D5.4
Key findings from the joint implementation of the interventions

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WHO WE ARE

The ECF consortium consists of ten partners. The project is coordinated by Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT).

Name	Country	Logo
Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas **CIEMAT**	ES	
Instituto Superior Técnico. University of Lisbon **IST**	PT	
Universidad de Sevilla **USE**	ES	
University of Jyväskylä **JYU**	FI	
Universitat Autònoma de Barcelona **UAB**	ES	
Meda Research Ltd **MedaResearch**	RO	
Instituto de Soldadura e Qualidade **ISQ**	PT	
Trebag Szellemi Tulajdon Es Projektmenedzser Korlatolt Felelossegu Tarsasag **TREBAG**	HU	
Smartwatt Energy Sercuces SA **Smartwatt**	PT	
ENLITIA	PT	
Que Technologies Kefalaiouchiki Etaireia **QUE**	GR	

ABOUT THE PROJECT

Through a multidisciplinary, transdisciplinary and participatory process, ECF4CLIM develops, tests and validates a European Competence Framework (ECF) for transformational change, which will empower the educational community to take action against climate change and towards sustainable development.

Applying a novel hybrid participatory approach, rooted in participatory action research and citizen science, ECF4CLIM co-designs the ECF in selected schools and universities, by: 1) elaborating an initial ECF, supported by crowdsourcing of ideas and analysis of existing ECFs; 2) establishing the baseline of individual and collective competences, as well as environmental performance indicators; 3) implementing practical, replicable and context adapted technical, behavioural, and organisational interventions that foster the acquisition of competences; 4) evaluating the ability of the interventions to strengthen sustainability competences and environmental performance; and 5) validating the ECF.

The proposed ECF is unique in that it encompasses the interacting STEM (Science, Technology, Engineering, and Mathematics)-related, digital and social competences, and systematically explores individual, organisational and institutional factors that enable or constrain the desired change. The novel hybrid participatory approach provides the broad educational community with: an ECF adaptable to a range of settings; new ways of collaboration between public, private and third-sector bodies; and innovative organisational models of engagement and action for sustainability (Sustainability Competence Teams and Committees).

To encourage learning-by-doing, several novel tools will be co-designed with and made available to citizens, including a digital platform for crowdsourcing, IoT solutions for real-time monitoring of selected parameters, and a digital learning space. Participation of various SMEs in the consortium maximises the broad adoption and applicability of the ECF for the required transformational change towards sustainability.

LEGAL NOTICE

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1. EXECUTIVE SUMMARY

The **ECF4CLIM hybrid participatory approach**, rooted in participatory action research and partly based on the STAVE tool (Systematic Tool for Behavioural Assumption, Validation and Exploration) encourages students, teachers, staff and external stakeholders to work together to assess sustainability competences and reflect on the impact of actions. By emphasising creativity, transdisciplinarity and iterative reflection, it **supports transformative change and enhances institutional capacity to address sustainability challenges**.

In each of our 13 Demonstration Sites (DS) in Finland, Portugal, Romania and Spain, we have established two types of innovative organisational structures: **Sustainability Competence Teams (SCTs)**, made up of students, teachers and staff, and **Sustainability Competence Committees (SCCs)**, which include representatives from the wider education community, such as experts, authorities, NGOs, etc. At this stage of the project, around 800 participants are actively involved in our SCTs and SCCs.

To promote reflection and ownership, the SCTs and SCCs will meet up to six times during the course of the project. The first two meetings (SCT/SCC 1 and 2) encouraged critical thinking on competences and preferences towards sustainability and on co-designed a set of interventions to promote sustainability competences in each DS. In **Task 5.3**, SCTS and SCCs 3 and 4, aim to **further involve the educational communities in the ongoing interventions** and to generate meaningful empirical evidence on the individual, organisational and structural **drivers and barriers to sustainability competences**. In addition, SCT/SCC meetings 3 and 4 promote reflection on the first two steps of our roadmap: **engagement and connections.**

Results show the significant potential of our hybrid participatory approach. First, the participatory process has demonstrated a **high potential for fostering meaningful engagement** within the participating educational communities. Evidence gathered from participants and research teams underlines the transformative value of this approach in empowering individuals and groups to develop sustainability competences. Despite challenges such as time constraints, participant turn-over and resistance to change, the participatory process provided a platform for meaningful engagement and action. With regard to the second objective, our participatory approach provided **rich empirical insights**. At the individual level, experiential learning, teamwork and participation in decision-making emerged as key drivers of engagement. However, individualistic thinking, an age-related decline in commitment and teachers' resistance to change were notable barriers. At the organisational level, motivated leadership, interdisciplinary teacher collaboration and membership of networks such as Eco-Schools were key enablers. Structural factors such as policy alignment and community support also played

a critical role, while resource scarcity, social inequalities and competing priorities sometimes relegated sustainability to a secondary concern. The participatory approach also helped to validate the project roadmap by gathering **valuable reflections on engagement and connections**.

The **flexibility and adaptability** of the methodology was crucial in tailoring interventions to local contexts, enabling schools to overcome silos and adopt integrated approaches to sustainability education. The approach is adaptable and evolves to incorporate learning from the specific contexts of the Demonstration Sites (DS). These findings represent an important first step towards broader systemic action and transformative change in educational communities.

2. GOALS

Through our participatory, reflective and deliberative process, Task 5.3 supports the joint implementation of the interventions co-designed to boost sustainability competences at our Demonstration Sites (DS). In Task 5.3, all actors involved in the interventions engage in 'reflection' on whether and how the interventions have affected their competences and capabilities to act towards sustainability.

The aim of Task 5.3 is twofold: to engage our educational communities in transformational change towards sustainability, and to generate meaningful empirical evidence on the drivers and barriers to such change:

- → Deliberative process to **engage our Demonstration Sites** in reflection on whether and how the interventions affect competences and capabilities to act towards sustainability and to **engage the wider educational community** in providing suggestions, modifications or changes on the on-going interventions.
- → Preliminary identification of the individual, organisational and structural **drivers for and barriers to sustainable behaviours.**

In addition, although not foreseen in the initial Description of Work, we took advantage of the SCT/SCC sessions 3 and 4 to promote r**eflection on the different steps of our roadmap**, as follows

- → Sessions 3 focus on the 1st step of our roadmap: **engagement.**
- → Sessions 4 focus on the 2nd step of our roadmap: **connections.**

3. METHOD: THE HYBRID PARTICIPATORY APPROACH

The ECF4CLIM hybrid participatory approach, rooted in participatory action research (Kemmis, 2014) and partially based on the STAVE tool (Systematic Tool for Behavioural Assumption, Validation and Exploration) (Horlick-Jones & Prades, 2015; Espluga et al. 2016; Prades et al. 2016, 2017), allows the educational community to jointly identify, understand, assess, and evaluate their own sustainability-related competences and obstacles to improvement. The communities engage in joint deliberation on how to promote sustainable individual and collective behaviours, and to jointly evaluate the outcomes of the learning experience. This experiential learning process will empower the broader educational community to take steps towards a transformational change for a more sustainable future.

As describe in D4.4, at each Demonstration Site, two types of innovative organizational structures were set up:

- → **Sustainability Competence Teams (SCTs)**, composed of members of the educational community at each Demonstration Site (students, teachers, staff).
- → **Sustainability Competence Committees (SCCs)**, including also representatives from the wider educational community such as experts, public authorities, NGOs, and members of other education services.

At this stage of the project, 89 SCTs and 33 SCCs have been established in 13 educational institutions from four EU countries to discuss and reflect on sustainability competences and practical ways to promote them. Around 800 participants, including students, teachers, staff and representatives of the wider educational community are actively engaged in understanding their sustainability competences, co-designing interventions to promote them and assessing and evaluating the outcomes of the learning experience. To foster reflection and ownership, the SCTs and SCCs meet several times throughout the project. Figure 1 shows the sequence of relationships between SCTs and SCCs.

Figure 1: Sequences of relationships between SCTs and SCCs

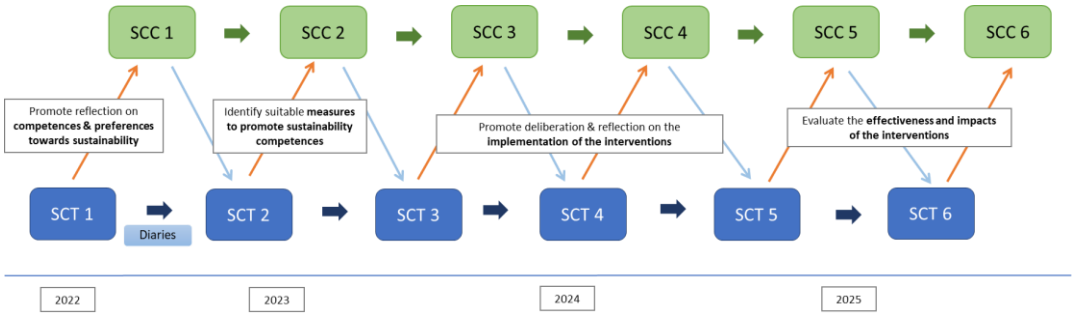
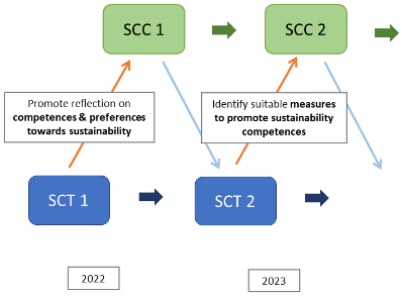
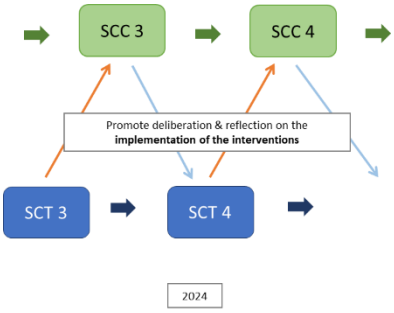


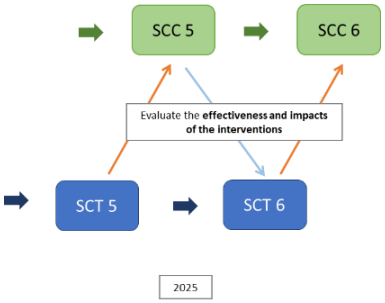
Figure 2: SCTs and SCCs sessions



SCT/SCCs 1 & 2 engage participants in reflection on the starting point of our schools in terms of sustainability competences: How is sustainability understood? How is it integrated into school activities? What are the individual and collective sustainability competences? From this starting point, 159 interventions to empower the educational community and promote sustainability competences were co-designed



SCT/SCCs 3 & 4 promote reflection on ongoing interventions in the DS: How are the interventions evolving? Is there a need for modifications? From this reflection, preliminary insights on the impact of the interventions on individual and collective competences, as well as on environmental performance are gathered.
Sessions 3 focus on the 1st step of our roadmap: engagement.
Sessions 4 focus on the 2nd step of our roadmap: connections.



SCT/SCCs 5 & 6 engage all involved actors in the participatory evaluation of the interventions. Participants explore and possibly revisit their 'intervention theories' in light of the experience gained: Did the intervention operate as expected? Which unanticipated factors constrained or facilitated the improvement of sustainability competences? (Theory-based stakeholder evaluation)
Sessions 5 focus on the 3rd step of our roadmap: visions.
Sessions 6 focus on the 4th step of our roadmap: actions




3.1. The methodological basis

Our hybrid participatory approach strongly relies on the principles of participatory action research and on the STAVE tool (developed, tailored and operationalised in the EU Pachelbel project) (http://pachelbel.eu). STAVE supports policymaking for sustainability in real-world settings. Creativity and transdisciplinarity are fundamental components of our hybrid participatory approach.

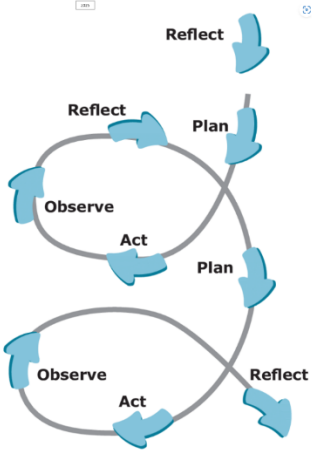
Methodological basis

Participatory action research

Iteration

Creativity

Transdiciplinarity



The Action Research Planner: Doing Critical Participatory Action Research | SpringerLink

→ **Participatory action research** sees self-reflection as the driving force for change and transformation. Individuals are not passive subjects but active agents in the research process and in drawing conclusions from what they learn (Kemmis, 2014).

→ In line with the principles of the STAVE tool, and to strengthen our capacity for reflection, **iteration** is another pillar in our hybrid participatory approach. Successive interactions within and between different actors contribute to rethink existing knowledge and assumptions (Prades et al, 2017).

→ **Creativity** is an essential part of learning for sustainability. Rather than education which, is limited to instruction and transfer of knowledge, creativity supports innovation and problem solving to address complex ecological problems (Sandri 2013).

