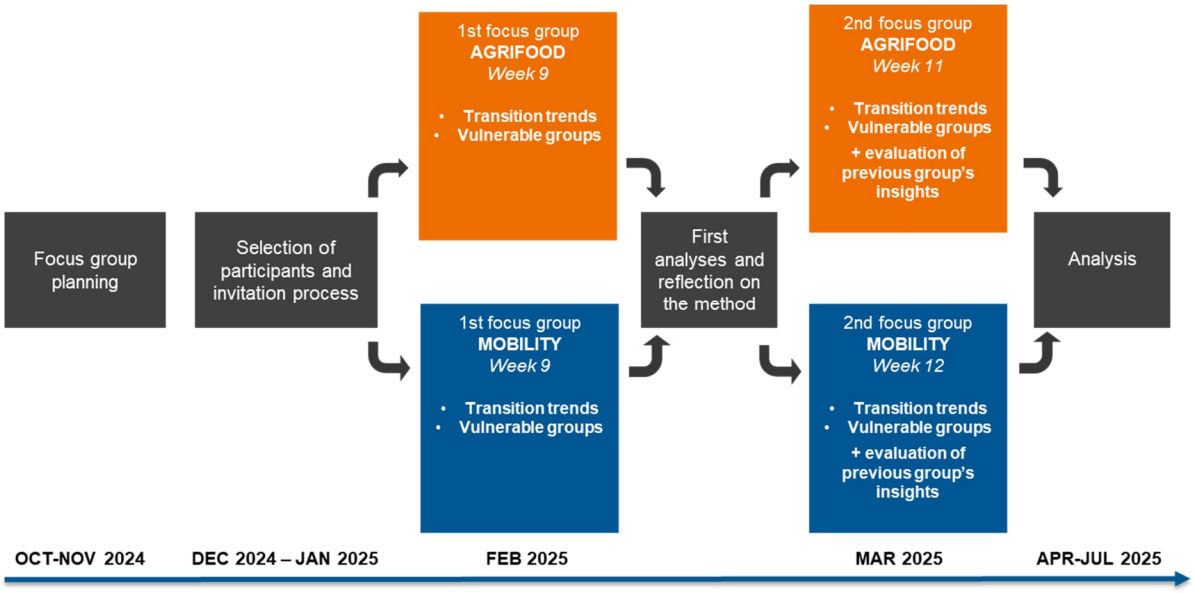

Figure 6. The design and phasing of the focus group events

2.2.1 Selection and engagement of experts

The quadruple helix framework stresses the importance of integrating knowledge from several societal clusters for innovation and change, including academia, industry, civil society and policymaking (Carayannis and Campbell, 2009). Aligned with this framework, the experts were selected based on the following criteria:

- The focus groups should include representatives across the quadruple helix framework: academia, civil society organisations (CSOs)/non-governmental organisations (NGOs), industry, and policymaking.
- The experts should have insights on the transitions or policies affecting agri-food/mobility sector, and how these transitions affect different societal groups.
- The focus groups should include experts who are knowledgeable about transitions and/or policies at different levels, ranging from local levels to the level of EU.
- The participants should derive from different countries within the EU.

Based on these criteria, all READJUST members were asked to scan through their networks to identify and invite potential participants. In addition, participants were identified through other stakeholders' recommendations and web searches. Using these methods, we collected **a database of 118 experts** (59 in each sector) who were invited to the events. All potential participants were contacted using personal invitations and

provided with two options for focus group attendance. They were also asked to recommend a colleague, if they could not participate themselves. Out of these invited participants, **37 registered for the events**, and due to last-minute cancellations, **26 finally joined the process.** Two of the participants could not join the actual events but provided their insights through email. Table 1 shows the distribution of the participants based on the sector and role in quadruple helix.

Table 1. Experts participating in the study

Participant profile	Agri-Food	Mobility	Total
NGO/CSO	3	7	**10**
Academia & RTOs	6	4	**10**
Policymaker	2	2	**4**
Industry	1	1	**2**
Total	**12**	**14**	**26**

This table shows that most participants represented the civil society organisations and academia. Tentative discussions with READJUST members and other stakeholders indicate that these two groups may typically be more aware of potential vulnerabilities. Furthermore, many of the participating NGOs represented industry stakeholders, such as companies and workers. Therefore, we believe that the participants were able to provide a holistic understanding of the two sectors. However, albeit a number of policymakers registered to the events, the actual number of policymakers joining the events was low. While this is a limitation, it was not considered to be a major limitation, as the discussion focused on the actual sector-specific changes and their practical implications. The low representation of policymakers might reflect their commitment to other urgent tasks, but it is also possible that their awareness of vulnerabilities at individual and group level is currently limited. This possibility motivates the development of policy recommendations in READJUST.

2.2.2 Focus group method and contents

The four events were designed based on similar principles but tailored to each situation. The general principles were as follows:

- The method should **allow specifying the context in which vulnerabilities are discussed.** Because twin transition involves a broad range of changes that vary between countries and regions and affect societal groups in different ways, the participants should be able to specify their views while the method should also allow common discussion and reflection.
- The method should enable **democratic participation of every expert** so that all insights and opinions are collected, instead of focusing on the development of a consensus opinion or giving most space to those with strongest opinions.
- The method should allow the participants to **exchange their insights and learn** from each other, to motivate their involvement.

Based on these principles, we decided to plan focus group events which 1) started with an evaluation of the relevance of different changes in agri-food and mobility sectors before mapping vulnerable groups, and which 2) involved both individual writing phases and common discussion. The individual writing task aimed to collect everyone's opinions in a short time, while common discussion aimed to delve deeper into the change dynamics associated with the different observations. Figure 9 summarises the general structure of the focus group events.

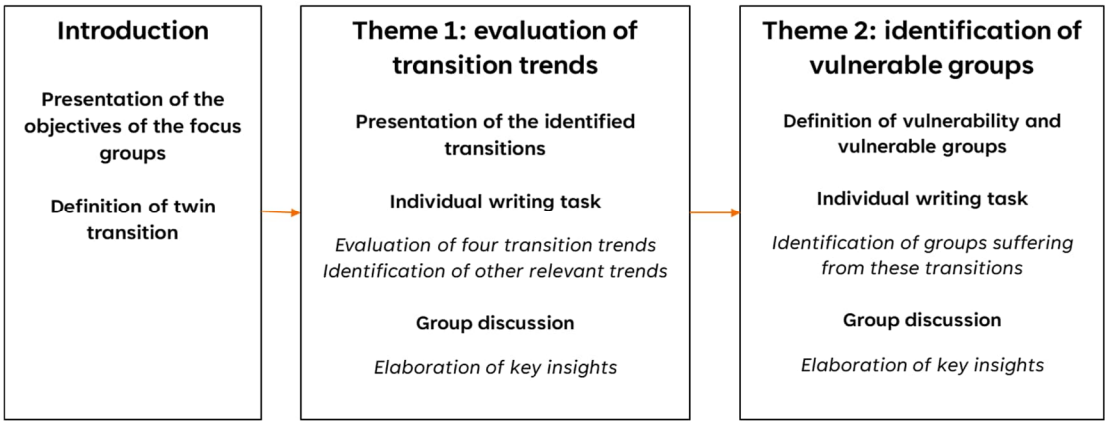

Figure 7. Themes in the focus group events

The events were held online using Microsoft Teams software and Miro platforms. Each event lasted 90 minutes and was recorded and transcribed upon the consent of the participants. After introductions and orientations, each event began with an individual writing task, in which the participants were asked to evaluate the relevance of the changes identified in the system mapping exercise, and list and characterise any other

changes that they considered to create inequality impacts in the given sector. These themes were then discussed with the entire group so that READJUST partners specialising in each sector raised relevant observations for common discussion (see findings in sections 3.1.1. and 3.2.1). Then, the participants conducted another individual writing task and listed potential vulnerable groups (defined as groups who may suffer because of the changes) and defined the change and reason why the group could suffer in the change. These insights were again discussed collectively, facilitated by READJUST partners (see findings in sections 3.1.2 and 3.2.2). Everyone was encouraged to write additional notes during the discussion, to ensure that all insights were gathered.

All events followed similar format, but the questions were sector specific. In addition, the experts joining the latter workshops were asked to comment on the vulnerable group identified in the first events. The events resulted in four Miro boards packed with individual notes and memos written by the facilitators. Figure 8 shows an example of a resulting Miro board with an overall structure (left) and a detail from the first theme (right). This data is supported by recordings and transcripts from Microsoft Teams.

Figure 8. Example of a Miro board from the first Mobility focus group event.

2.3 Vulnerability assessment

Vulnerability assessment in this study leans on a qualitative analysis of the focus group data and on the vulnerability assessment framework that describes our situational and systemic understanding of vulnerability (see Chapter 1.1). The aim of the analysis was to identify factors and mechanisms that create the vulnerability of some groups in the context of twin transition in the target sectors. As we preferred remaining open to new and surprising observations, we chose an abductive approach (e.g. Dubois and Gadde, 2002). Key concepts, such as vulnerability, sensitivity and capacity derive from theory (e.g. Gallopín 2006; Gilodi et al. 2024), but the empirical analysis follows an inductive approach where experts' observations and justifications were analysed to identify the vulnerability issues and vulnerable groups, instead of deducing from and elaborating on vulnerability indices created for other contexts and purposes (e.g. Mah et al., 2023).

The logical chain of vulnerability assessment can be described as follows:

1. What changes will twin transition policies bring about in the target sector?
2. Which of these changes create/aggravate vulnerabilities and how?
    - In accordance with situational and systemic thinking, vulnerability can emerge due to uneven impacts of changes (exposure), the sensitivity of different groups to the change, and/or the different capacity of groups to respond to and adopt changes.
3. Which groups may be affected by the vulnerability factors described above?
    - For example, changes (e.g. electrification of transport) can have different impacts on different groups depending on their *sensitivity (e.g.* how dependent they are on car use*)* and the *capacity to respond* (e.g. the capacity to purchase and charge electric vehicles).