→ **Transdisciplinarity** is another critical element in ECF4CLIM, as we aim to involve interaction between the academia and the "outside world", most notably including citizens and stakeholders holding various types of experiential knowledge (Ortiz et al. 2020). Complex problems require participation, openness and new and diverse forms of knowledge (Bergman et al 2008, 2021; Jahn et al 2012) as well as disciplinary integration (Gibbons et al 1994)

Finally, participatory action research is dynamic and reflective by nature and, therefore, as the project evolves, **new methodological insights** may be incorporated to our participatory process. **Sensitivity to context** (adaptive and constructed iteratively through the project) (Wickson et al, 2006) is also crucial in ECF4CLIM.

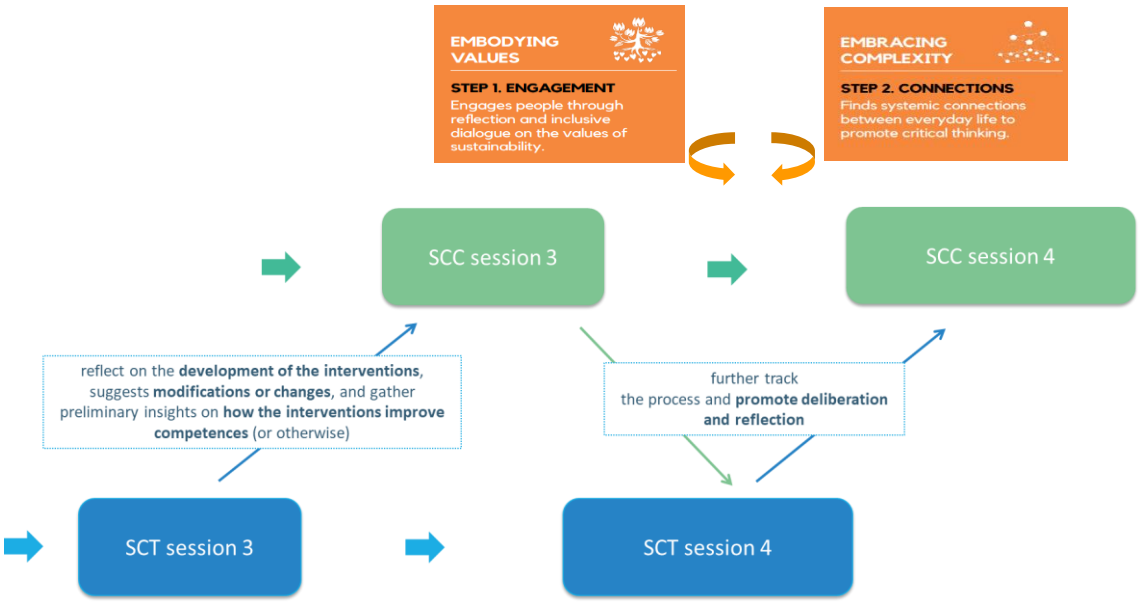
The focus of our hybrid participatory process is therefore on developing **practical and applicable tools that promote thinking and self-reflection** on sustainability competences at our Demonstration Sites (DS), as a first step towards transformational change in the educational community. We need to consider that, in ECF4CLIM, the design of specific tools and methods is strongly constrained by the limitations of data collection at our Demonstration Sites (DS) and by the challenges associated with applied transdisciplinary research. Participants at our DSs have very little time available for data collection, keeping full control over sampling and data collection procedures is difficult, and some of the research partners responsible for data collection lack specific expertise in social science methods. It should also be considered that, given the time and resources available within our project, the elaboration of scientifically valid scales to measure sustainability competences is beyond our reach, and that our hybrid participatory method is based on the triangulation of diverse types of quantitative and qualitative data.

Next, we introduce the set of specific tools and methods included in the 3rd and 4th sessions of our Sustainable Competence Teams and Committees.

3.2. The joint implementation of the interventions

As mentioned, SCTs and SCCs 3 & 4 encourage reflection on ongoing interventions at our Demonstration Sites (DSs): How are the interventions evolving? Does something need to be modified? This reflection will provide initial insights into the impact of the interventions on individual and collective competences and on environmental performance. In addition, although not foreseen in the DoW, these SCT and SCC meetings stimulate reflection on the first and second steps of our roadmap: ENGAGEMENT and CONNECTIONS. Thus, all sessions have a dual purpose: to monitor the interventions and to collect data to validate our roadmap.

Figure 3: SCT and SCC sessions 3 & 4



Next, we present the methodological guidelines designed for the SCT and SCC sessions 3 and 4, with their specific tools and methods, including: mind maps, ad hoc designed short surveys, open debates, concept mapping, evaluation questionnaires, etc. In order to encourage a more precise description of the contexts and particularities of our DS, observation protocols were also designed to help the research team collect data.

Sustainability Competence Teams Session 3 (SCT3):

The third sessions of our SCTs focus on monitoring the interventions and linking the interventions to the first step of our roadmap (ENGAGEMENT): How can the interventions help various groups to engage in work towards sustainability?

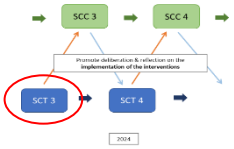
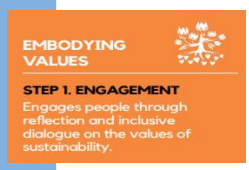


Figure 4: Structure of SCT3

Sustainability Competence Team Session 3

Welcome & short introduction about engagement (5')
Sustainability conceptions survey (10')
Reflecting on the interventions (60)
- On-going interventions. First impressions (15')
- On-going interventions. Barriers and enablers (30')
- On-going interventions. Further improvement (15')
- Rejected interventions (10') (optional)

Farewell & next steps + evaluation questionnaire (5')



To establish **a common ground for ENGAGEMENT**, participants were shown a short video about our roadmap at the beginning of the meeting: https://youtu.be/TaEaStic7Qw. A national version of this one-minute video is available on the ECF4CLIM website.

In addition, facilitators were asked to keep in mind a series of questions throughout the session, such as: What is sustainability? What are the challenges? What helped overcome the challenges? What did not work as planned? How can the intervention be improved?

In order to gather **evidence on sustainability thinking**, participants were asked to complete a short survey on sustainability conceptions, which was designed ad hoc by the research team. The design of the survey drew on three main sources:

→ Review of the literature presenting the currently dominant views on sustainability and sustainable development. The review focused on the recent survey articles that explicitly address the question of the various conceptualisations of sustainability.

→ Two webinars organised by the ECF4CLIM to explore the views among education-sector practitioners and the ECF4CLIM team concerning sustainability (the findings from the webinars are summarised in D.8.5). The webinars gathered a total of 20 participants to discuss the key concepts and identified gaps and misunderstandings between disciplines regarding sustainability and its application in educational settings. The participants included experts from various disciplinary and professional backgrounds (environmental sciences, ecology, biology, industrial engineering, mathematics, educational sciences, psych pedagogy, geography, political science, economics, philosophy, and sociology).

→ The decades-long experience of many ECF4CLIM members on sustainability-related research and practice. This experience dates back all the way to the introduction of sustainable development as a central concept of international governance (WCED 1987), and has included a continuous stream of scientific and other publications in the area of sustainable development (e.g. Lehtonen, 2004; 2005; 2008; 2009 and forthcoming; Nokkala et al. 2024; de Perthuis et al. 2002;). This experience provided a solid understanding of the evolution of sustainability debates and governance, and hence gave orientation for the literature review as well as for the framing and analysis of the webinar discussions.

The above-mentioned three sources provided a basis for the survey on sustainability conceptions, including four models of sustainability: 1) the conventional three-pillar model, adopted as the dominant conception of sustainability at the Rio 1992 conference on environment and development (UNCED 1992); 2) the planetary boundaries concept,

popularised in the 2010s, notably following the publications of Rockström et al. (2009) and Steffens et al. (2015); 3) the bioeconomy model advocated especially by scholars in ecological and institutional economics, with their foundations traceable to the eco-development Ideas in the 1970s (Sachs 1980; 1999) – and theoretically, all the way to the old American institutionalism of the early 20th century (e.g., Veblen, 1919; Clark, 1995); and 4) degrowth thinking, spearheaded today by research centres in Barcelona (e.g. Martínez-Alier, 2002; Kallis, 2019), Leeds and Vienna, with close links with grassroots movements advocating degrowth at the local level.

As mentioned above, the aim was not to produce a scientifically validated survey, but a **practical and applicable** tool to stimulate thinking and self-reflection on sustainability. We did not aim to produce statistically significant results, but rather a qualitative/deliberative scientific tool.

To this end, two versions of the survey were designed, one for primary schools (with a single open question) and another for secondary schools and universities (with five questions to be rated on a 5-point Likert-scale and a one open-ended question). Participants completed the survey individually, without discussing with the others. The survey will be repeated in SCT4 to stimulate further reflection and track possible changes in our participants' sustainability conceptions.

Sustainability conceptions: short survey for kids

Q1. There has been a lot of talk about sustainability in this project. What does it mean to you?

Sustainability conceptions: short survey for adults

Q1. Are economic growth and sustainability compatible with each other?
Q2. How would you characterise the relative importance of the social, economic, and environmental dimensions of sustainability?
Q3. Is sustainability an objective (an end-state to be achieved) or a continuous process?
Q4. Are democracy and sustainability compatible with each other?
Q5. Is technological development an impediment to or a precondition for sustainability?
Q6. Please describe, in a few words, what – if anything – motivates you to take action towards greater sustainability, and why.

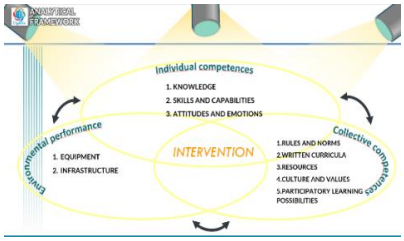
Then, and in line with the principles of participatory action research (Kermis et al., 2014) and with our transdisciplinary approach (Bergman & Jahn, 2008; Bergman et al. 2021) we sought to encourage **self-reflection on the interventions**. To this end, each DS, in close collaboration with the research team, selected in advance up to three interventions to be discussed in STC3. Where possible, we tried to select one intervention that focused on individual competences, one on collective competences and one on environmental performance. To promote active engagement, the discussion

started with a short introduction to understand the degree of involvement of participants with the design and implementation of the interventions. The moderator then invited the participants to engage in an "ice-breaker" debate about their experiences and expectations.

"Ice-breaker" debate: What is going on?

- → *How actively have you been involved in the execution of the planned interventions?*
- → *Has the experience been good?*
- → *Have things worked out as expected?*
- → *Has your thinking (values/attitudes/knowledge) changed during the process?*

To encourage further reflection and deliberation, participants engaged in a discussion on **drivers and barriers they face when implementing the interventions** in their DS **and how they relate to our analytical framework.**



To surface and display perceptions, understandings, and ideas about the interventions and to explore links with the analytical framework, we relied on the technique of "oval mapping" (or "concept mapping") (Morgan et al. 2008). This is a low-tech' decision support method to assist groups agree the nature and boundaries of complex and messy problems they must tackle, and to secure shared commitments to action (Rosenhead & Mingers, 2001; Horlick-Jones et al. 2007). Concept mapping has been identified as an empowering method for facilitating learning, thinking, teaching and research (Åhlberg, 2013). As in ECF4CLIM, concept mappings are used iteratively across the different SCT/SCC sessions, the resulting oval maps may help to create a useful cumulative resource that generates a sense of continuity between subsequent sessions of the SCTs and SCCs (Horlick-Jones & Prades, 2015).

The moderator briefly introduced the three spheres of our analytical framework for sustainability competences (individual competences, collective competences and environmental performance) and invited participants to consider how relevant they are in their interventions[1].

[1] SCT members were already familiar with our analytical framework, as it was part of the guidance and training provided by the research team for monitoring the interventions (Task 5.1 and Task 5.2).

Concept mapping: identifying drivers & barriers related to our analytical framework

- → *Which of these spheres (individual, collective, environmental) is the most important for your intervention? Why?*
- → *Is there something constraining or enabling the realisation of the planned intervention?*
- → *Are there some other constraints or enablers that are not included in the picture?*
- → *What has helped to overcome the challenges?*

The moderator emphasized that there is no single and unequivocal answer to the question: which of the three spheres is the most important in your intervention? The inherent ambiguity is precisely what makes our analytical framework meaningful and useful, as it draws attention to the interactions between the "spheres" and the dependence of answers on the perspective that one adopts. It should be noted that in the SCT3 in primary schools, with children, the concept mapping excluded the links with the analytical framework and focused only on the identification of enablers and constraints for the successful implementation of the interventions.

The last step in our SCT3 gather evidence **on how to improve the interventions and, more specifically, how to improve their ENGAGEMENT potential.** Relying once more on oval mapping, the moderator invited participants to reflect on ways for improvement and to write down up to three proposals for each intervention. Through these proposals, our educational communities engage in joint reflection on how to promote sustainable competences and actively contribute to the learning experience at the DS.

Oval mapping: improving the interventions and their ENGAGEMENT potential

- → *How to communicate the activity in an inspiring way?*
- → *How to share our experiences with others?*
- → *How to attract further participants?*

Participants were informed about the next steps in the hybrid participatory process, and finally, to check the quality of our SCT session as a participatory and deliberative process, the participants were asked to answer some questions at the end of the session. This short survey was based on Rowe & Frewer's well-known evaluation criteria (Rowe & Frewer, 2000). Each question was rated on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

Evaluation questionnaire

Q1. I feel that the people running the group discussions did not seek to promote a specific view on the issue.
Q2. The way the group discussions were run allowed me to have my say.
Q3. It was clear to me what I was supposed to be doing throughout the group meetings.
Q4. The meetings seemed to provide sufficient time for everyone who wanted to contribute to the group discussions and have their say.
Q5. I found the discussion meetings interesting.
Q6. How to get best possible impact of this collaboration with students and decision makers for both this research and for promoting sustainability?
Q7. Any additional comment, suggestion you may have regarding this committee

Sustainability Competence Committee Session 3 (SCC3):

In SCC3, the wider educational community in each DS (NGOs, relevant public and private sector organisations, etc.) reflect on the development of the interventions and suggest modifications or changes (if necessary).

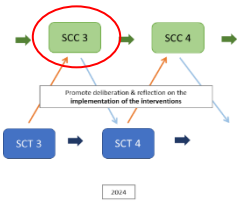


Figure 5: Structure of SCC3

Sustainability Competence Committees Session 3

Welcome (10')
Reflecting on the interventions (70')
- Intervention 1
  - Explanation of the intervention (5')
  - Findings from SCT3 (10')
  - How to improve further (20')
- Intervention 2
  - Explanation of the intervention (5')
  - Findings from SCT3 (10')
  - How to improve further (20')

Farewell & next steps + evaluation questionnaire (10')

As in SCT3, to establish **a common ground for ENGAGEMENT**, participants watched a short video about our roadmap at the beginning of the meeting: https://youtu.be/TaEaStic7Qw.

Next, to promote the deliberative process of reflection among the wider educational community (NGOs, relevant public and private sector organisations, etc.), each DS, in close collaboration with the research team, selected up to two interventions to be discussed at SCC3. The meeting therefore began with a brief introduction by the research team to the selected interventions, including their objectives, status and

implementation, and preliminary findings. Afterwards the moderator invited the participants to an open debate about their preliminary impressions and expectations.

To encourage further reflection and **to actively involve the wider educational community in the monitoring and progress of the interventions**, the participants engaged in a new concept mapping exercise (oval mapping).

Oval map: ways to improve the interventions (links with SCT4)

- → *How to overcome the identified barriers?*
- → *How to communicate the activity in an inspiring way?*
- → *How to attract more participants?*
- → *How to motivate?*
- → *How to involve more local institutions/entities, generate additional resources?*
- → *How to institutionalize the intervention?*

As a result, participants wrote down up to three concrete suggestions for improving each intervention. This whole process (getting to know the interventions, sharing first impressions and working together on ways forward) was repeated for each selected intervention.

Participants were informed about the next steps in the hybrid participatory process, and finally, as in all our SCT and SCC meetings, to check the quality of the session as a participatory and deliberative process, participants were asked to complete a short questionnaire based on Rowe & Frewer's evaluation criteria (Rowe & Frewer, 2000).

Sustainability Competence Teams session 4 (SCT4):

The 4th sessions of our SCTs focus on further developing and broadening the perspectives of the interventions on the one hand, and on how the interventions and their objectives are linked to different environmental challenges and different stakeholders (CONNECTIONS) on the other.

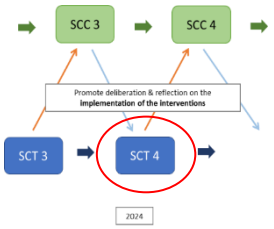
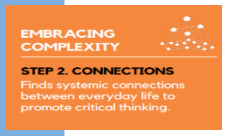


Figure 6: Structure of SCT4

Sustainability Competence Teams session 4

Welcome (5')
Description of the interventions (10')
Creative exercise on connections (50')
Sustainability conceptions (25')
Farewell & next steps + evaluation questionnaire (5')



To establish **a common ground for CONNECTIONS**, participants were invited to watch a short video on the 2nd step of our roadmap at the beginning of the meeting: https://youtu.be/ZBqbW8-qa5g.

Facilitators could also use the first ECF4CLIM roadmap to deepen their understanding of this second step of the roadmap and thus stimulate the debate on this topic during the meeting. (https://mappa.fi/en/greencomp-roadmap/connections)

Then, as in SCT3 and following the principles of participatory action research and transdisciplinarity, we encourage **self-reflection on the interventions** (Kermis et al., 2014; (Bergman & Jahn, 2008; Bergman et al. 2021). Each DS, in close collaboration with the research team, selected in advance one intervention to be discussed in SCT4. If possible, we tried to select an intervention aimed at improving the different spheres of our sustainability competencies (individual, collective, environmental). We could either select an intervention that has not been discussed before in SCT3/SCC3 meetings, or an intervention that has already been discussed in previous meetings. The point of revisiting those already discussed is to reflect on them from the perspective of CONECTIONS.

Open debate (ice breaker): What is the problem?

→ *Objective & status of the implementation.*
→ *What is the intervention and what does it aim to have impact on or change? (What is the problem?)*

The moderator invited participants to discuss the various issues that impact or interfere with the intervention and its objectives: e.g., infrastructures, service providers, cultural habits, rules, resources, people's competences such as knowledge, skills, and attitudes, etc.

To encourage further reflection and deliberation, participants engaged in a **creative exercise to understand the systemic nature of sustainability activities**. Creativity is an essential part of learning for sustainability as it supports innovation and problem solving to address complex ecological issues, rather than education limited to instruction and knowledge transfer (Sandri 2013). The design of our creative exercise relied on mind map methods as they are dynamic, activity-based, participatory, and support systems thinking, which is an essential domain of sustainability competences (Palmberg & al. 2017). Mind-map method helps to activate participants and organize individual and collective mental activity (Mautenbaev, 2018).

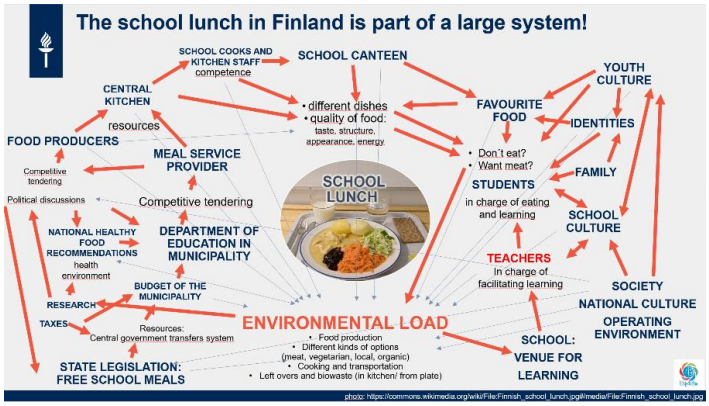
Creative exercise on CONNECTIONS: mind map

The aim of this exercise is to think together, to make visible connections and different perspectives to sustainability, to elevate collective understanding of the problems and possible ways to change the situation through interventions

- → *What kind of issues have impact on or interfere in the intervention and its object? How they have an impact? Why?*
- → *How the interventions and their aims are interconnected and connected to different challenges and different stakeholders?*

Participants are invited to create a mind map together in a big paper or a board, using words, colours, and pictures. They also take a photo of their collective drawing.

Participants collaboratively created a mind map of the connections with the help of the facilitator's questions: How do they have an impact? Why? How are the interventions and their aims interconnected and connected to different challenges and stakeholders? How does the intervention relate to or connect with sustainability in your school or university? What aspects facilitated the intervention? What did not work? An example from Finland regarding school lunches was provided to help participants grasp the concept.



https://mappa.fi/materiaalit/kouluruoan-yhteydet

In the final debate, participants concluded how the interventions and their aims are interconnected and connected to different challenges and stakeholders.

Next, to enrich the evidence **and stimulate further thinking on sustainability**, the research team presented the results of the short survey in SCT3 and the facilitator engaged participants in an open debate on their impressions and reactions to the results.

Sustainability conceptions: open debate (linking SCT3 & SCT4)

- → *Do the visions and conceptions on sustainability change or do they remain the same? Why?*
- → *What are the main arguments underlying current (or part) visions or conceptions of sustainability?*
- → *Do the changes relate to the ECF4CLIM participatory process and/or interventions?*

At the end of the discussion, and in order to track possible changes (or not) in the sustainability conceptions, participants were asked to repeat the short survey.

Participants were informed about the next steps in the hybrid participatory process, and finally, as in all our SCT and SCC meetings, to check the quality of the session as a participatory and deliberative process, participants were asked to complete a short questionnaire based on Rowe & Frewer's evaluation criteria (Rowe & Frewer, 2000).

Sustainability Competence Committee Session 4 (SCC4):

In SCC4, the wider education community in each DS (NGOs, relevant public and private sector organisations, etc.) will continue to monitor the interventions, deepen the framing of the problem and the connections between everyday school life and sustainability (CONNECTIONS), and develop proposals to further improve the interventions.

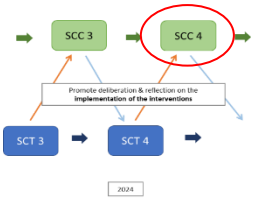
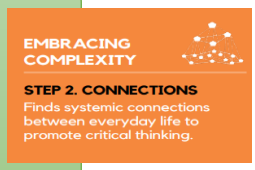


Figure 7: Structure of SCC4

Sustainability Competence Committees Session 4

Welcome (5')
Description of the selected intervention(s) (10')
Main findings from SCTs4: creative exercise. (45')
How to improve further (25')
Farewell and next steps (5')

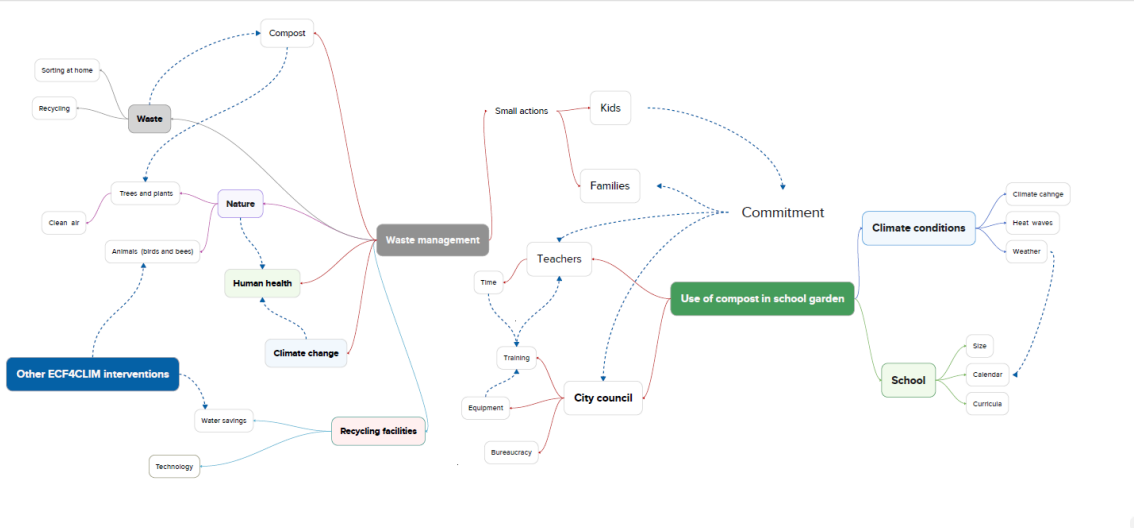


As in SCC3, to **encourage the deliberative process of reflection** among the wider educational community, each DS, in close collaboration with the research team, selected the interventions to be discussed with them, on this occasion using the **mind maps elaborated in SCT4**.

As there are up to three SCT4 sessions in each DS (one with students, one with teachers and one with staff), there could be up to three mind maps per intervention. In this way, the research teams helped the DS to prepare the materials to be discussed in SCC4. In those DS where the creative exercises of teachers, pupils and staff focused on the same

intervention, the research team presented all their mind maps, highlighting similarities and differences in terms of strengths and weaknesses of the intervention.

Figure 8: Creative exercise al SCT4



Where the creative exercises at SCT4s focused on more than one intervention (as in the example above), the research team produced a single mind map for each intervention, showing the main similarities and differences in terms of strengths and weaknesses. In fact, this required prior analysis by the research team.

The meeting began with a brief presentation of the selected mind maps by the research team, followed by an open discussion of initial impressions and expectations.

Open debate: impressions and reactions on CONNECTIONS (links with SCT4)

- → *Are the connections meaningful to you? Why?*
- → *Anything/anyone especially relevant or remarkable?*
- → *Is there anything missing? What?*
- → *Is there anything that surprised you? Why?*

Next, to encourage further reflection and **to actively involve the wider educational community in the monitoring of the interventions**, participants engaged in a new concept mapping exercise (oval mapping) on practical ways to improve the interventions.