It should be noted that the actual analysis iterated between these questions to capture the systemic nature of factors causing vulnerabilities. The data enabled approaching the questions from the two ends of the chain, as we asked the experts to evaluate both the changes related to the twin transition and the groups that could suffer from the changes. In the analysis, connections between these two questions were sought with the help of the vulnerability assessment framework described above. First, we aimed to identify and

analyse changes that experts considered most impactful in each sector. This analysis resulted in preliminary insights on the exposure of societies to different transitions and different groups' sensitivity and capacity to respond to changes. The analysis was thematic in the sense that all data from focus groups was used and synthesised to identify relevant transitions and their effects (see Chapters 3.1.1. and 3.2.1).

Second, we mapped the groups in which vulnerabilities are likely to emerge because of these transitions. This analysis started by categorising the groups of people that the experts identified as potentially vulnerable. Then the groups were connected to different transitions by mapping experts' responses about transitions affecting these groups, the types of responses required from different societal groups (i.e. the required capacity to respond, such as the capacity to purchase and charge electric vehicles) and the sensitivity issues that reduced this capacity for the group in question (e.g., low income connected with living in apartments without access to affordable charging stations for electric vehicles) (see 3.1.2 and 3.2.2).

These two analysis tasks – the transitions and the groups – were integrated in the results (See Chapter 3) and in the creation of a generalised vulnerability assessment that may help to identify also other groups prone to vulnerabilities in twin transition in agri-food and mobility sectors (see Chapter 4). Figure 9 shows the structure of vulnerability assessment framework that is applied in the results chapters 3.1.2 and 3.2.2.

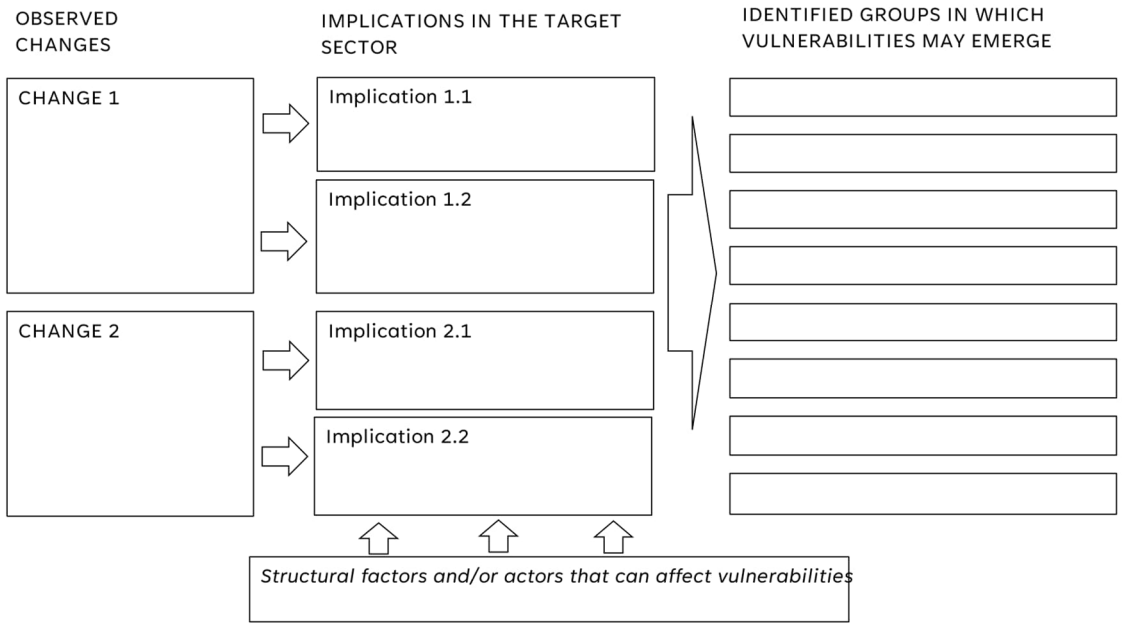

Figure 9. Structure of the Vulnerability assessment framework.

3 Results & Discussion

This chapter presents the results of the analysis described above. Chapter 3.1. presents the results related to the agri-food sector, first evaluating the transitions that the experts considered to have notable effects in societies in the near future and then describing the groups that experts identified as potentially vulnerable in these transitions. Chapter 3.2. discusses the same themes in relation to the mobility sector.

3.1 Twin transition and vulnerabilities in agri-food systems

3.1.1 Twin transition in the agri-food domain

As described in Chapter 2, the first assignment for the focus group interview participants was to evaluate the implications of the pre-selected transitional changes on people's lives. This task aimed to open the discussion and form a general overview of the experts' positions on the discussion questions. Participants placed their evaluations freely on the evaluation scale, and we calculated the number of evaluations on a certain part of the scale. Figure 10 shows the evaluation results in relation to the agri-food sector. This result should be seen only as indicative, because the evaluation tool (Miro board) did not allow exact evaluations, and the number of evaluations is low (including participants

of both focus group events). Therefore, the evaluations are rather indications of the "mood" of the group than precise opinions on the effect of the change.

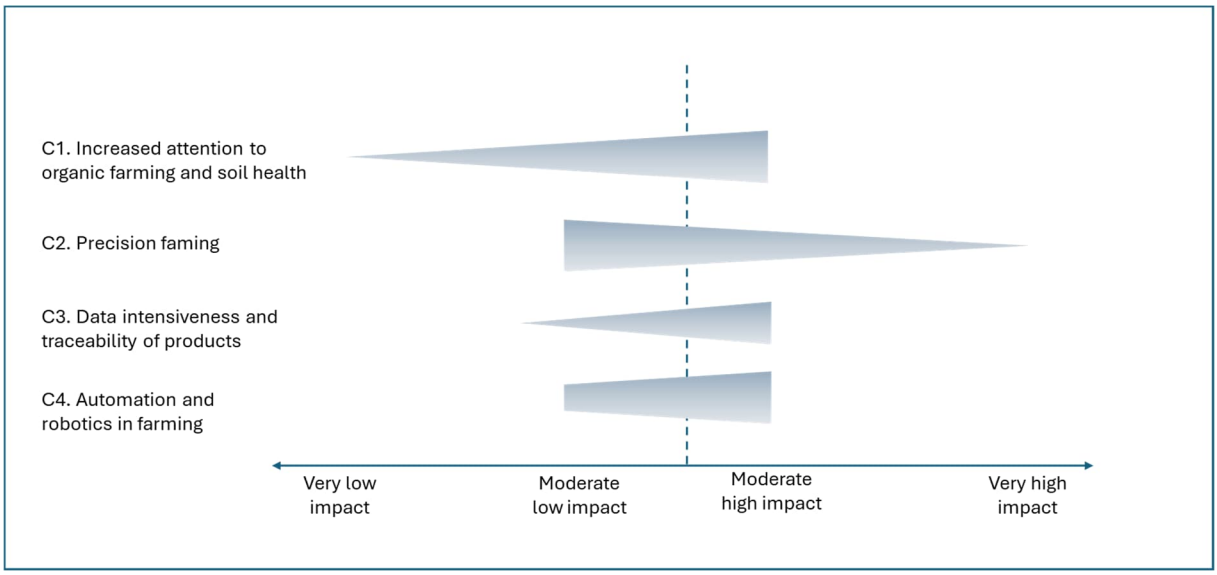

Figure 10. The impact of selected changes on people's lives in the agri-food sector, based on the frequency of evaluations among focus group participants (the thickness of the bar refers to a higher number of evaluations given, N=12).

As Figure 10 shows, the evaluations on the changes related to green transition (C1, increased attention to organic farming and soil health and C2, precision farming) range on wider scale than evaluation on the changes related to digital transition (C3, data intensiveness and traceability of products and C4, automation and robotics in farming). This may be an indication of the expertise profiles of the participants, as it may be easier to express moderate impact, if the issue is not among one's strong expertise area. A factor supporting this interpretation is that the topics C3 and C4 generated less discussion in the later phases of the interview event than the first two topics. Participants commented also the general difficulty of the evaluation task, as it was very generally formulated. For example, we did not separate between positive and negative implications, nor between the probability and impact of the change.

However, in the discussion, participants expressed some justifications for their evaluations. For example, in relation to the increase of organic farming (C1) evaluations were placed towards the lower impact of the scale, because some participants believed that it would rather affect farmers willing to practice organic farming (through increasing administrative tasks due to compliance processes) than consumers or population in

general. Those who evaluated that precision farming (C2) would have only moderate impact on people justified their choice stating that the enabling technologies will not be available for all farmers. Evaluations on the last two changes were commented only at a general level. For example, the experts noted that data-based systems (C3) enable informed decision and thus they can have an impact, and that automation (C4) could be a good way to counteract shortages of workforce, but it would change the work practices profoundly. Figure 11 shows a summary of the discussions on the twin transition effects on the agri-food system, based on the two focus group interviews.