Oval map: practical ways to improve the interventions

If the intervention would take place again in the next school term….

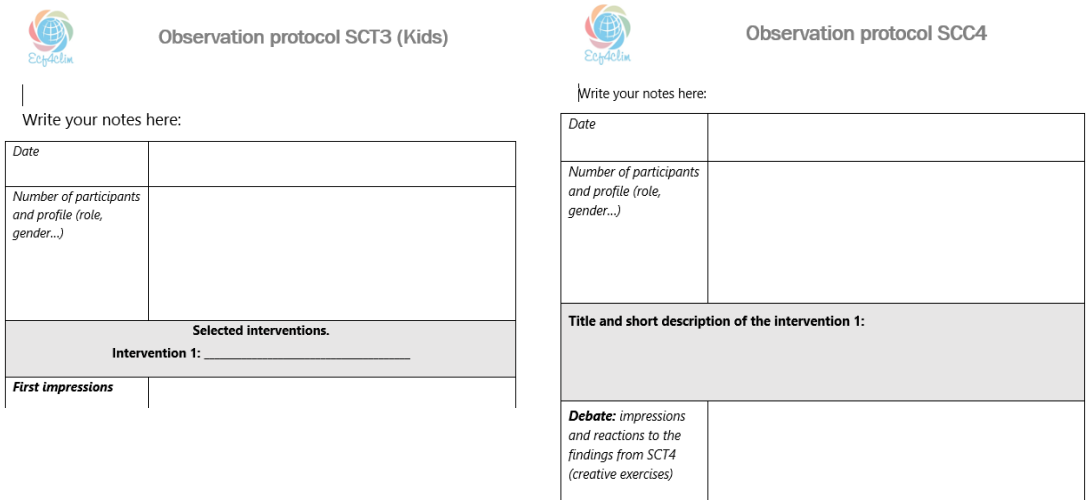
- → *What would you change? What would you do differently?*
- → *Who else should be involved? How?*
- → *What would you do the same? Why?*

Participants wrote down up to three suggestions for improving the interventions.

Participants were informed about the next steps in the hybrid participatory process, and to conclude, as in all our SCT and SCC meetings, to check the quality of the session as a participatory and deliberative process, participants were asked to complete a short questionnaire based on Rowe & Frewer's evaluation criteria (Rowe & Frewer, 2000).

Besides this methodological guidance for each SCT and SCC sessions, and in line with the suggestions by the reviewers in the 1st reporting period, simple **observational protocols** were designed and facilitated to the research teams in the different countries. The objective is capturing ethnographic elements to promote contextualization and facilitate the transfer, the flexibility and, in case of need, the re-adaptation of the methods and tools (Lynch, 2002).

Figure 9: Observation protocols



Observation protocol SCT3 (Kids)

Write your notes here:

Date	
Number of participants and profile (role, gender…)	
Selected interventions. **Intervention 1: _____**	
First impressions	

Observation protocol SCC4

Write your notes here:

Date	
Number of participants and profile (role, gender…)	
Title and short description of the intervention 1:	
Debate: *impressions and reactions to the findings from SCT4 (creative exercises)*	

4. DATA GATHERING

Once the methodological guide was ready, we organised three **training sessions** with partners to familiarise them with all the tools and methods, and to invite them to express their views and concerns and to suggest changes to the practical implementation in each DS. The training sessions took place on 22/02/2024 (SCT3

training session); 30/04/2024 (SCC3 training session) and 29/05/2024 (SCT4 and SCC4 training sessions).

Figure 10: Training session

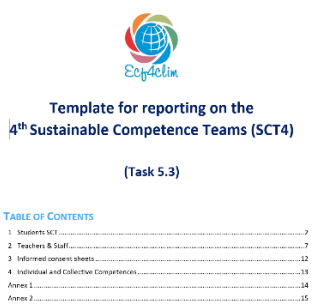
Throughout 2024 and up to the date of this report, **62 meetings of our Sustainability Competence Teams and Committees,** Sessions 3 and 4, have taken place, involving **543 students, teachers, staff and other members of the wider educational community.**

Table 2: SCTs and SCCs 3 & 4 meetings and participants

	Number of meetings	Number of participants
SCT3	25	216 144 students; 51 teachers; 21 staff
SCC3	9	81
SCT4	22	195 134 students; 48 teachers; 13 staff
SCC4	6	51
TOTAL	**62**	**543**

The task leaders provided specific **reporting templates** for each SCT/SCC meeting, illustrated with examples of reports from research teams including social scientists.

Figure 11: Reporting templates



Template for reporting on the
4th Sustainable Competence Teams (SCT4)

(Task 5.3)

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2 Teachers & Staff 7
3 Informed consent sheets 12
4 Individual and Collective Competences 13
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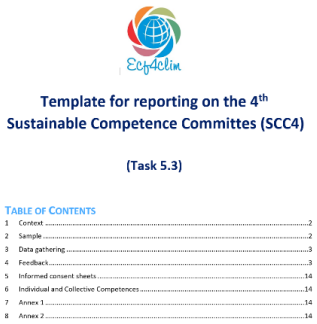
Annex 2 15



Template for reporting on the 4th
Sustainable Competence Committes (SCC4)

(Task 5.3)

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2 Sample 2
3 Data gathering 3
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37 reports were produced by the research teams in the four countries: 11 SCT3 reports, 9 SCC3 reports, 11 SCT4 reports and 6 SCC4 reports. It should be noted that the SCC4 meetings are still ongoing. These reports, ad produced by each research team in each Demonstration Site, are the main source of evidence for the preliminary identification of drivers and barriers to sustainability competences in D5.4

5. FINDINGS

The findings are first presented according to the two objectives of Task 5.3: to engage our educational communities in transformational change towards sustainability (4.1), and to generate meaningful empirical evidence on the drivers and barriers to such change (4.2). Next, we present additional findings on the evidence gathered in relation to the first two steps of our roadmap: engagement (4.3) and connections (4.4.). Finally, we include additional findings on sustainability conceptions (4.5.) and the gender dimension (4.6).

5.1. The deliberative process: SCT/SCCs 3 and 4

To assess the effectiveness and the quality of the hybrid participatory approach, in particular of our SCT/SCC sessions 3 and 4, we rely on actual data (number of sessions and participants), and on the feedback from both the members of the educational communities (students, teachers, staff and others) and the research teams engaged in the practical implementation of the SCTs and SCCs in Finland, Portugal, Romania and Spain.

→ **Number of SCT/SCC sessions and students, teachers and staff actively involved in SCT/SCCs 3 & 4**

Despite the limitations of participatory action research in our DS, the research teams, hand in hand with the DS, managed to hold 62 meetings of our Sustainability Competence Teams and Committees, involving 543 students, teachers, staff and other members of the wider educational community.

→ **Feedback from participants in SCT/SCCs 3 & 4: the evaluation questionnaire**

As described earlier, to check the quality of our SCTs and SCCs sessions as participatory and deliberative process participants were asked to answer some questions at the end of each session according to Rowe & Frewer's well-known evaluation criteria (Rowe & Frewer, 2000).

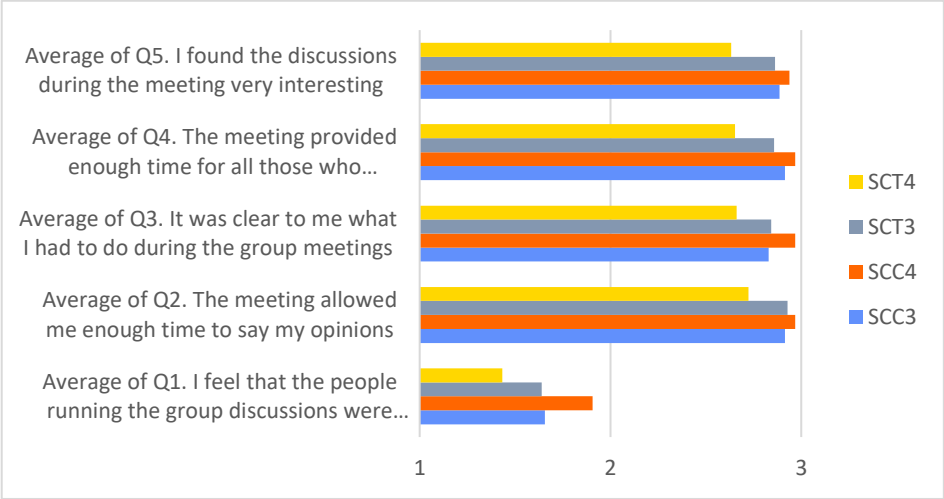
The short survey included five questions, to be rated in a 3-point Likert scale, ranging from 1 (disagree) to 3 (agree), dealing with: clarity of content, time management, freedom of expression, and whether participants found the discussions engaging and worthwhile.

Evaluation questionnaire

Q1. I feel that the people running the group discussions did not seek to promote a specific view on the issue.
Q2. The way the group discussions were run allowed me to have my say.
Q3. It was clear to me what I was supposed to be doing throughout the group meetings.
Q4. The meetings seemed to provide sufficient time for everyone who wanted to contribute to the group discussions and have their say.
Q5. I found the discussion meetings interesting.

The results show that our participatory process meet with a high level of acceptance and lead to effective engagement, as shown by the results, which almost reach the maximum value in the assessed dimensions.

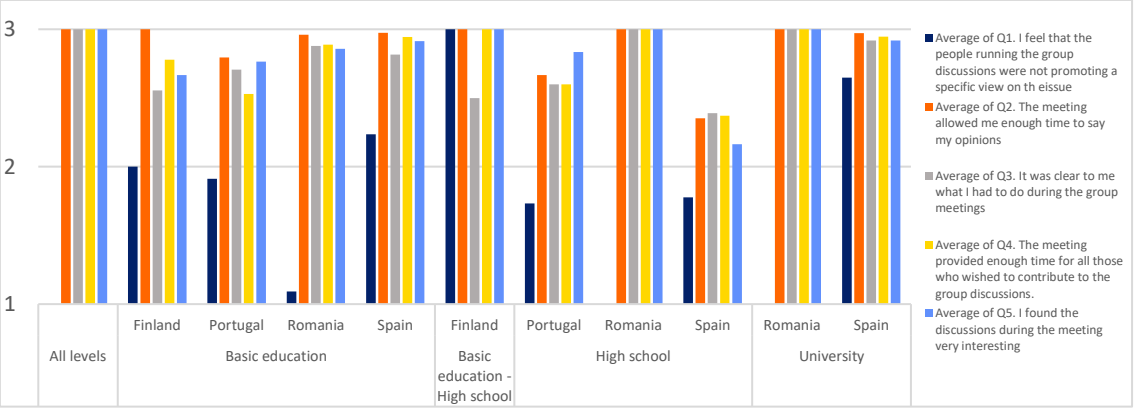
Figure 12: Evaluation questionnaire results



As the figure sows, there is only one exception that slows down the trend: Q1. There are two possible explanations for this. The first relates to the wording of the question: as it was formulated negatively, it could have led to a difficult understanding on the part of the participants. The second relates to the perceived neutrality of the moderators: participants may have felt that the research team was actually promoting one view of sustainability, which was probably the case.

Beyond Q1, the evaluation highlighted several strengths across different dimensions.

Figure 13: Evaluation questionnaire results by country and educational level



Participants rated time allocation for expressing opinions (Q2) the highest, with an overall score of 2.85, reflecting extensive satisfaction, especially among university participants, where Spain and Romania scored a perfect 3. Similarly, sufficient time for group discussions (Q4) was highly appreciated. The Romanian participants consistently gave excellent ratings across all educational levels, and the discussions at high school and university level were particularly appreciated. Engagement in discussions (Q5) also stood out, especially at the university level and among Romanian participants, achieving high marks for interest and contribution. These results demonstrate that time management and participant engagement were key strengths in the meetings, especially for university-level participants.

The findings will be shared with the research teams to collaboratively refine discussion and improve clarity. These adjustments will build on the strong performance of the participatory process which effectively facilitated engagement, time allocation, and participant satisfaction across most areas. While neutrality in discussions (Q1) requires attention, the widespread success in other dimensions highlights the tools' robustness. By addressing gaps and reinforcing strengths, feedback from evaluations aim to create even more inclusive and impactful meetings.

→ **Feedback from research teams involved in the implementation of SCT/SCCs 3 & 4**

In line with the principles of participatory action research, and in order to promote reflection and insight into the practical implementation of our hybrid participatory method, we organised a **feedback session on the SCT/SCCs 3 and 4 at the 7th General Assembly**. All partners working hand-in-hand with our Demonstration Sites in Finland, Portugal, Romania and Spain were invited to share their experiences of the SCT/SCC meetings, including concerns and suggestions for improvement. They provided feedback on both the overall participatory strategy and its various methods and tools.

According to the research teams, the hybrid participatory approach has proven to be **useful in fostering interaction** between the different actors, including students, teachers, staff, and other stakeholders. These procedures are effective in **leading focused discussions**, structuring conversations, and ensuring that these discussions remain productive. By forming separate teams for each group, valuable encounters have taken place that have allowed for meaningful interactions, insights, and **critical understanding** of the topics discussed. However, there have also been some **challenges**.