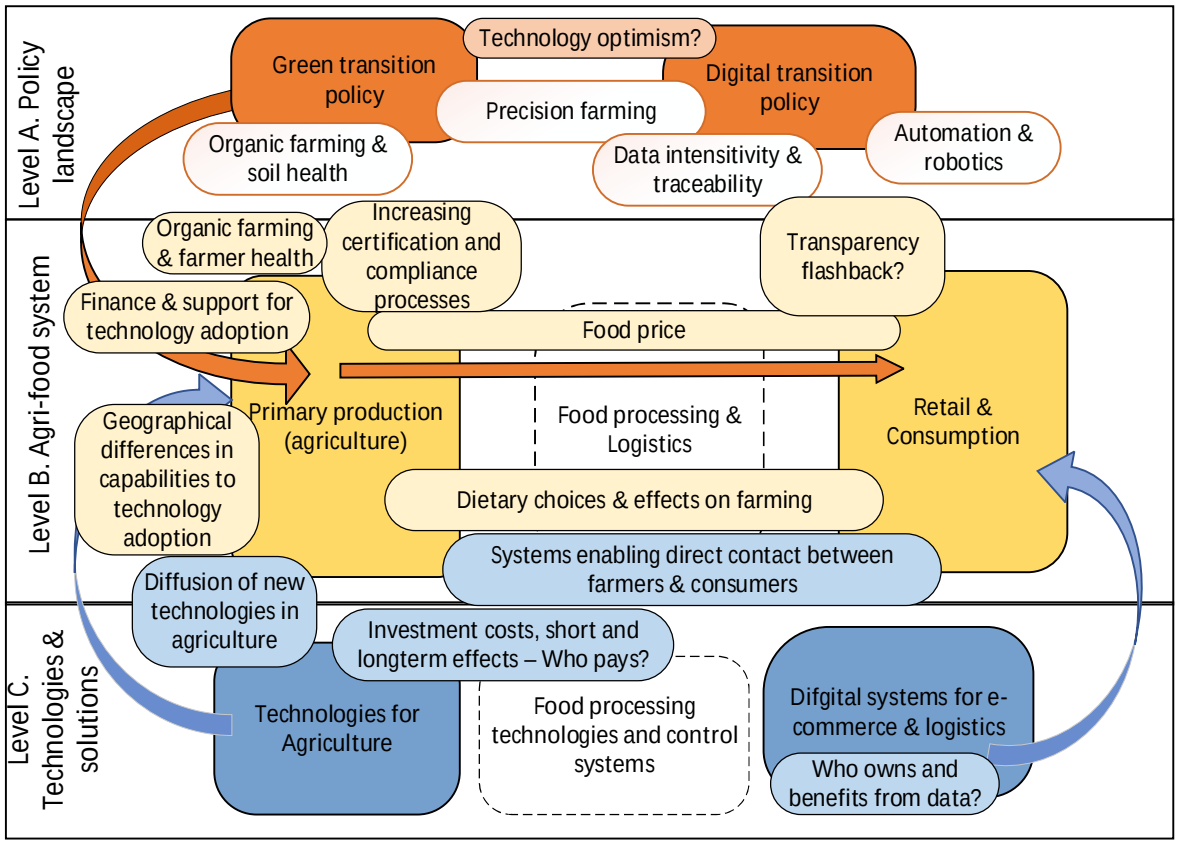

Figure 11. Summary of focus group discussions on the twin transition effect on the agri-food system.

From the *perspective of production*, **precision farming** was seen to be the most important twin transition change in agriculture. However, there is a need for policies promoting investments in the enabling farming technologies to gain the environmental benefits and support the diffusion of technologies. On the other hand, it was noted that the concept of twin transition may create technology optimism, which views all technological changes to be beneficial to environmental aspects, too. For example, **automation** could improve the working conditions in agriculture and widen the

possibilities of people with disabilities to participate in working life, but it does not have clear connection to environmental benefits. Access to new technologies may be limited due to knowledge or educational gaps, or limited access to finance for investments. There may be differences on these factors between different geographical areas. Investments on farming technologies increases costs in the short run, even if technology may create savings in the long run. It is not clear who should pay the price of this temporary cost increase: public sector, farmers or consumers.

The experts did not consider the increase of **organic farming** to be as important change from the perspective of twin transition as precision farming. However, they noted that organic farming decreases the chemical burden of farming, which can have a positive effect on farmers' health. On the other hand, organic farming creates additional burden to farmers as it requires more complicated certification and compliance processes. Organic farming may also increase food price, which may limit the possibilities of lower income households to get access to healthy food.

The focus group participants anticipated that shift towards more sustainable farming practices may decrease farm size. This creates a need for new collaborative practices in farming. Support for incentives on such collaboration is needed. Digital technologies can support such collaborations and benefit the profitability, e.g. through enabling the direct selling of products to consumers. The focus group participants believed that there are socio-geographic differences between different areas which affect farmers' capabilities to adopt to the transitions. Such factors may concern differences in educational opportunities and socio-economic or environmental conditions.

The consumer perspective on twin transition was not widely discussed in the focus groups. However, citizen engagement and increasing knowledge and skills on sustainability issues were seen as key elements in the green transition, indicating a need for profound behavioural changes across society. For example, climate-conscious dietary changes may impact the profitability of some farmers. Also, information systems and **increased data transparency** in food systems were seen to enable informed consumer choices, but participants also reminded that more information may create pressure on consumers and create negative implications and reluctancy towards

sustainable or ethical choices. On the other hand, this development may put consumers on unequal positions based on their differing digital capabilities and ability to acquire information on the health effects of food, for example. The increase of data-based technologies creates also concerns on data ownership: Who owns the data and has the rights to benefit from it?

3.1.2 Vulnerable groups in agri-food systems

The experts evaluated the effects of green and digital transitions on both food producers and consumers, but the conversations emphasised producer perspectives. The discussions were centred on the impacts of two types of changes: digital technologies and organic farming. The effects of these changes are next discussed for producers and consumers separately, since the depth of the discussion and the identified change dynamics differed between these two groups. Note that the findings present the groups in which vulnerabilities *are more likely to arise* due to their specific sensitivity or capacity issues, but these issues do not necessarily characterise all group members, nor create vulnerabilities.

Vulnerable groups among food producers

Figure 12 summarises the groups of food producers that the experts believed could suffer from the transitions. A focal point in these discussions was the financial perspective: the application of digital technologies requires investments, and **those producers that cannot get loans and invest in the new digital technologies** can lose their competitive edge when the technological transition proceeds. The groups that may have difficulties in this respect include small and low-income farms, farms located in low-income regions, older farmers (if the future of the farm is not secure), and farms located in areas suffering from extreme weather conditions (for the same reason). Furthermore, the experts noted that farms working independently may have difficulties in investing in new technologies when compared to farms with contracts with large food companies or those that are members in cooperatives/associations. This indicates that banks may have a pivotal role in decreasing or aggravating these vulnerabilities.

"[small farms] lack the financial capacity to adapt to the changes. It is often not worthwhile to purchase expensive technology either. Forming an association of farmers in certain regions could help." (Written input from the first agri-food focus group)

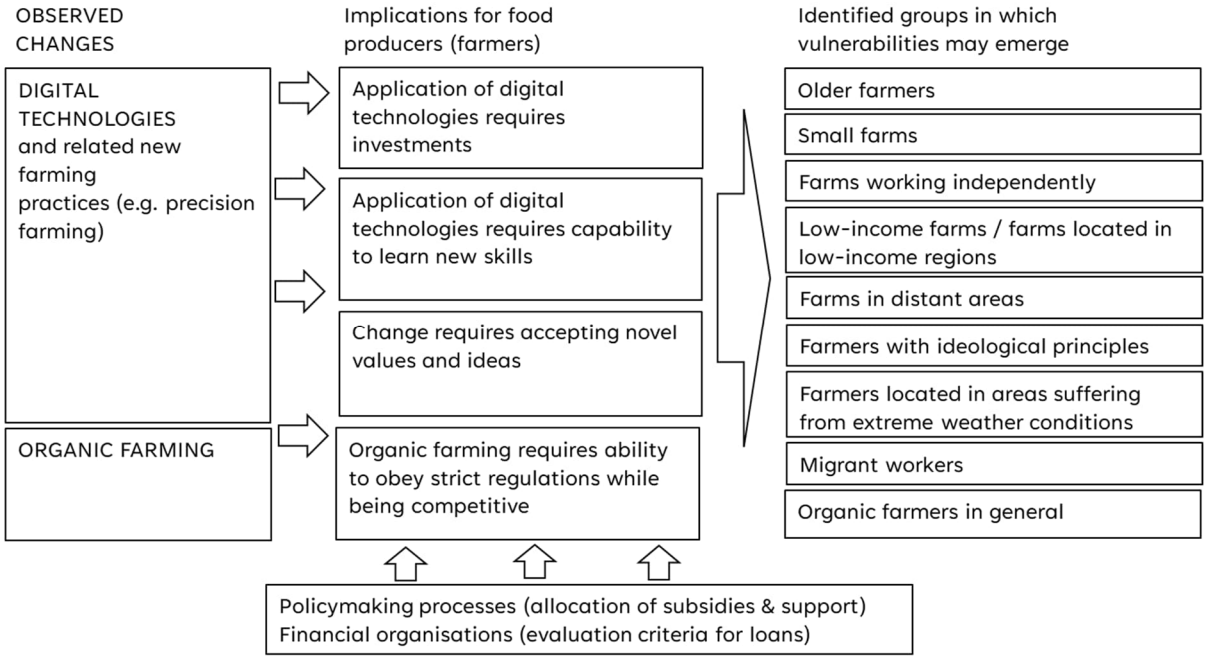

Figure 12. Agri-food sector: potential vulnerable groups among food producers

Second, the use of digital technologies requires **digital literacy and capability to learn new skills**. According to the focus groups findings, this requirement hits the same groups who may face financial difficulties, including old-age farmers (who may be deeply embedded in established cultural practices); and small, independent, and/or low-income farms (who may lack sufficient networks for information sharing and training). In addition, learning may be difficult for farmer in distant areas without proper connections to training, and for migrant workers, who may lack language skills required in training. Furthermore, the experts mentioned **ideological barriers** for technology adoption, such as reluctancy to use digital tracking solutions for moral reasons.

"I think the farmers of cooperatives / contract farmers delivering their crop for large companies are in very different position as compared with those, who are selling each crop separately. Reporting and certifying actions are much better supported for them." (Written input from the first agri-food focus group)

Organic farming was mentioned less often. The experts noted that a transition towards organic farming requires the ability to obey strict regulations, that may render the entire field of organic farmers vulnerable when compared to non-organic farming. The challenge is to obey to these regulations while still being productive and relatively competitive in relation the entire field of food production.

> *"E.g. feed additives they can't use cause of EU law (though they still might receive other support, but then there is a one take, one give situation)" (Written input from the first agri-food focus group)*

To sum up, the focus group outcomes suggest that vulnerabilities may arise because of a combination of farm-specific factors (size, location, business model, age of the entrepreneur), policymaking processes (inequal distribution of support and subsidies), and the behaviour of the financial sector (the principles of evaluating who should be granted a loan for investments). When considering the potential intersectionality between factors causing vulnerability, the results would suggest that the harmful consequences may accumulate to small and independent farmers located in areas that are already challenged by unclear future, due to unclear economic pathways or climate change adaptation challenges, for example. While the experts emphasised unequal access to finance as the prime reason for vulnerabilities, the importance of learning skills should not be underestimated. Some of the proposed solutions included actions that support possibilities for a greater number of farmers to get loans for digital investments; promoting accessible training and information-sharing; and the formation of cooperatives and other joint actions to combine the resources of small farms.

Vulnerable groups among food consumers

Figure 13 summarises focus group outcomes addressing consumers in agri-food systems. Three types of changes were estimated to create or increase vulnerabilities among consumers: digital transition in farming, organic farming (and other similar new methods), and digital consumer interfaces. Regarding the first two changes, a key challenge for consumers is that novel technology investments and sustainable food choices may **increase food prices**. This hits hardest low-income consumers that are most sensitive to price changes, especially those living in urban areas. They may be tempted

or forced to prioritise cheaper, ultra processed food, that may negatively affect their health. Furthermore, the experts mentioned elderly consumers as a potential vulnerable group that may be sensitive to price changes and that may find it difficult or demotivating to change food consumption habits. However, the increase in prices may be a temporary phenomenon, since digitalisation may reduce prices in the long term. Therefore, a key issue in reducing these vulnerabilities is to consider who, in the food value chain, pays for the new investments required in twin transition.

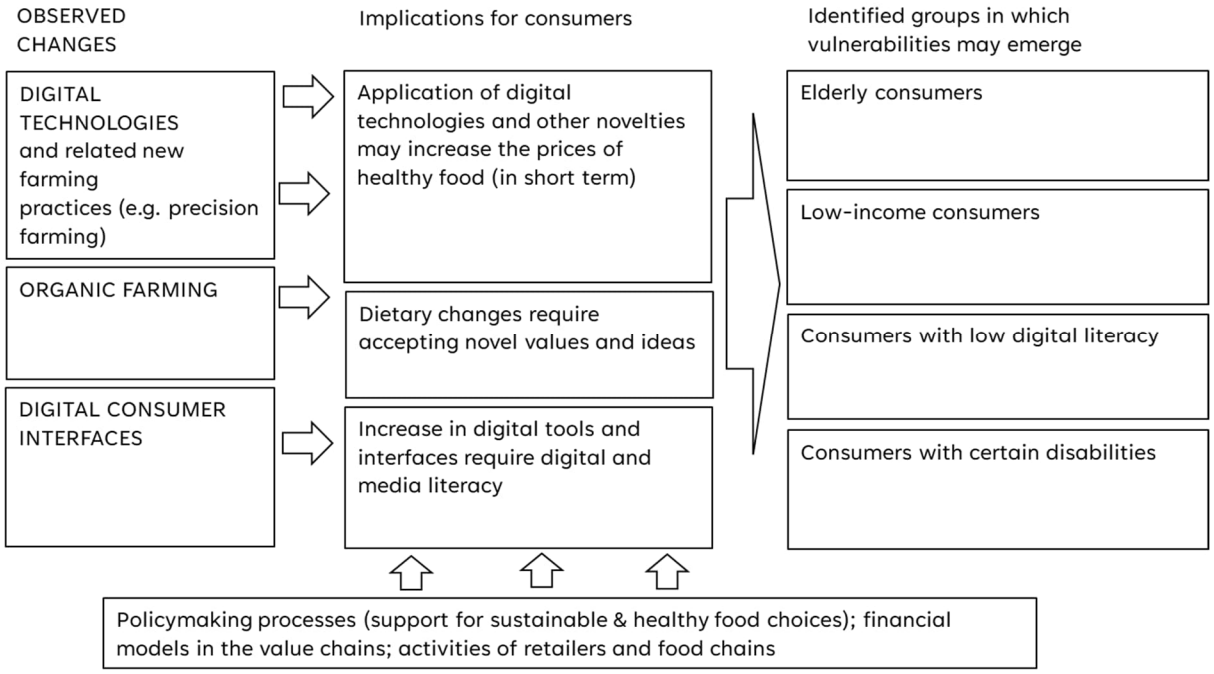

Figure 13. Agri-food sector: Potential vulnerable groups among consumers

Finally, the experts mentioned potential vulnerabilities created by digital consumer communication channels that require **ability to use digital tools.** This requirement may create problems for consumers with certain disabilities or low digital literacy, challenging their ability to get adequate and correct information about healthy and sustainable food choices.

> *"Certain disabilities (e.g. sensory impairments) might hinder access to certain digital contents" (Written input from the second agri-food focus group)*

Overall, the focus group discussions suggested that vulnerabilities may arise because for consumers to benefit from the green and digital transitions, they are expected to be able

to invest more into sustainable and healthy food and be capable of acquiring information about food through digital channels. Low-income consumers, consumers with disabilities, and elderly consumers may face difficulties in these issues. However, it should be noted that the discussion about consumers was scarce, and therefore it is possible that some groups or effects of transitions were not discussed.

Finally, in addition to discussing specific changes and groups, the experts evaluated the entire twin transition from a critical perspective. Some of them argued that the entire food system is vulnerable in such transition. The experts evaluated that the political and media discourses about transitions are not neutral but may represent the interests of technology businesses and urban populations, while depressing the voices of rural populations and food producers. Furthermore, attention needs to be paid to the current vulnerabilities and how green and digital transitions change the positions of the groups which are already vulnerable. The following excerpts illustrate these discussions.

> *"Many vulnerabilities are inherent in the structures of the current system (e.g. food insecurities related to marginalized groups), and we have to be conscious which of these we are carrying with us in the transition. It can create a discursive (and policy) bias if the focus is solely on the impacts of the transition activities, and the existing (and continuing) injustices are not considered"*

> *"I see several missing questions around me, such as "**Who are the owners** of these technologies?", "Who are the owners of data processed by digital tools?", "**Do really farmers need** (and are able to manage) all digital technologies that input providers try to sell them?", "Which is the most appropriate approach to the management of such technologies? An individualistic or a collective one?", etc." (an email response to focus group questions)*

3.2 Twin transition and vulnerabilities in mobility systems

3.2.1 Twin transition in the mobility domain

The evaluations of the changes in relation to the mobility sector spread across the entire scale (see Figure 14). Of the four changes, new mobility services (C3) aroused most

debate. This may be due to the controversies connected to the concept of Mobility as a Service (MaaS) that was used in the assignment. It seemed that the participants held strong opinions on the concept. Those who were against it warned that digital platforms will exacerbate inequalities due to digital divide, and those who favoured it believed that people would get used to digital apps and mobility services will change mobility system profoundly.

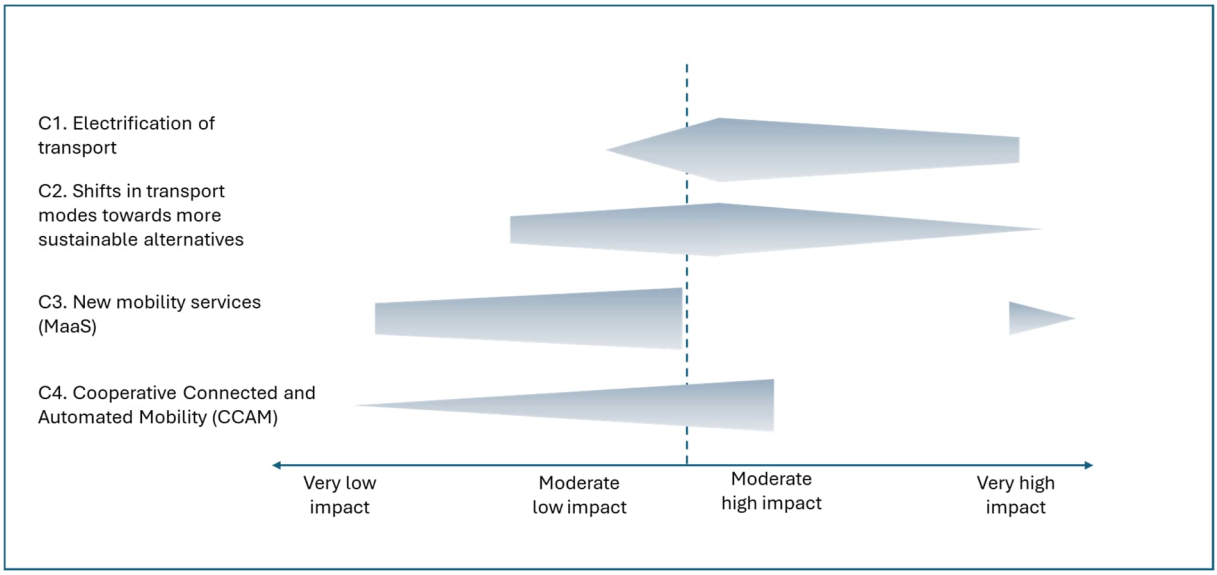

Figure 14. The impact of selected changes on people's lives in the mobility sector, based on the frequency of evaluations among focus group participants (the thickness of the bar refers to higher number of evaluations given, N = 14).