One of the main difficulties is that the guidelines cannot always be strictly followed everywhere. They need to be adapted to the specific context of each situation. In addition, the facilitation of these discussions cannot be done consistently across all sites or by different types of researchers (with different disciplinary backgrounds). In fact, some researchers (with natural sciences or engineering backgrounds) highlighted the need for additional training on certain tools to ensure the process runs smoothly. In some countries, not in all, another problem is the frequency of the meetings and the repetitive nature of the discussions, which can be tiring for participants. Furthermore, if the turnover of participants is high, it becomes even more difficult to apply the method effectively.

It should be noted that our research teams present significantly different disciplinary backgrounds: in Finland, educational sciences; in Portugal, environmental sciences and engineers; in Romania, engineers; and in Spain, environmental sciences, engineers and social sciences. These **disciplinary differences, coupled with the socio-cultural context of each country**, influenced the implementation and reception of the participatory methods, leading to both unique strengths and challenges in each setting.

In Romania, where the technical background dominates, tools such as mind maps and oval mapping were particularly appreciated for their visual and structured nature. These tools helped to improve communication and creatively engage participants, although their effective use required preparation and familiarity. Challenges included the risk of marginalising less confident participants in large groups and the need for facilitation skills tailored to collaborative approaches.

In Portugal, the combination of environmental science and technical expertise emphasised the benefits of open debate and structured discussion. Short surveys were particularly effective in setting the tone of the sessions, although issues such as copying of responses by younger participants were noted. Teacher turnover and scheduling issues were cited as significant barriers, reflecting structural challenges in the education system.

In Spain, the combination of social sciences and engineering supported the focus on inclusivity and active participation. Students and teachers were encouraged to interact with each other as equals, using tools such as mind maps and post-it exercises to promote creativity and structured decision-making. However, the repetitive nature of the assessment questionnaires reduced the engagement of younger participants, suggesting a need for more dynamic approaches.

In Finland, the educational background of the research team facilitated the seamless integration of participatory tools such as mind maps, which were already familiar to the participants. This familiarity allowed participants to focus on the topic, which encouraged their critical engagement. However, the tight schedule limited the opportunity for open debate, which was otherwise highly valued to encourage deeper reflection.

In terms of the **specific tools** used during the workshops:

- **Deliberative workshops and open debates** are specially valued for encouraging all participants to express their views. These debates serve as an excellent platform for the development of creative ideas. Splitting the discussions into smaller groups before all participants come back together has proved particularly effective with younger participants, such as children, who might otherwise feel inhibited by the presence of teachers. In addition, debates on the results of previous sessions have proved engaging and useful for both participants and researchers. Despite these positive outcomes, challenges remain. It has been difficult to find the right balance between focusing on the topic at hand and allowing participants, especially children, to express their own ideas. There is also a risk of digression, and the tight schedules of the sessions have limited the time for open debate. One suggestion to improve the process would be to devote more time to these debates in future sessions.
- Another tool used in the workshops is the drawing of **mind maps,** which helps to make elements that are difficult to put into words more visible and easier to understand. This tool encourages free thinking and creativity through its non-linear structure and is useful for discovering connections between ideas. Students particularly enjoy this activity because it is engaging and somewhat playful, which improves their participation. Mind maps work best in smaller groups.
- **Oval mapping**, where ideas are written on post-its and then moved around the board to form clusters and hierarchies, has also been shown to be an effective way of focusing students' attention on key points. This method stimulates the generation of ideas and leads to fruitful reflection. At the same time, the participants have sufficient time to think about and reflect on the information.

- **Short surveys,** especially those on sustainability, proved useful in understanding the evolution of participants' ideas and setting the tone for the meetings. However, some of the questions were difficult for participants to answer and there were instances where children copied answers from each other or discussed their answers with friends rather than answering them individually. This has led some participants to favour group discussions rather than completing the surveys individually.
- The **evaluation questionnaire** used at the end of the workshops is easy to complete and allows participants to reflect on what they have learnt. However, some participants, particularly children, have found it repetitive and somewhat boring, especially as they have completed similar forms in the past. In some cases, participants even skipped questions or did not answer because they felt redundant. In addition, certain questions, especially the first one, could be misunderstood by the participants.

To summarise, the participatory process was successful in terms of promoting engagement, reflection, and deliberation on the interventions as well as on stimulating critical thinking. Creating spaces for interactions and discussions is specially valued by the research teams in ECF4CLIM. Even though there is still room for improvement, especially in terms of flexibility, time management, and sensitivity to the different contexts. Suggestions for improving the process include emphasising the flexibility of the process, improving time expectations by arranging meeting dates early, and allowing more time for open discussion. To this end, and in line with the principles of participatory action research, the methodological strategy will be adapted and iteratively constructed throughout the project.

5.2. Preliminary evidence on drivers and barriers

As mentioned above, our SCT/SCCs 3 & 4 encourage reflection on the ongoing interventions and on how they may affect sustainability competences in each demonstration site. In this section, we present preliminary findings on the impact of the interventions on individual and collective competences and, more specifically, on the drivers and barriers to such competences.

With regard to the interventions, for very practical reasons (i.e. available time at the SCT/SCC meetings) it was not possible to discuss all of them in each DS (which ranged from three to six depending on the site). Therefore, the research teams, in close collaboration with the DS representatives, selected the two or three that they considered most relevant or that they wanted to discuss at the SCT meetings. Table 3 shows the list of interventions selected for reflection in each DS.

Table 3. List of selected interventions by DS

Country	Educative Centre	Analysed Interventions (SCT3 & SCT4)
Finland	***Juhannuskylä school***	Vegan tasting and vegetarian food (SCT3)
		Engaging students and the whole school through awareness raising and positive behaviour campaign: Change goods recycling day (SCT4)
		Clean environment & promoting effective use of resources: Art supplies storage room rearranged [only teachers] (SCT4)
	Samke High School	Recycling (SCT3)
		Campaigning on sustainable transport [only teachers] (SCT4)
	University of Jyväskylä	Sustainability curriculum development work (SCT3)
Portugal	***Bobadela school***	Taking care of a river section (SCT3)
		Waste Separation Competition (SCT3)
	Camarate school	Quinta do Charco (SCT3)
		Waste Separation Competition (SCT3)
Romania	***Dragasani school***	Solar panels (SCT3 & SCT4)
		Educational programme on solar energy (SCT3)
	Sercaia School	Solar panels (SCT3)
		Educational programme on solar energy (SCT3)
	Mioveni High school	Infrastructure improvement: water sensors at sanitary rooms (SCT3 & SCT4)
		Educational programme on water saving (SCT3)
	Pitesti University	Course development: "Sustainability in the context of technological changes" (SCT3 & SCT4)
		Improvement of infrastructure: installing smart sensors to the water in toilets (SCT3)
Spain	***Mozart school***	Second-had market (SCT3)
		Umbralejo Field Trip (SCT3)
		Visit to the municipal composting and recycling plant & promotion of sustainable work in the school garden' (SCT4)
	Itaca High School	Action plan for the proper use of waste bins in the school (SCT3)
		Participation in environmental training programmes. Sustainability awareness (SCT3)
	Autonomous University of Barcelona (UAB)	Facilitate transversal learning spaces (SCT3 & SCT4)
		Improve thermal insulation (SCT3)

The interventions in Table 3 deal with different topics, ranging from environmental improvements (such as water or energy saving, renewable electricity production, sustainable mobility, improving biodiversity or waste management) to information campaigns and training activities on sustainability. Often, environmental interventions are linked to debates, discussions or exercises to be carried out in the classroom, with the aim of raising awareness and giving students the opportunity to reflect on their implications and consequences in terms of sustainability.

It is important to note that the initial expectation at some of our DS was that the environmental improvements could have an impact on the individual and collective

competences of pupils and schools. Let's see what the evidence says. To this end, we outline below the drivers and barriers for sustainability competences as identified in SCT/SCC 3 and 4.

5.2.1. Individual competences

In ECF4CLIM, we conceptualize **sustainability competences '***as the abilities to act in an appropriate way to achieve sustainability goals successfully and efficiently'.* This general definition applies to both the individual and the collective competences[2]. **Individual competences** refer to the '*development of a combination of personal qualities and qualifications', that is, the knowledge, skills, and attitudes that individuals need in order to achieve certain goals through their actions and activities* (Vare, 2022). In our case, such goals are *promoting sustainability and planetary wellbeing* (JYU, Wisdom community 2021). Individual competences are one of the three main aspects of our roadmap towards sustainability[3] and refer to *the **individuals' inner, personal qualities and abilities.***

We now present the range of factors that seem to promote or hinder sustainability competences from an individual perspective, based on the qualitative analysis of the SCT reports produced by the research teams at each DS.

→ **Drivers for individual competences**

Experiencing our hybrid participatory approach seems to be the main driver of individual competences for sustainability, especially among students. This includes factors such as group meetings, teamwork and collective discussion of environmental interventions and sustainability issues at the DS. Experiencing the co-decision process encourages students to think about sustainability (valuing sustainability) and helps them to realise that their involvement can change and improve things.

a) Participation in group discussions and teamwork

Participation in SCTs seems to have an empowering effect on students, increasing their sense of doing something for sustainability (collective action, individual initiative, in GreenComp terms). Students perceive teamwork as a form of action. In a way, the hybrid participatory approach helps to change perceptions, as what seemed impossible may now be possible.

> "After the intervention, some students are more aware of the power of a group to do something together". (Sercaia School, Romania).

[2] See D4.1 for the assessment of collective competences.

[3] See D3.3. for the development of an initial ECF

In some cases, even though the intervention did not work as well as desired, there was student engagement and satisfaction. This is well described in the SCT report from Juhannuskylä School (Finland):

> "Not everything went as planned. For example, the vegetarian market day at the primary school was a little different from what the children would have liked: it wasn't as big as planned and the group of children didn't have many days to prepare; it was done in one day, from baking to the end. Nevertheless, it was a successful day for the children. One pupil said: "I didn't think it was possible, but it was". This experience was also important for the teachers". (Juhannuskylä School, Finland).

Besides, participating in SCTs allows students to develop their own opinions and express them freely, while also facilitating the experience of being heard. This point is highlighted in several reports. For example, the SCT report from Bobadela School (Portugal), states:

> "Unlike previous SCTs, where students tended to copy three or four sentences that someone shared aloud and did not elaborate further, this SCT was different. Everyone wanted to talk, argue, and discuss each other's ideas. We believe this was due to their high level of involvement in the activities. Students expressed a sense of being able to communicate their thoughts to the research team while also feeling heard. This aligns with the idea that their opinions should be valued and acknowledged by teachers." (Bobadela School, Portugal).

A similar experience was reported at Mozart School (Spain), where, according to the SCT report, students became more aware of sustainability issues and adopted more proactive attitudes through their participation in established groups.

> "Students discovered their potential to save water and reduce CO2 emissions. They expressed their willingness to actively engage in the next edition of the second-hand market." (Mozart School, Spain).

b) Students' experience of communicating and being heard

Students expressed a strong sense of being able to share their thoughts while also feeling genuinely heard which aligns with the "action" dimensions of the GreenComp framework. On one hand, participation in small peer groups (with fellow students and no teachers) creates a safe space for students to voice opinions they might not feel comfortable sharing in other contexts. This environment fosters a broader exchange of ideas and deeper reflection, ultimately contributing to the enhancement of students'

competences. On the other hand, participation in plenary sessions with representatives from various sectors or entities (such as SCCs) enables students to feel heard by the educational institution. This has an empowering effect, encouraging greater involvement and a deeper understanding of the factors influencing the sustainability of the school.

> "Students expressed a sense of being able to communicate their thoughts to the research team while also feeling heard. This aligns with the idea that their opinions should be valued and acknowledged by teachers." (Bobadela School, Portugal).

c) Discussing intervention results and data in the classroom

According to the teachers involved in the SCTs, one of the most effective strategies for enhancing individual sustainability competences among students is bringing the results and data from interventions into classroom discussions. This approach facilitates the assessment of sustainability, aligning with the GreenComp framework.

> "The discussion of these data within the framework of a subject or during a debate organized specifically for this purpose serves to enhance the students' skills." (Bobadela School, Portugal).

> "Teachers state that understanding the value of results (such as electricity savings, increased school knowledge, and sustainability awareness) helps students' better grasp the complexity of sustainability and improves their knowledge of the topic." (Dragasani School, Romania).

d) Performing activities outside the classroom

Engaging students in learning activities outside the classroom significantly enhances their interest, motivation, and knowledge—at least according to the teachers' perspectives.

> "This type of free, home-based activity outside of school leaves a lasting impression on students and helps shift their thinking and attitudes." (Bobadela School, Portugal).

At Camarate School (Portugal), one of the interventions led to the creation and arrangement of a natural space near the school, *Quinta do Charco*, aimed at enhancing biodiversity and serving as both an educational and recreational space. According to the teachers, students expressed a strong desire to actively participate:

> "(...) They want to use the space in the future not only for classes but also for leisure. They also want to take care of the space. The area acts as a vehicle for teaching about nature, sustainability, and responsibility." (Camarate School, Portugal).