Another aspect that seemed to influence the evaluations was the perceived plausibility of the changes. For example, the higher impact of the electrification of transport (C1) was justified based on the strong policy support that makes this change likely to happen. On the other hand, the experts expressed scepticism on people's willingness to change their mobility behaviour. Therefore, the impact of transport mode shifts (C2) was evaluated to be lower, even if their impact on sustainability was believed to be good. The impacts of Cooperative Connected and Automated Mobility (C4. CCAM) were evaluated to be low, which participants justified based on the long time needed for the development of these technologies – given that we asked the participants to evaluate the impacts in shorter-term future (approximately in 5 years). Figure 15 shows the summary of the discussions on the twin transition effects on the mobility system.

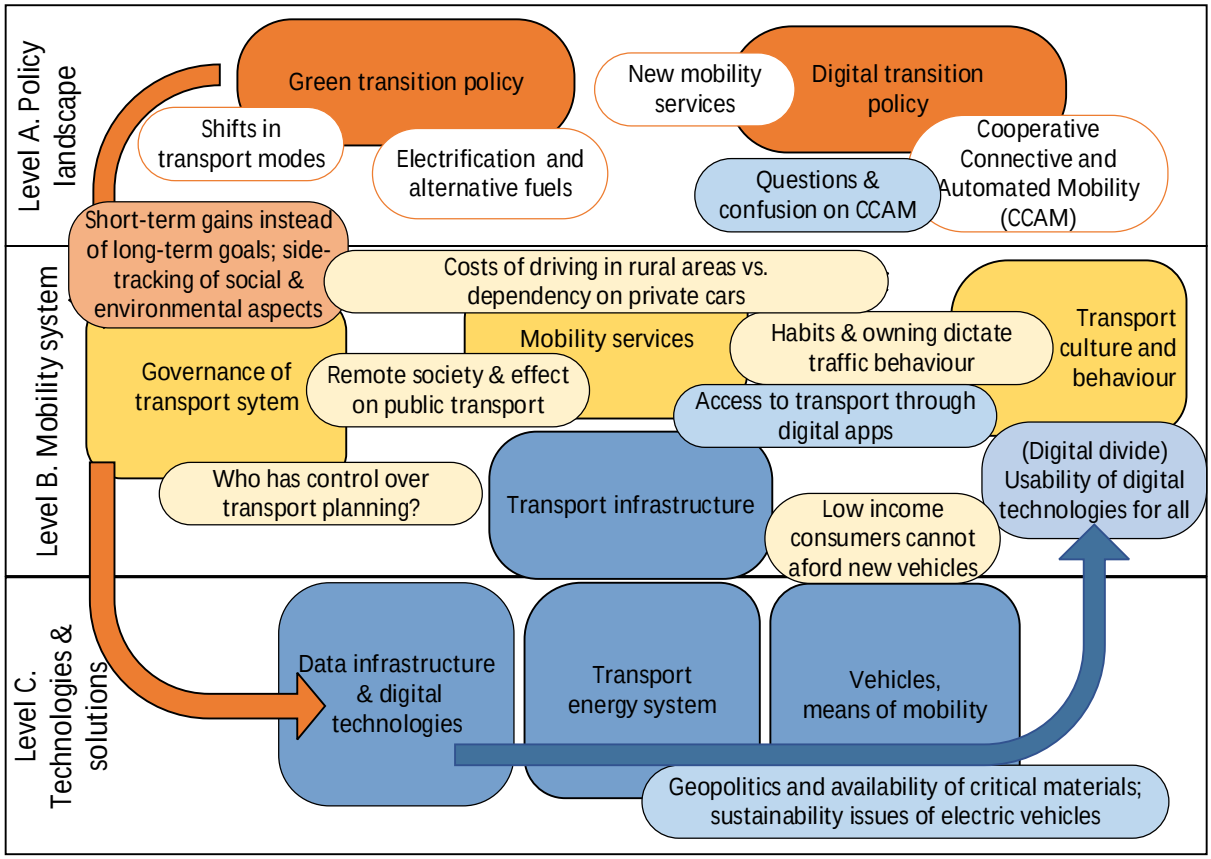

Figure 15. Summary of discussions on the twin transition effects on mobility system.

Some of the experts were concerned about the possibility that political and economic priorities are shifting away from sustainability or putting more emphasis on competitiveness and the economic aspects of sustainability at the expense of social and environmental aspects. Some were also concerned about traffic planning, especially about how artificial intelligence and the short-sightedness of decision-making change the priorities of traffic planning. Decision-making power in the public sector may slip away from public actors, which may narrow the consideration of intersectional approaches in transport policy and measure planning. This development may emphasise short-term gains instead of long-term goals. Digitalisation was also seen as a phenomenon which may have contradicting effects on societal development and mobility systems. Digitalisation enables the emergence of a *remote society*, which can have a positive impact on the environment and the development of societies because it enables people to continue living in their native (rural) areas. On the other hand, increasing remote work in urban areas decrease the use of public transport, which may

have a negative impact on the supply of public transport services, especially in sparsely populated societies.

According to the focus group participants, **electrification of transport** has a strong policy support at the moment, but there are some contradictions in this development. Infrastructure investments to the electrification of transport will create a transport system that continues to be based on private cars. Simultaneously, the spatial concentration of services and housing leads to deteriorating transport services in sparsely populated areas, which maintains the need for car ownership. However, not all regions have the same opportunities for the electrification of mobility, for example due to inadequate infrastructure. This can lead to regional inequality and an increase in the cost of driving in areas where owning a car is necessary. Another source of inequality may originate from the requirement to purchase new vehicles due to the electrification of transport, which may not be possible for low-income consumers. In addition, issues concerning the supply chains and availability of critical raw materials can affect negatively the sustainability of electric mobility, even if it is seen as a sustainable alternative. Prioritising this one option may slow down the development of other alternatives.

When discussing about the **shifts in transport modes**, the participants highlighted the need to consider both mobility needs and the overall urban developments, as transport systems are always linked to urban development: Urban areas can become polarised because of price developments if high housing costs force people to move away from centres. Due to this development, transport corridors emerge between residential and commercial areas. On the other hand, the participants noted that people's travel behaviour is guided by habits, ownership and financial aspects; "Once you own a car, you will use it" (written input from the focus group discussion). Therefore, economic incentives can be central means to influence behaviour. The costs of driving may increase, for example, if the costs of cars-only infrastructures are directed to private car users by implementing tolls or similar payments.

Because of digitalisation, **mobility services** are increasingly accessible only through digital apps. Therefore, digital divide can become a factor limiting access to transport

services. In addition to missing skills or digital devices, it is a matter of usability of technologies. Different user groups may have physical or sensorial limitations that make the use of digital apps difficult. For example, the elderly may suffer from hand tremors or impaired vision, making it difficult to use digital apps. On the other hand, technologies develop constantly and a new generation “beyond mobile apps” (quote from the focus group discussion) is coming on the market, such as voice-based interfaces. Digitalisation can also give rise to negative societal developments, such as the “platformisation” of working life or the emergence of a surveillance society. In addition, social media distribute false information and can have a significant role in manipulation of people’s minds.

Cooperative, connective and automated mobility (CCAM) systems were not discussed very deeply in the focus group interviews. One explanation for this may be that the deployment of these systems is still in an early stage, even though considerable research and development investments are already made. However, some participants raised open questions concerning these solutions: How does automation affect active modes of mobility? How will CCAM affect jobs in the transport sector and what kind of retraining needs will it create? How is the relationship between automation and connectivity emphasised in development? “If all the energy goes towards automated driving, policies may be captured by a small group of technology companies."

3.2.2 Vulnerable groups in mobility systems

The experts discussed vulnerabilities among both service providers and transport users. As the transitions were seen to affect these groups differently, they are next discussed in turn.

Vulnerable groups among service providers

Figure 16 summarises the discussion about service providers, including businesses, entrepreneurs and employees in the mobility sector. The changes that experts evaluated as potential sources of vulnerability for these groups were the electrification of transport, most importantly shift to electric vehicles (EVs), and the introduction of new mobility services and digital interfaces.

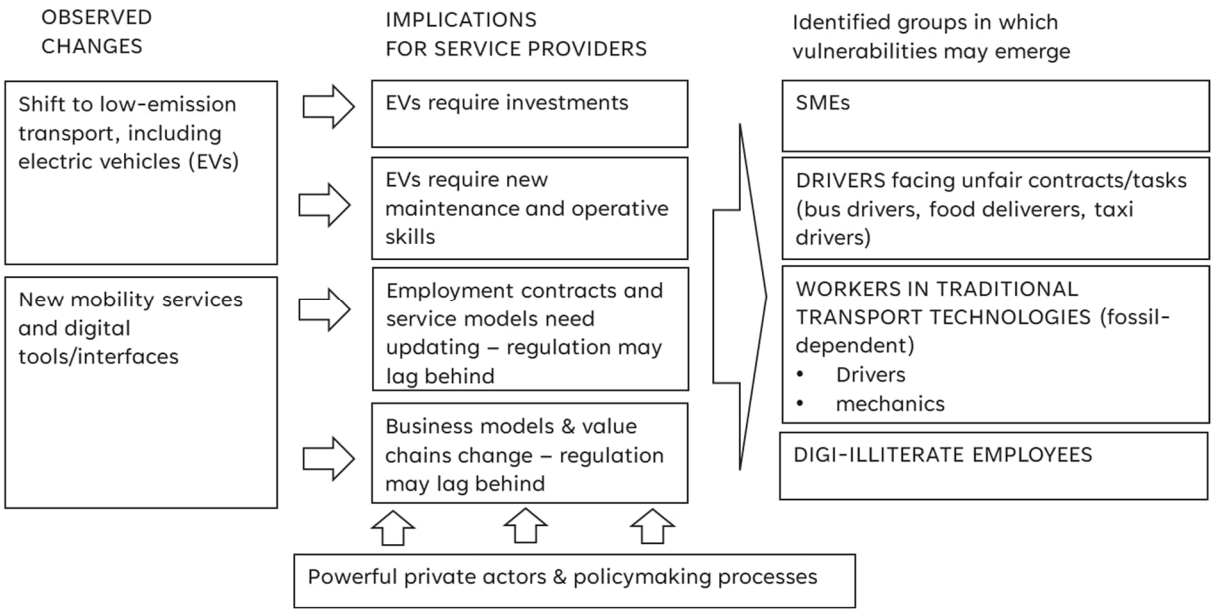

Figure 16. Mobility systems: Potential vulnerable groups among service providers

A central issue in the **shift to electric vehicles is the investments and skills needed**. In addition, the focus group participants noted that both EVs and new mobility services and digital interfaces bring along **changes in value chains, employment contracts, and business models**. All these changes may negatively affect certain groups, including small and medium-sized companies (SMEs), drivers, workers specialised in fossil-dependent transport technologies, and employees with limited digital literacy. At the level of companies, SMEs may be negatively affected due to limited possibilities to invest in electric vehicles and infrastructure.