→ **Barriers for individual competences**

In this section, we report on individual barriers that are primarily rooted in the human nature of the individuals involved in our SCTs. However, it should be noted that many of these barriers also have a collective, organisational or contextual nature, which will be analysed in the following section.

a) Individualistic thinking

Students often tend to attribute sustainability deficits to the poor attitudes or behaviours of others, rarely acknowledging contextual barriers.

> "The children focused mainly on individual skills and not so much on collective ones. They talk a lot about wrong attitudes or lack of knowledge on the part of some members of the school community, especially other students." (Bobadela and Camarate Schools, Portugal).

b) Age group

According to the SCT reports, younger students tend to show higher levels of attention and interest in sustainability issues.

> "The influences will have an age-driven effect, as attention and interest seem to be higher for younger students." (Mioveni High School).

However, as students grow older, it appears increasingly difficult to engage them in sustainability topics, even within the SCTs. In the case of the universities involved in the project, establishing long-term discussion groups proves especially challenging. Students' motivation declines rapidly as their schedules fill with numerous academic and extracurricular tasks. As will be discussed in the next section, several contextual factors contribute to these challenges, particularly in relation to collective competencies.

c) Students' Habits and Preferences

In some cases, lack of reading habits among students emerges as a barrier to engagement with sustainability issues.

> "Some students do not like to read too much, which prevents engagement. Even if the material is very interesting, some students will ignore it because they simply do not like to read." (Dragasani School, Romania)

Interventions involving contests and awards seem to work well in many cases. However, it is observed that some students' interest is driven more by the attractiveness of the award than by the sustainability goals themselves.

> "The implementation of one of the interventions was based on the design and application of the regulation of flags, through which students observe how habits are changing. As a result, many feel that at the group level, they are gaining a culture of waste management through participatory learning. This regulation, implemented by the environmental coordinators, involves the entire class. However, some students complain that they do not want to recycle mainly because they do not find the award sufficiently attractive. They confessed that a significant part of their interest lies in the appeal of the reward." (Itaca High School, Spain)

While this approach promotes sustainability through "collective competencies," it also affects the acquisition of individual competencies. It highlights that certain individual factors determine whether reward-based strategies succeed with some students but fail with others.

d) Teachers' resistance

Individual actors that hinder the development of sustainability competencies are also observed among teaching staff. Several SCT reports highlight the presence of teachers who personally resist adopting new and innovative practices, thereby limiting progress toward sustainability. This resistance is often attributed to the entrenched routines common in educational institutions, which are notoriously difficult to change. This observation points us toward collective competencies, where we find the factors that sustain routines that fail to adequately address sustainability. According to our analysis, collective competencies appear to represent the primary constraints to the development of individual sustainability competencies. These factors are explored in the following section.

5.2.2. Collective competences

In ECF4CLIM we conceptualise collective competences as the set of enabling and constraining characteristics that condition the ability of a community or organisation to function in a way that promotes sustainable development and to prepare younger generations for behaviours that promote such a goal. We have identified three types of collective competences:

- Regulatory competences (external to the organisation: Derived from written rules (laws, regulations) that specify how sustainable development is to be considered and promoted - and by whom.

- Normative competences (internal to the organisation): Norms and values reflected and institutionalised in the organisation's own strategies, action programmes, plans, guidelines, performance agreements with authorities at different levels of government, etc.

- Cultural-cognitive competences: related to the internalisation of regulative and normative competences as taken-for-granted social norms of normal and acceptable behaviour; translation of regulative and normative competences into the organisation's operating culture, daily routines, habits and practices, e.g. schools.

→ **Drivers for collective competences**

The main drivers for collective competences relate to the profiles of the teachers, the schools and the interventions carried out in our DS. In addition, the characteristics of our hybrid participatory approach to promote reflection and support the co-design of interventions seem to facilitate progress towards sustainability competences (from a collective point of view).

a) Teacher profiles (interdisciplinarity, motivation, commitment)

Motivated teachers, predisposed to work for sustainability, emerge as a key driver for the development of the interventions and, therefore, of sustainability competences in the demonstration sites. Although they seem to be a minority in each school, they are quite active. They tend to come from a variety of disciplinary backgrounds, which is very positive for the development of sustainability education activities. The most involved teachers frequently have an interdisciplinary profile.

> "Different teachers have different strengths: some come up with a lot of ideas, others are good at concrete practical things. Different teachers are in charge of different interventions, and they come from different disciplines: maths, physics, chemistry, languages, biology, geography, history, primary teachers, special education, social studies, student counselling. The point is that whenever someone asks for help there are always volunteers". (Juhannuskylä School, Finland).

One way to increase interdisciplinarity among teachers is to organise training courses on sustainability. When tried, it seems to have worked well.

> "The sustainability training was important for the person in charge of the teacher team. (Juhannuskylä School, Finland).

There are always (a few) teachers who are able to involve not only pupils but also their families. This supports the promotion of sustainability competences.

> "This team involves both students and parents, not just teachers." (Juhannuskylä School, Finland).

b) School profiles (leadership, commitment, new rules, network membership)

Teachers' leadership and commitment especially that of the headteacher, is key to promoting sustainability in the demonstration sites.

> "A good team leader who keeps reminding us of these things is important." (Juhannuskylä School, Finland).

Some interventions have succeeded in establishing new sustainability rules shared by the whole educational community (e.g. in recycling competitions, water saving, etc.). This helps not only the development of the intervention but also its maintenance over time.

> "It requires a rethinking of resources: how to save water for irrigation, what to plant in the garden and what to do with these vegetables, among other things. It will be a space that can be part of the curriculum of the special education class, for which there will need to be well-established rules and regulations". (Camarate School, Portugal).

> "They [the students] highlighted very clearly that the main driving force for them to implement a waste management procedure was the establishment of rules". (Itaca Secondary School, Spain).

In other cases, it has not yet been possible to create new rules, but the intention is to institutionalise some of the activities carried out in order to make them permanent or periodic. In a way, the institutionalisation of interventions, even if only partial, is an indicator of change in the organisation, showing progress towards sustainability.

> "They [the students] clearly emphasised the need to institutionalise the activity." (Mozart School, Spain).

The school's membership of green school networks (e.g. eco-schools) facilitates the development of and commitment to sustainability activities. In fact, several of the demonstration sites seem to engage with the interventions and the SCTs and SCCs

precisely because they want to join these eco-school networks or because they are looking for ways to stay in them.

> "This action is used to create curriculum content. The school and its community, as long as they are members of the UNESCO Blue School Programme, are responsible for this stretch of river. This responsibility contributes to changing values and strengthening the culture of sustainability in the school". (Bobadela School, Portugal).

> "What stood out was the fact that the school is involved in several environmental projects (including ECF4CLIM) and is an eco-school, which opens the door to raising awareness among more people". (Camarate School, Portugal).

> "Trying to achieve the goals of the Green School is a good enabler" (Dragasani School, Romania).

> "Green week (school event)". (Dragasani School, Romania).

> "Becoming a recognised prosumer school can influence a lot in its modernisation (the economy will be a driver), but also the reduction of the carbon footprint will support our efforts to become a green school (to be certified as a green school)". (Sercaia School, Romania).

c) The nature of the interventions

According to the SCT and SCC reports, some of the interventions could influence (and even help to change) teaching practices. For example, demonstrative interventions could help to set realistic priorities because of the measurability of the impacts.

> "Teachers understand the limitations of resources (money, time, staff) and need to think more about prioritisation. The interventions can help for a realistic prioritisation as impacts can be measured (instead of a rough estimation)". (Dragasani School, Romania).

> "The solar panels and the recognition of the school as a pro-summer can help a lot, not only to reduce the environmental impact, but also to extend the infrastructure intervention." (Dragasani School, Romania).

Another element that seems to help promote sustainability competences is the complementarity of different interventions in the same centre. These are usually a variety of interventions in different spheres: individual, collective or environmental.

> "The two interventions are related; the educational material and the structural intervention become complementary. The coupling of the educational material with an already implemented measure (solar panels on the canteen roof)". (Dragasani School, Romania).

d) ECF4CLIM Hybrid Participatory Method

Our hybrid participatory approach promotes inclusiveness (freedom to think differently) and participatory learning, both of which are crucial for fostering sustainability competences.

> "It's also important that you can say if you think differently about something or if you just don't have time for something right now." (Juhannuskylä School, Finland).

> "Teachers are aware of the need to prioritise in the context of limited resources (money, time, staff...). Discussions in SCTs/SCCs are important for understanding different perspectives and setting priorities. The step-by-step approach of the interventions confirms priorities and adapts to existing constraints". (Sercaia School, Romania).

As mentioned in the section on the drivers for each competence, discussions in small peer groups allowed students to speak more freely. In addition, mixed groups (consisting of students, teachers and other stakeholders) ensured that students felt heard.

> "Students focused more on criticisms and barriers than on facilitators and what went well. The fact that they don't have teachers nearby allows them to express everything they feel and want differently, which (according to the research team) could indicate that there should be more communication between students and teachers in order to improve the activities". (Bobadela School, Portugal).

The method also facilitates the involvement of external actors (e.g. NGOs, city councils, neighbourhood associations) who can play a key role in sustainability by promoting systems thinking, making connections and embracing complexity.

> "Two teachers receive financial compensation for their responsibility in leading the teacher-student teams". (Samke High School, Finland).

> "The school management assured the Municipal Council of Loures that it would have a maintenance plan for the space for the coming years, which was considered essential. The Parents' Association also expressed interest in working together. (Camarate School, Portugal).

> "The existence of this space and its maintenance over the years will reinforce the school's values and culture of sustainability. It will require the responsibility of the whole community, from the students to the school board. This approach facilitates participatory learning for the whole community, while also involving external actors". (Camarate School, Portugal).

> "We hope to influence the awareness, attitudes and knowledge of the local community about solar energy". (Sercaia School, Romania).

The economic and organisational resources provided by the ECF4CLIM project (including the time devoted to sustainability) have been crucial in fostering sustainability competences.

> "ECF4CLIM provides resources by buying time for teachers. Working on this project has not taken up any of the school's other scarce resources. Otherwise, everything done in this team would have been unpaid overtime. Resources for longer team meetings and substitute teachers during the meetings have also been very valuable". (Juhannuskylä School, Finland).

> "The most mentioned obstacle against the intervention was the lack of funds for investments, but this was overcome by the support received from the ECF4CLIM project." (Sercaia School, Romania).

> "Without adequate planning and logistics, the experience may not take place, and even if it does, it could have a limited impact on the individual competences of students, teachers and staff." (Mozart School, Spain).

> "Pupils focused more on criticisms and barriers than on facilitators and what went well. The fact that they don't have teachers close by makes it easier.

→ **Barriers for Collective Competences**

Despite factors that support sustainability competences among students and teachers, a number of interrelated barriers hinder progress towards sustainability. These include lack of time (for both students and teachers), insufficient teacher commitment, institutional resistance to change, low prioritisation of sustainability in schools, excessive teacher turnover, difficulties in connecting classrooms with external communities (e.g. neighbours, families) and a generally unsustainable societal context.

These barriers are analysed below, based on the SCT and SCC reports.

a) Time constraints

Time constraints are one of the most common barriers across all demonstration sites. They affect students, teachers and school organisations as a whole.

> "It would be important to have less teaching hours for the person in charge - even if the project pays for extra hours, time is limited and you also have your own family". (Juhannuskylä School, Finland).

> "Tight schedules and students with no time for extra-curricular activities due to sports training. (Samke High School, Finland).

> "Teachers, on the other hand, mentioned the lack of time for extra-curricular activities (...) as a clear obstacle". (Camarate School, Portugal).

> "The very full schedules of teachers and staff leave little time for other tasks." (Dragasani School, Romania).

> "The very full schedules of teachers and staff leave little time for other tasks. (Dragasani School, Romania).

b) Involvement of teachers beyond the minority already involved

A key barrier is the lack of teacher involvement beyond the motivated minority. Widespread teacher involvement is crucial for the implementation of interventions and the active involvement of students. However, overcoming this barrier is challenging. Teachers who lead by example can communicate that sustainability is important for the school.

> "One of the teachers argues that it is best to involve other teachers first. It's not clear that most of the teachers in the school involve the pupils in the intervention (market). This teacher believes that they need to involve more teachers first so that they can explain to their pupils that this market is important. She also believes that participating in the exchange as a teacher helps to make connections between the Second-Hand market and its importance for the school". (Mozart School, Spain).

> "There is a lack of teachers willing to go to Umbralejo (...) Lack of monitors." (Mozart School, Spain).

> "According to what the students shared, the group of teachers involved in these activities is very limited, although highly motivated. The rest of the teachers may be aware of the action and have opinions to share, but they do not effectively contribute to it". (Bobadela School, Portugal).

c) The Rules of the Center (Resistance to Change)

Changing the unwritten rules of a school is a challenge. Efforts to persuade more teachers to prioritise sustainability have often been met with suspicion or limited success. There is still a belief that sustained interventions over time could gradually bring more teachers on board.