> *"[SMEs] may lack resources to adapt to new clean vehicle or reporting requirements. For instance, those that need zero emission trucks or vans" (email response)*

Furthermore, the participants noted that the drivers of various types of vehicles, including bus drivers, food deliverers, and taxi drivers, may suffer from changing conditions for employment or unfair contracts. These challenges may accumulate to migrant workers, as the driver position may be a typical entry-level job for them. Furthermore, the workers that are specialised in fossil-dependent technologies and those with limited digital skills have the challenges of learning new skills and finding

their place in new business models and ecosystems. The following excerpts exemplify these potential negative effects.

> *"Digitalization - route optimization and optimizing schedules can lead to more stress for the drivers if the schedules have unrealistic time frames"*
>
> *"Electrification - charging takes time and taxi drivers are not paid for idle time (potentially)"*
>
> *"The maintenance [of EVs] may be outsourced to bus manufacturers"*
>
> *(written inputs from the second mobility focus group)*

In summary, like in agri-food focus groups, the experts estimated that in addition to obvious sufferers such as businesses dependent on fossil technologies, small companies may suffer from the transition. Furthermore, several types of drivers and mechanics may be inadvertently affected due to changing business models and skill requirements that may create unanticipated and unintended consequences for work.

Vulnerable groups among mobility system users

Figure 17 summarises the outcomes of the focus group discussion about vulnerabilities among mobility system users. In these discussions, the shift to EVs and new digitally enabled mobility services were emphasised, in addition to which shifts in transport modes were briefly evaluated.

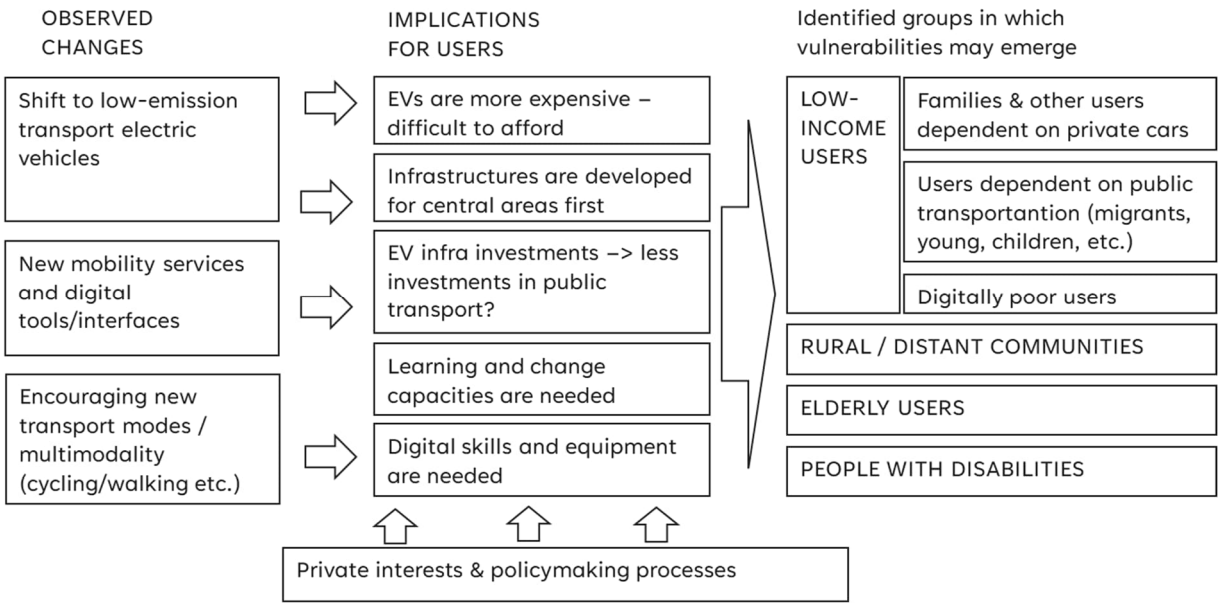

Figure 17. Mobility systems: Potential vulnerable groups among users

The shift to electric vehicles aroused intensive discussion. The experts noted that **inequal investments in EV charging infrastructure, as well as the costs of electric vehicles** affect certain groups more than others. These groups include low-income users that are dependent on private car use, such as people with disabilities, caregivers and families that have diverse mobility needs, and other people who need to carry a lot of luggage.

> *"High upfront cost of electric vehicles (EVs) may be unaffordable for many caregivers, especially those in low-paid or informal roles" (written input from the first mobility focus group)*

Furthermore, the experts identified several other groups that may suffer in the electrification of transport, if the change is not accompanied by better public transport options and equal development of charging infrastructure across rural and urban areas. Some participants estimated that investments in public transport may decrease due to high costs of the infrastructure for EVs. The groups that may suffer include rural and distant communities, if there is no incentive to build infrastructure and increase public transport options. Furthermore, people living in apartment buildings may be in unfavourable position if there is no access to home charging and public charging is more expensive.

> *"Rural and less-connected communities stuck with expensive or inefficient options" (written input from the first mobility focus group)*

In addition, the development of new (digital) mobility services may create difficulties for people who have **limited access to digital equipment or limited digital skills**. Vulnerabilities may arise among elderly people, children, people with disabilities, and among other people without smartphones. Besides challenges in digital literacy and difficulties in accessing digital devices, people with limited planning skills may consider it difficult to book their travels in advance, which may be required for several mobility services.

> *"No connection to the Digital world is no connection to Mobility Services offered" (written input from the second mobility focus group)*

In summary, people that lean on fossil-dependent private cars, with limited possibilities to invest in EVs or use public transportation, and those that rely on public transportation but face difficulties in the use of digital interfaces belong to groups most prone to vulnerabilities. Furthermore, the experts briefly mentioned difficulties of some groups, such as the elderly and people with disabilities, to adapt sustainable transport modes, such as cycling and walking.

In addition to the groups in which vulnerabilities may arise/intensify, the experts also mentioned other actors that have difficulties in these transitions. These actors include those that are unwilling to change their travel habits, such as white men used to private car use, and politicians whose career may suffer from active promotion of twin transition, if fossil-dependent industries still hold considerable lobbying and decision-making power. Furthermore, as mentioned above, the experts noted that current policies may still favour private car use (e.g. highway investments) at the expense of more sustainable transport modes.

In conclusion, the focus group outcomes suggest that the effects of transitions in mobility sector are more dependent on local and regional characteristics, such as local policies and infrastructure, than the effects of the transition in agri-food sector. Therefore, fair local-level policies are in a key position in reducing vulnerabilities by ensuring accessible

services and solutions that serve people living in different urban and rural areas. However, the experts also noted country-level differences, arguing that the progress is faster in more affluent regions and countries, and the solutions developed for these contexts may not be directly applicable to regions and countries with other types of characteristics and challenges. Therefore, balancing power relations across a broader context (EU, global) require careful consideration when designing and scaling up technological solutions.

> *"Solutions developed for a limited set of contexts will overlook the needs and complexity of contexts other than the frontrunners" (written input from the second mobility focus group)*

4 Vulnerability assessment for the design of engagement

The focus group interviews resulted in an overview of the causes of vulnerability in the processes of digital and green transition in the agri-food and mobility sectors and the groups that are most likely to suffer from these transitions. This overview supports further actions and planning of engagement activities (see Appendix 2) in the READJUST project. In this section, we summarise the main findings and discuss how they could be used for scoping the further research activities. Thereafter, we propose an approach for vulnerability assessment and designing the engagement of vulnerable groups.

4.1 Summary of findings: Vulnerability issues and groups

Table 2 summarises the findings of the focus group interviews on **vulnerability issues—including sensitivity and capacity—arising from the identified green and digital transitions** and lists the groups which may struggle with these issues in the studied sectors. It should be noted that the results are based on the insights of the 26 expert participants, and the method did not allow deep analysis of each vulnerable group identified during the events. Therefore, the findings should be understood as **an indicative list of the mechanisms causing vulnerabilities and societal groups that should be investigated in more detail in further research and in the co-design of responsible policy measures**. The identified vulnerability issues are likely to be generalisable beyond the identified groups and could therefore be used to triangulate

and elaborate on our findings in specific use situations. As discussed in Chapter 1.1, vulnerability issues summarise the extent to which a specific group is affected by the change (exposure and sensitivity) and its ability to respond and adjust to the changing situation (capacity to respond).

Table 2. Summary of the identified vulnerability issues and groups in the Agri-food and Mobility sectors.

Context	**Change** (exposure)	**Vulnerability issue** (sensitivity or lack of capacity to respond)	**Groups that may suffer from the vulnerability issues**
Agri-food, producers	Digitalisation of production methods (e.g. precision farming)	No access to digital technologies (e.g. precision farming) due to limited access to financing	• Farmers of high age • Farmers located in areas suffering from extreme weather conditions
		Low digital literacy and lack of access to relevant training and information	• Farms that are small, work independently, and/or have low income • Migrant workers in farms • Farms in distant regions • Farmers of high age
		Lack of general capacity for changing habits and practices	• Farmers of high age • Farmers with ideological principles
	Organic farming	Need to obey strict regulation which creates difficulties in operating competitively	• Organic farms
Agri-food, consumers	Technology investments and organic food	Price-effect of transitional changes and difficulties in affording sustainable food	• Elderly consumers • Low-income consumers
		Difficulties in changing established preferences	• Elderly consumers
	Digital systems for traceability and product information	Lack of digital and medial literacy	• Consumers with low digital literacy • Consumers with certain disabilities
Mobility, service providers	Shift to low-emission transport (electrification)	Difficulties in investing in electrification of transport	• Small and medium-sized transport companies
		Challenges with unfair contracts or work practices	• Workers (drivers and mechanists) whose employment contracts/work changes

		Threat of losing jobs or facing difficulties in reskilling	• Workers working with fossil-dependent technologies
	New mobility services and digital tools	Difficulties in adopting digital tools and interfaces (low digital literacy)	• Entrepreneurs and employees with low digital literacy
		Challenges with automated and other new work practices	• Workers (drivers and mechanists) whose work changes
Mobility, users	Shift to low-emission transport (electrification)	Difficult to afford EVs and difficult to use public transport due to mobility needs	• Low-income families and caregivers • Other low-income users with luggage/diverse mobility needs • Users with physical, mental and/or sensorial impairment
		Difficult to afford EVs and difficulties with public transport if investments in public transport decline	• Low-income users dependent on public transport (migrants, young people, children, etc.)
		Lack of access to EV infrastructure and difficulties with public transport unless connections are improved	• Rural and distant communities
	New mobility services and digital access to mobility	Lack of digital literacy and tools	• Elderly users • Users with low digital literacy • Users with physical, sensorial and/ or mental impairment
		Lack of planning skills	• Users that find it difficult to plan and focus (e.g. due to mental impairment or learning disability)

The vulnerability analysis in Table 2 can be used as a source for scoping the engagement activities of READJUST project, especially in Task 1.5 and in WP3. In the following, we list the main conclusions for each sector.

Conclusions regarding the agri-food sector:

- **The digitalisation of agriculture** and technological change enabling precision farming were considered as the most relevant changes from the perspective of twin transition. This change, however, depends on the level of technology adoption among farmers. It was considered problematic for farmers who have limited access to financing or training, or who have limited skills or expertise for changing their practices. Based on this finding, we conclude that further analysis should concentrate on the barriers and enablers of technology adoption among European farmers.
- **Organic farming** is included in the European strategies for sustainable farming. However, organic farming as sustainability strategy did not receive strong support among the focus group participants. By contrast, the experts brought up the administrative burden in relation to the compliance requirements accompanied by organic farming, which may hinder this change. Based on this finding, we conclude that organic farming is less relevant question for the further phases of READJUST project. However, farmers practicing organic farming can be included in engagement activities on technology adoption as one target group.
- The potential impact of increased organic farming and technology adoption on food prices was mentioned in the focus groups. These changes may increase the vulnerability of **consumers** who cannot afford more expensive healthy food. However, the price formation of food is dependent on more complex factors than just production costs. As READJUST project does not cover the entire food supply chain, and there are other projects dedicated to this topic, we conclude that this topic is less relevant for further analysis in the project.

Conclusions regarding the mobility sector:

- Discussion in the focus groups highlighted two changes that are relevant to twin transition: the shift to low-emission transport, especially electrification, and new mobility services, enabled by digitalisation. Both changes are ongoing and require system-level changes in transport infrastructures, service provision, as well as in mobility habits. Therefore, we conclude that these two topics should be included

in further analysis in READJUST project. Another conclusion is that local conditions and structures have a central role in understanding twin transition in the mobility sector. Therefore, we recommend collaboration with local partners, such as cities and other organisations responsible for transport planning in the later phases of the project.

- Based on the focus group results, the requirement to invest in new vehicles in the shift to **low-emission transport** may cause vulnerabilities. This concerns both some—likely small-size—transport companies and consumers who cannot afford electric vehicles. In addition, electrification can change the conditions of working life (e.g. due to charging time), which may cause vulnerabilities if the system relies on unfair contracts.
- **New mobility services** change the transport system so that access to mobility is dependent on digital platforms. This can be a serious factor creating vulnerabilities among people who have limited digital capabilities. Therefore, we conclude that this aspect should be approached in the later phases of the project through the engagement of groups such as elderly people or people with physical, sensorial and/or mental impairment limiting the use or digital applications.
- An important finding of the focus groups is that vulnerabilities arise when more than one vulnerability issue affect simultaneously a specific group (i.e. intersectionality). This concerns especially the **electrification of transport**, which challenges users who cannot invest in or charge an electric car *nor* access public transport for some reason (geographically uneven infrastructure development, diverse mobility needs, etc.).

4.2 Towards the engagement strategy for vulnerable groups

Based on these findings, we propose that policymakers need to engage the representatives of groups in which vulnerabilities are likely to arise when planning policy measures for green and digital transitions. However, it is important to note that there is **no universal list of vulnerable groups**. Due to the situation-dependent nature of vulnerability, it is important to conduct **a comprehensive, situation-specific mapping of groups that may suffer from the issue at hand**. In what follows, we propose how these

groups can be identified. We exclude a consideration of engagement methods from this report as these methods will be addressed in D4.1 in READJUST project.

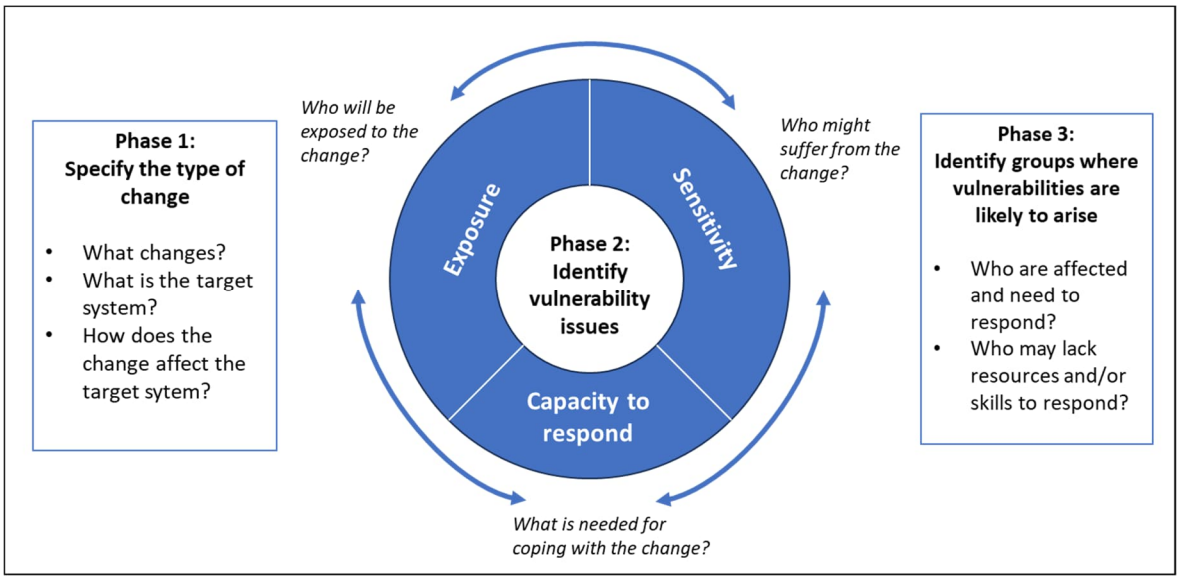

Figure 18. Assessment process for identifying vulnerable groups.

The proposed process (see Figure 18) can be seen as a practical application of the vulnerability assessment analysis discussed in Chapter 2.3, including three phases:

Phase 1. Specify the type of change discussed.

- This phase includes explicating the concrete manifestations of the green/digital transition within the target society. What is the social system within which the change is taking place? Can the change be accurately defined and named so that its effects are easier to evaluate? How does the change influence practices, technologies or regulations within this system? To what extent it affects businesses, users, citizens, and other actors?

Phase 2. Identify the vulnerability issues caused by the change.

- This includes considering the implications of change within the society, specifically, the sensitivity of different societal groups (e.g. businesses, employees, users, citizens) to the change, and types of responses that are required from them to benefit from or cope with the change. For example, when considering the groups that are exposed to the change, are their responses mandatory or voluntary? What kinds of

resources or skills do the different actors need to benefit from/cope with the change? Who lacks these resources or skills? This phase is likely to be iterative because the three elements of vulnerability are interrelated. The third column (vulnerability issues) in Table 2 can be used to respond to these questions.

Phase 3. Identify groups where vulnerabilities are likely to arise.

- The final phase includes in-depth evaluation and prioritisation of vulnerable groups, based on the previous two phases: 1) who are affected by the change and need to respond to it and 2) who may lack the resources and skills identified in phase 2. In this phase, the groups where these two features co-exist should be considered as the prioritised groups to be engaged and listened to when planning the transition.

When planning the engagement, attention should be paid to the inclusion of vulnerable groups representing different roles in society (e.g. households and businesses) but also to how vulnerability issues may cumulate to specific people or groups and how the change may indirectly affect specific groups. For example, while many new mobility services may profoundly affect the lives of those using public transportation, this change does not necessarily require any actions from private car users. Therefore, it may be useful to focus the analysis of vulnerable groups to the users of public transportation and seek those groups that do not have the necessary capacity to respond (e.g., digital skills and tools, planning skills). Nevertheless, it should be noted that the change may create indirect consequences for private car users (e.g., if public investment priorities change, or if the relative costs of transportation options change), whereas it may not create consequences for public transport users if the use of new mobility services, such as digital interfaces, is voluntary instead of mandatory. Therefore, we strongly support the conduct of situation-specific evaluation of the groups to be selected for closer investigation or co-creation events.