> "One of the goals of Juhannuskylä School is to influence teachers' attitudes. This is a big goal, but also a kind of taboo. We have not done much for this goal. This goal could also be achieved in a hidden way when teachers take part in events created by the team". (Juhannuskylä School, Finland).

> "Interventions should not be organised during lessons: Many things have to be organised by the teachers, and for example the vegetarian food competition couldn't be attached to the daily lessons". (Juhannuskylä School, Finland).

> "Teachers understand the resistance to change, even among educators. It is easier to stay and imagine many obstacles than to act". (Dragasani School, Romania).

> "Resistance to change is evident in all segments of the educational community and the local community. There is a tendency to stay within the known boundaries of existing infrastructure, technology or habits". (Sercaia School, Romania).

> "Students are aware of the resistance to change, even when awareness is reached. Therefore, more efforts are needed to create the conditions for collective action (perceived as crucial to create the conditions for change)". (Pitesti University, Romania).

The SCT reports indicate that even when the ECF4CLIM project can count on financial resources, resistance to changing the academic curriculum is very strong. In some cases, focusing the intervention on this issue has led to paralysis.

> "The first impression at the beginning of the cooperation with the sustainability education officer at JYU was enthusiasm - as we were additional resources for the work on sustainability curriculum development, but as the cooperation with the faculty curriculum development staff was challenging and did not work as expected, the attitude changed and the cooperation did not continue". (University of Jyväskylä, Finland).

> "The staff working with curriculum development in different faculties were not interested in us bringing expertise to their work. They were busy and struggled with

> lack of time; they did not see our facilitation or advice as relevant to them. They did not ask for it. We had no direct contact with them. (University of Jyväskylä, Finland).

Educational centres tend to have other priorities, with sustainability being a secondary objective or pushed aside in favour of other more pressing issues. Institutional changes contribute to the diversion of attention away from sustainability (e.g. two universities merging), so that the priority of sustainability is relegated to current decisions to be made).

> "Sometimes the school has other priorities than sustainability. Many priorities compete with sustainability. " (Dragasani School, Romania).

> "The staff expressed their opinion about other priorities of the university, especially to harmonise the functionality in this new administrative status (shift from UPIT to UNSTPB). The priorities should be re-analysed and future decisions will take such considerations into account. " (Pitesti University, Romania).

> "They [teachers] mentioned the current policy as a driver for sustainability, but the implementation is hindered by the current context (lack of knowledge, difficulty to cooperate to merge efforts, orientation of the school towards exams)." (Dragasani School, Romania).

Moreover, it is difficult to link the interventions to the classroom activities. It is known that when this happens it can make a great contribution to sustainability competences, but it is not always possible. In fact, it is very difficult due to the excessive and rigid compartmentalisation of subjects and curricula.

> "Interventions cannot be organised during lessons: A lot of things have to be organised by the teachers, and for example the vegetarian food competition couldn't be included in the daily lessons. (Juhannuskylä School, Finland).

> “The curricula are very full; it is very difficult to add other elements". (Dragasani School, Romania).

In some cases, the centre's lack of interest in changing the academic curriculum may be related to the urgencies resulting from funding restrictions.

> "The financial resources for teaching have been reduced, so the faculties try to minimise their time spent on curriculum development and have no time for extra/new courses." (University of Jyväskylä, Finland).

The lack of a network of contacts within the centre could be another serious barrier (coupled with lack of time, resources and interest). As the Finnish research team states:

> "ECF4CLIM support to promote sustainability competences should not be advertised and offered to all faculties in general, but to personal contacts with people whom our contacts know beforehand. It was a big problem to involve people without the interest or the time to collaborate, but with very tight work schedules. The problem was collective competences - lack of time resources and lack of networks, as we were new researchers at the university. (University of Jyväskylä, Finland).

d) Excessive student and teacher turnover

An important obstacle is the excessive turnover of pupils in our SCTs. This makes it difficult to discuss the ongoing interventions. This is mainly due to the way the school dynamics work within the demonstration sites, where students have a variety of tasks and are not always able to achieve as much as they would like.

> "The students did not have strong opinions about this phase of the project or the meetings with other colleagues. They gave positive feedback but did not identify any barriers or drivers. The barriers and drivers that were discussed were broader, focusing on the whole intervention and its success. On the one hand, this makes sense, as most of the students were not part of the groups with which the activities took place before". (Camarate School, Portugal).

> "Since there was a lack of information for a few months, most participants spoke about the intervention in a more general way, with the exception of the two teachers who are involved in the whole process". (Camarate School, Portugal).

> "The participating students have changed considerably from last year to this year. This has prevented continuity in the follow-up of the planned interventions". (UAB, Spain).

The same happens with teachers. A specific reason that prevents teachers' involvement is their high turnover, as many of them have temporary contracts and change schools regularly. This makes it difficult to set up coherent long-term projects such as ECF4CLIM.

> "Temporary contracts for teachers are a problem. Three teachers in SCT do not know if they will have a job next year". (Juhannuskylä School, Finland).

> "Because there was an information gap for a few months, most of the participants spoke about the intervention in a more general way, with the exception of the two teachers who are involved in the whole process". (Camarate School, Portugal).

e) Difficulties in involving other stakeholders (such as families or neighbours)

The school sometimes finds it difficult to communicate with other stakeholders and involve them in sustainability activities. It is difficult to get information flowing and the relationship with external actors is not easy. This can be an obstacle to promote sustainability competences, as transdisciplinarity becomes a key issue.

> "Communication with parents is difficult, but not only when it comes to the Second-Hand market (one of the interventions at the school). There is an App to communicate with parents, but it's not a success. The teachers agree that parents are "too busy" to be aware of what is happening in the school. That's why they decided to postpone the next flea market". (Mozart School, Spain).

> "They [the teachers] are aware of the general context of greening, global warming, creating green schools (as a basis for future education). However, there is a local resistance to change, which comes from the local community's habits. (Sercaia School, Romania).

f) General context (social, economic, political) adverse to sustainability

The SCTs also refer to the difficulties of teaching and living in an unsustainable society. In this sense, society outside the school is perceived as an obstacle, as well as politics and politicians, who tend to create a framework that is unfavourable to sustainability.

> "The pupils' opinions integrate the context of the school, the city and society. They criticised the inaction and false actions of politicians and some groups". (Sercaia School, Romania).

> "Pupils understand the context of modern society; there are different forces for and against sustainability. More awareness and empowerment are needed. (Pitesti University, Romania).

g) Lack of technical training

In some cases, a lack of specialised information or technical knowledge is cited as an obstacle to the development of interventions and therefore to their sustainability. This is particularly true for environmental interventions.

> "Lack of information, such as some technical misunderstandings, fear of maintenance, fear of bureaucracy in the case of a pro-summing option (solar panels)". (Dragasani School, Romania).

"The lack of knowledge (how to do it) was mentioned as another constraint, together with the low level of confidence in technological changes." (Sercaia School, Romania).

"It was not possible to carry out certain activities due to the lack of technical staff with sufficient knowledge and time to install certain equipment (sensors, etc.)". (UAB, Spain).

5.3. Reflecting on the roadmap: engagement

At the SCT3 meetings, participants were asked to reflect on "how to engage" people in sustainability in their schools or universities. Engagement is one of the main dimensions identified by GreenComp and in our Roadmap. To this end, each DS chose one intervention (the one they considered most relevant) and the participants discussed the engagement of the different actors of the educational community: who had participated, with what intensity, who should have been there, what was the result, etc.

In most cases, engagement emerges as a crucial issue for the success of our interventions. Otherwise, it would be very difficult for such interventions to change or improve the sustainability competences of the students and the school or university. They could improve environmental sustainability, but without affecting pedagogical competences.

The analysis of the SCT3 reports allowed us to draw the following conclusions. As there are considerable differences in the engagement of students, teachers and staff, we have divided the presentation of the results according to the profile of the participants.

5.3.1. Engaging students in sustainability

The project identified several factors that facilitate and/or hinder student engagement in sustainability interventions. Firstly, student engagement was quite high in all cases, although it was not always possible to involve the right number of students or the desired types of students. In addition, it is often difficult to maintain student interest and motivation over time.

"Students are very keen to take part. They are convinced of the value for education and they will try to contribute". (Mioveni High School, Romania).

"Students seem to be really involved in a process to improve sustainability. Even if they are not very communicative, sometimes shy, they show a real reflection on the problems". (Sercaia School, Romania).

> "Some of the students (about half) were really involved in the process, the others seemed to be more passive. (...) The engaged students are mainly interested in future jobs". (Pitesti University, Romania).

> "The challenge will always be to keep people involved for a long time and to convince other members of the school community who do not participate in school activities beyond their compulsory work". (Camarate School, Portugal).

According to our empirical evidence, the following aspects are critical to improving engagement.

a) Social relations between students

Pupils are encouraged to participate if their friends participate. Participation is a collective phenomenon. Social relations are key motivating factors for students.

> "We promoted reflection on motivational profiles and found out how teachers' and students' motivational profiles differ - how peers & social relations are very relevant for students". (Samke High School, Finland).

There is close collaboration between students from different disciplines around the same sustainability project:

> "A significant part of the intervention depends on the work and collaboration of students from other faculties (e.g. architecture). This dependency is perceived as both a driver and a barrier. While the students' availability and enthusiasm are assets, their lack of professional experience and their academic commitments are challenges". (ITS University, Portugal).

There are interventions that can bring together students from different schools:

> "Umbralejo [an educational mountain village where students have gone on excursions] is perceived as an opportunity to interact not only with peers and teachers (you leave together in an unusual way), but also with children from other schools." (Mozart School, Spain).

b) The opportunity to have a voice and a choice

Having a voice emerges as one of the main drivers of engagement. Engaged students expect their voices to be heard and their suggestions to be taken into account. There is evidence that working in a team helps students to feel that their opinions are relevant and that they are valued by others (SCC3).

> "It is important for the participants to talk to each other and find solutions together; they feel that their opinions are relevant and valued by others. There is a feeling of group and unity working together for the sustainability of the school, and, this way, interventions like this, with complicated logistics, are successful and last over time." (Bobadela School, Portugal).

Related to this, the perception of a real ability to influence the decision-making process is crucial in terms of commitment.

> "In our SCT3, participants felt that their opinions were relevant and valued by others, and that their ideas would ultimately improve the next edition of the Second-Hand market and therefore the sustainability of the school." (Mozart School, Spain).

Tailoring activities to pupils' schedules and interests seems like a good idea. In fact, there are different individual interests among the students that need to be reconciled, and the hybrid participatory process in the ECF4CLIM project has made it possible

> "Enabling students' involvement: adapting the group's action plan to the limited time and students' interests. Inviting friends to participate". (Samke High School, Finland).

In this context, the experience of having a good time is very stimulating and helps to keep students engaged. Interventions and activities should be designed with this in mind.

> "In particular, having fun emerged as a driver for engagement." (Mozart School, Spain).

c) Breaking the classroom routine

Interventions that break the classroom routine seem to be successful in terms of student engagement.

> "They [students] consider this type of intervention as a different way of learning, which, by getting out of the daily routine of the classroom, makes them more motivated and attentive to get the most out of the experience." (Itaca High School, Spain).

There are different ways to break routines. One is to organise activities outside school (excursions, visits to places of interest, etc.). Another is to introduce challenges and competitions into the school dynamic. Competitions, prizes and awards can stimulate pupils' engagement.

"The competition associated with this intervention has led to a high level of student engagement (according to the teachers)". (Bobadela School, Portugal).

"They [the students] stressed the strong influence of the prize (for better recycling) as a motivational aid." (Itaca High School, Spain).

"This recycling competition is perceived as an opportunity to engage with colleagues, teachers and staff (...) They [the students] also believe that the more colleagues participate in the competition, the easier it is for them to continue recycling in their daily lives and to take these lessons home." (Camarate School, Portugal)

Visits to nature parks, forests or places of environmental quality could help students to engage with nature and foster a sense of being part of it.

"There are interventions that have helped students to feel part of nature." (Mozart School, Spain).

5.3.2. Engaging teachers in sustainability

Effective engagement strategies include not only encouraging student participation, but also ensuring ongoing support from teachers and staff. In general, students tend to be more willing to participate. The most challenging is involving teachers (beyond the minority who are already convinced).

"Without greater commitment, more and better communication and more motivated teachers willing to collaborate (students say there are few), the activity may work because students will always make the request, but it will have no effect on their attitudes and future ways of thinking." (Bobadela School, Portugal).

"The wider involvement of teachers, beyond those directly involved in the SCTs, is the crucial point." (Mozart School, Spain).

"The wider involvement of teachers, beyond those directly involved in SCT, is the critical issue. Teachers often mentioned that it is difficult to involve more colleagues and that they do not show interest. They even avoid asking about the interventions because they don't want to be invited to participate". (Camarate School, Portugal).

"The involvement of teachers is modest, with the exception of the teacher in contact with ECF4CLIM. It seems that they have other priorities; they are very busy and not open to make special efforts for sustainability". (Pitesti University, Romania).