Finally, it should be repeated that this mapping implies only a likelihood of vulnerabilities. A person belonging to a group mentioned in Table 2 does not necessarily face any problems with the transitions in question. So, for example, ‘the elderly’ includes persons with varied capacities, resources, and social connections, and the age alone

does not imply vulnerability. Therefore, it is useful to consider intersectionality by targeting individuals who represent more than one group in which vulnerabilities are likely to arise. In the case of elderly consumers and the electrification of transport, a potential target group could be the low-income elderly people living in rural areas. However, the emergence of vulnerabilities among this group would depend on personal and local circumstances and the features of the transition at hand.

5 Next steps

The primary purpose of Task 1.4 in READJUST project was to synthesise experts' views on vulnerable groups affected by the twin transition in the agri-food and mobility sectors. Based on this, we proposed an outline for the formation of engagement strategy, both in READJUST project and for policymakers that aim to advance twin transition in a specific local, national or international context. This work will continue in the READJUST project, specifically in task 1.5 where the experiences of key vulnerable stakeholders will be collected based on the recommendations summarised in Chapter 4.1. and situation-specific analyses outlined in Chapter 4.2. In addition, the development and testing of engagement methods for the purposes of engaging vulnerable and other stakeholders for policy design in the context of twin transition will continue in WP3. In collaboration across the consortium and its stakeholders, these and other tasks in READJUST project strive to facilitate fair policymaking processes for green and digital transition across the European Union.

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7 Annexes

7.1 Appendix 1: System mapping

Guiding questions of the system mapping workshop:

STEP 1. Discuss the system boundaries

Look at the system figure and discuss in the group what you will include in the system and what you leave outside your model boundary. Write down your model boundaries.

STEP 2. Start from a policy or inequality

See the list of policies and inequalities. If you think something important is missing, you can add it. Choose a starting point (see question below). The goal is to connect policies and inequalities through building chains of consequences between them.

- Do you want to consider the consequences of a policy or the causes of inequalities?

STEP 3. Draw chains of consequences (processes that may create inequalities between groups)

Working forward (start from a policy):

- What are the consequences of your chosen policy in the agri-food system?
- Consider both the desired consequences and the possible undesirable consequences.
- Write consequences on the notes and connect the notes with arrows.
- Continue the chain of consequences as long as you come up with new consequences. Chains can also branch.
- Do you find connection to some of the inequalities?

Working backward (start from an inequality):

- List inequalities/vulnerabilities that are currently identified/anticipated in Agri-food system.
- What are the causes of your chosen inequality?

- Consider different possible routes that might cause the inequality. Write the causes on the notes and connect them with arrows into chains of causes and consequences.
- Continue the chain as long as you come up with causes. Do you find connection to some of the identified policies?

Repeat STEP 3 for different policy / inequality

STEP 4. Identify Impacted groups

- View chains of consequences. Can you see connections between different chains?
- Can you identify a group of people or organization that could be negatively impacted by the changes described in the chains?
- Add a brief description of the group and the impact at the appropriate point.

7.2 Appendix 2: Engagement activities in the READJUST project

WP1 Identify inequalities in twin transition and track driving policies aggravate existing inequalities

Task	Purpose	Engaged group	Engagement method	Time	Organizer
T1.1 Identify inequalities in the two identified sectors (agri-food and mobility) in twin transitions	Verification of inequalities identified	Experts in agri-food and urban mobility	Stakeholder interviews	Mar–Nov 2024	FhG ISI
T1.2. Analyse policies and regulations pertaining to the green and digital transitions	Verification of policies identified	National experts in the related sectors and cases of focus	Stakeholder interviews	Mar 2025	FhG ISI
T1.3. Identifying & mapping factors for inequalities in twin transitions and developing simulation model for policy adjustment	Knowledge dissemination, engagement with students, input for simulation model	Policymakers, experts in agri-food, urban mobility & education; digital & sustainability; education, students	Stakeholder interviews, Hackathon, student supervision, conferences	Nov 2024 – Sep 2025	UvA
T1.4. Conceptual mapping of vulnerability and identification of needs to address the 'leave no one behind' principle	Map impacts of twin transitions and identify vulnerable groups	Experts within a quadruple helix framework (policymakers, industry, academia and NGOs and CSOs)	Online focus group interviews with 10-15 participants	Mar – Jun 2025	VTT
T1.5. (Vulnerable) Needs assessment for a robust, socially inclusive, transition framework	Assess needs for a robust, socially inclusive, and just transition framework.	Key vulnerable stakeholders selected in task 1.4	Deliberative engagement process (e.g. wiki-surveys)	Jun – Sep 2025	VTT
T1.6. Identify inequalities in twin transition and track driving policies aggravate existing inequalities	Create a set of scenarios that illustrate potential futures where the twin transition has occurred in the agri-food and mobility sectors	International futurists (e.g. Foresight Europe Network, The Millennium Project), 4CF team members and experts in mobility, agri-food and twin transition (from 4CF's sister EU projects).	Focus Group (min. 10 and max. 20 participants)	tbd	4CF

WP2 READJUST inequality observatory

Task	Purpose	Engaged group	Engagement method	Time	Organizer
Policy roundtable 1	Understand how the policy tracker could be helpful in local decision-making processes	Policymakers and other participants at the 'local' level that are/plan to be engaged in developing twin transition policies	Design workshop	May-June 2025	Yaghma
Policy roundtable 2	Understand how the self-assessment could be helpful in local decision-making processes	Policymakers and other participants at the 'local' level that are/plan to be engaged in developing twin transition policies	Design workshop	Oct - Nov 2025	Yaghma
Policy roundtable 3	Get feedback on the tools created (policy roundtable and self-assessment tool)	Policymakers and other participants at the 'local' level that are/plan to be engaged in developing twin transition policies	?	Nov 2026-Feb 2027	Yaghma
T2.4. Participatory Scenario Analysis	Augmenting the WP2 analyses with participatory scenario implications assessment to identify opportunities, challenges, enablers and blockers of TT around READJUST use cases	READJUST's stakeholders	Online workshops to participate in the scenario analysis and sense-making process	Jan 2026 –Apr 2026	4CF

WP3 Co-creation of policy measures for equal twin transition

Case: Urban Mobility

Task	Purpose	Engaged group	Engagement method	Timeline	Organizer
T3.1. Stakeholder analysis	Identify relevant stakeholders in the city	City & regional partners	One to one	Autumn 2025	VTT
T3.2. Case study UM phase1 –responsible policy co-creation with key stakeholder groups	Collect stakeholder's viewpoints on identified inequalities	City & regional partners, stakeholders	Workshop Survey and/or online delibe ration	Nov 2025	EIT UM
T3.2. Case study UM phase 2 –responsible policy co-creation with key stakeholder groups	Co-creation of solutions and responses	City & regional partners, stakeholders	Workshop, Survey and/or online delibe ration	Spring 2026	EIT UM
T3.3. Validation of responsible policy measures	Validate policy recommendations	City & regional partners	Survey and/or online delibe ration	Autumn 2026	VTT

Case: Agri-food

Task	Purpose	Engaged group	Engagement method	Time	Organizer
T3.1. Stakeholder analysis	Identify relevant stakeholders in the agri-food cases			Autumn 2025	VTT
T3.2. Farmers questionnaire	Identify barriers and enablers of technology adoption in farming sector	Farmers and NGOs	Questionnaire	Autumn 2025	EIT FOOD
T3.2. Stakeholder workshop	Identify solutions for just transition in the agri-food sector	Farmers, NGOs, Experts, Policymakers	Workshop	2026	EIT FOOD
T3.2. Co-creation workshop	Co-create policies at EU Level	Policymakers	Co-creation workshop	November 2026	EIT FOOD
T3.3. Validation of responsible policy measures	Validate policy recommendations	Policymakers	Survey and/or online deliberation	2026	VTT

WP4 Policy roadmap and policy options for supporting twin transitions

Task	Purpose	Engaged group	Engagement method	Time	Organizer
T4.1. Map current routes for policy change towards a just transition	Identify drawbacks of the current policy and legislative process are analysed. Map paths to twin transition policies which promotes equality.	Practice partners and their networks (EIT Food, EIT UM, and Solidar)	Workshop and interviews	*tbd*	VTT
T4.2. Policy lab 1	Validating key lessons and promoting further discussion, interaction, synergies for tackling inequalities in twin transition	Policymakers at national/local levels, and other relevant stakeholders on agri-food	Policy lab	*tbd*	EIT UM
T4.2. Policy lab 2	Validating key lessons and promoting further discussion, interaction, synergies for tackling inequalities in twin transition	Policy-makers at national/local levels, and other relevant stakeholders on mobility	Policy lab	*tbd*	EIT FOOD
T4.2. Policy lab 3	Validating key lessons and promoting further discussion, interaction, synergies for tackling inequalities in twin transition	Policy-makers at EU/national/local levels, and other relevant stakeholders	Policy lab	Summer 2027	Solidar
T4.5. Sensitizing stakeholders and roadmap wind-tunnelling	Ensure that the roadmap developed in T4.4 is not only effective in the present but also resilient and adaptable to future uncertainties	*tbd*	Backcasting workshop	*tbd*	4CF

WP5 Innovation Management: Dissemination, Exploitation, Communication (DEC)

Task	Purpose	Engaged group	Engagement method	Time	Organizer
T5.3. READJUST Dissemination Plan & activities	Online and offline dissemination of project results and networking	Practice partners and their networks (EIT Food, EIT UM, and Solidar) Sister projects St4te, Fitter-EU	3 policy roundtables (see WP 2) 4 dissemination webinars 2 workshops with sister projects Final Conference (M40)	RT 1 in summer 2025 Workshop 1 in 2025	Yaghma, EURICE