The challenge is to keep people involved for a long time. Some teachers were very involved at the beginning, but after a short time, they stop or other priorities come up.

> "Teachers played an important role in the first phase of the project, known as "Semana Relâmpago". Since then, however, their involvement has diminished. This is an obstacle" (ITS University, Portugal).

There are cases where teachers have been more involved. Perhaps this reflects different organisational and academic cultures between countries and/or demonstration sites.

> "The discussion reflects a good engagement of all teachers. They are convinced of the value of working with ECF4CLIM and teacher involvement is seen as a key step. Even if there are some time constraints (busy schedule of the school) they are eager to contribute". (Dragasani School, Romania).

> "Teachers' commitment seems to be at a good level. They expressed their willingness to contribute to the improvement of the educational material, to test it and to use it to create some new lessons". (Sercaia School, Romania).

→ ***Suggestions for improving engagement:***

The reports contain a number of suggestions for increasing teacher engagement. For example, creating a context that promotes mutual support among teachers is a good way to encourage their involvement in sustainability projects. It is also good to ensure that everyone finds his or her role in the whole, which requires good team coordination.

> "A good atmosphere, support from colleagues, finding a personally suitable role and tasks within the group are good conditions for teachers' involvement. (Juhannuskylä School, Finland).

It seems that the creation of working committees or commissions in educational centres consisting of several teachers (in addition to pupils and staff) can be a good strategy. Clear leadership is needed to make them dynamic in the long run.

> "Effective engagement strategies should aim to create a cohesive and motivated team committed to the common goal of advancing sustainability projects within the university." (ITS University, Portugal).

In some cases, the participation of some of the most involved teachers has been rewarded (financially) to ensure that they can devote time and effort to promoting sustainability.

> "Good atmosphere among teachers. Two teachers receive financial compensation for their responsibility to lead the teacher and student teams". (Samke High School, Finland).

In short, the commitment of teachers does not only depend on their more or less predisposition, but above all on organisational and institutional factors related to the culture of the education centre. However, their commitment can be strengthened by seeking mutual support and resources to get involved.

5.3.3. Engaging school staff in sustainability

The commitment of the staff is important, with a plus for the principal. Principals should be supportive of the project and committed to its success.

> "The discussion reflects a fair engagement of the staff, with a special interest of the principals." (Dragasani School, Romania).

> "The involvement of the staff is significant, with a plus for the principal. They are aware of the importance of the educational material to have more impact in relation to the solar panels. (Dragasani School, Romania).

> "Separating waste and sending it for recycling may seem simple, but it requires several steps and involves several actors within the school. Everyone has to be involved and take responsibility. (Bobadela School, Portugal).

After the start of the interventions, staff seem to be more willing to get involved.

> "The administrative staff is very involved. After the implementation of the solar panels, they are more confident in the interventions. They appreciate working with the ECF4CLIM team. It seems that they are determined to contribute more". (Sercaia School, Romania).

The commitment of the staff is fair, with a particular interest of the principals. The principal is most interested in the values transmitted by the educational programme. Sometimes they make their future support dependent on seeing the results of the project.

> "Adequate commitment of the staff to this action. The principal is most interested in the values transmitted by the educational programme". (Mioveni High School, Romania).

> "The engagement of the staff is fair, with a special interest of the principals. (...) There is an interest in longer term cooperation, but depending on the real results". (Pitesti University, Romania).

In some cases, the director's position is more ambiguous, which reinforces the idea that his commitment is essential.

> "The principal, although always interested and open to ideas, has an authoritative attitude. For every issue raised, the director responds with a counter-argument and tries to quickly refute any criticism". (Bobadela School, Portugal).

Replicating (and institutionalising) the interventions would stimulate the engagement of the wider educational community.

> "The students felt that the market should be institutionalised: holding it regularly could help to increase the involvement of the whole educational community." (Mozart School, Spain).

However, engagement requires a good organisational capacity on the part of the school management, something that cannot be improvised and should be well planned, with adequate resources and well distributed responsibilities.

> "This school is full of projects and initiatives that show interest and willingness to participate, but it seems to us that there is sometimes a lack of organisational capacity. Communication needs to be improved". (Bobadela School, Portugal).

One of the things that good organisation and planning should address is time allocation. Lack of time and very tight schedules are recurring problems at all demonstration sites.

> "Lack of time and very tight schedules are the main collective challenge." (Samke High School, Finland).

> "It was a big problem to involve people who have no interest or time resources for collaboration, but very tight working schedules." (University of Jyväskylä, Finland).

5.3.4. Engaging actors outside the school

Throughout the group discussions of the SCTs, the need to extend sustainability beyond the boundaries of the DS is a recurring theme. Sustainability is perceived as something that needs to be linked to its social and territorial context. Therefore, other local actors,

external to the school, should be involved to effectively carry out educational sustainability projects.

> "Engaging with external actors, integrating their views and needs is crucial; without their active involvement, this intervention cannot happen. Communication and cooperation with other institutions is essential". (Mozart School, Spain).

> "This activity involves the whole school, including students, teachers, staff, school management and parents' associations. And only by involving all these actors from the beginning will there be a sense of belonging that will lead them to maintain the space for many years to come". (Camarate School, Portugal).

> "Involvement is seen in three ways: (1) the educational community of DS (students, teachers and staff), (2) parents, citizens and decision makers, (3) other schools. All of them are considered crucial to transform the intervention into a more fruitful one". (Dragasani School, Romania).

Involving families seems to be one of the key objectives.

> "It is important to involve the parents so that the students do not lose what they have learned at school at home. Communication and collaboration are important". (Camarate School, Portugal).

Local authorities should also be involved in the process of promoting sustainability in education.

> "There is a determination to use the DS to convince local decision-makers for better support in the activities to improve the sustainability performance of the school". (Mioveni High School, Romania).

Other schools in the area are also key actors to be involved in the interventions, especially in order to disseminate the experience and replicate it in other educational centres.

> "The involvement of the school community and external bodies is essential for this intervention". (Bobadela School, Portugal).

In some cases, the different actors (from the educational community and the territory) have been involved in thinking about how to extend the experience to other schools in the area (and perhaps to municipal buildings).

> "This involvement is seen as very important in order to move from the demonstration phase to widespread implementation. The SCC provided an opportunity to share experiences of implementing similar interventions in different contexts. The solar panels were implemented in Dragasani (small town) and Sercaia (village) with some specificities in terms of the size of the educational communities, the relationship with local stakeholders and the involvement of parents". (Dragasani school, Romania).

In some cases, there have been difficulties in organising interventions outside the school, as it is necessary to coordinate with other bodies that cannot always adapt to the needs of the school.

> "At the external level, the continued commitment of the Umbralejo institution is essential. If they do not facilitate planning and logistics, it will be very difficult for the school to continue with future editions of this experience". (Mozart School, Spain)

5.4. Reflecting on the roadmap: connections

"Connections" is step 2 of our roadmap to sustainability and links with the GreenComp competence area "Embracing complexity in sustainability". In schools and other educational institutions, everyday life flows through isolated situations and the holistic nature of issues is difficult to grasp. Without recognising the connections and underlying assumptions, it is impossible to find the root causes and frame the problems in a satisfactory way. To collectively define the problem (How to frame the problem?), it is also important to understand the different perspectives on sustainability and how our context and cultural background shape the way we see the problems and our knowledge about these issues.

To encourage further reflection and deliberation, participants in SCT4 engaged in a creative exercise to understand the systemic nature of sustainability activities. The aim of this exercise is to think together, to make visible connections and different perspectives to sustainability, to elevate collective understanding of the problems and possible ways to change the situation through interventions

- → What kind of issues have impact on or interfere in the intervention and its object? How they have an impact? Why?
- → How are the interventions and their aims interconnected and connected to different challenges and stakeholders?

Participants created a mind map together in a big paper or a board, using words, colours, and pictures. They also take a photo of their collective drawing.

At the time of writing, the SCT-4s were still on-going at some demonstration sites, so the analysis is based only on the DS in Table 4:

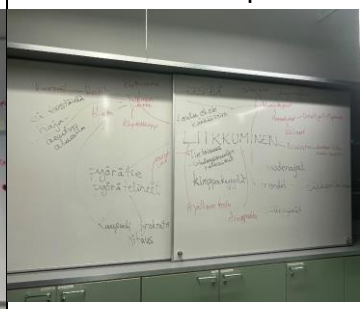
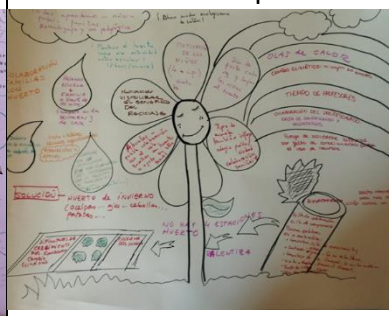
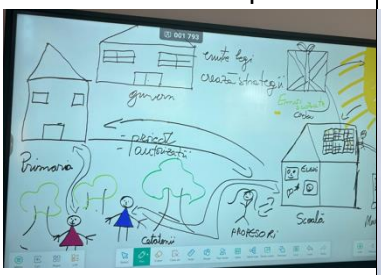
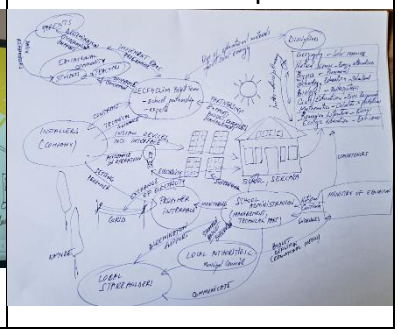
Table 4: Analysed interventions from the 'connections' perspective according to the available SCT-4 reports.

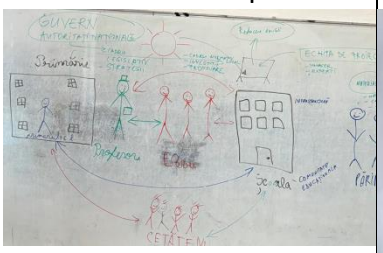
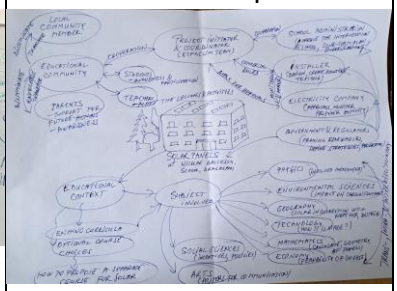
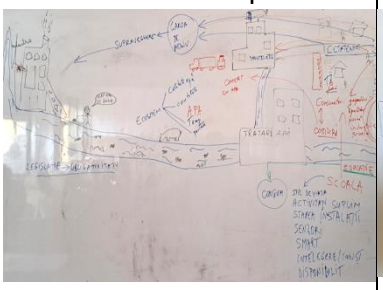
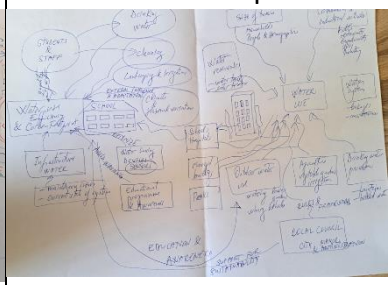
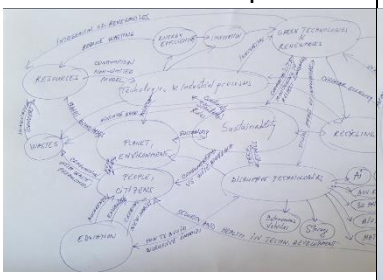
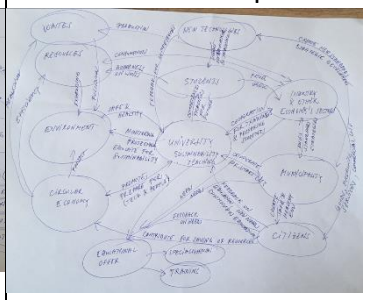
Contry	Demonstration site	Intervention analysed
Finland	Juhannuskylä School	Changing goods recycling day
	Samke high school	Sustainable mobility at school
Spain	Mozart School	Composting, recycling and school garden
	UAB	Training course on ecosocial crisis.
Romania	Dragasani School	Solar panels installation
	Sercaia School	Solar panels installation
	Mioveni School	Water saving
	Pitesty University	Training course on "Sustainability in the context of technological changes"

Table 5 shows the mind maps collectively produced at each demonstration site. In some cases, it was not possible to get teachers and staff together at the same time, so they were interviewed individually. In such cases, there is no collective mind map.

Table 5: Mind-maps by demonstration site and profile participants

Country	DS	Mind maps	
Finland	Juhannuskylä School	Students' mind map: 	There was no group discussion among teachers & staff. Individual interviews were conducted.

	Samke high school	Students mind map: 	Teachers mind map: 
Spain	Mozart School	Students' mind map: 	Teachers' mind map: 
	UAB	Students' mind map: 	There was no group discussion among teachers & staff. Individual interviews were conducted.
Romania	Sercaia School	Students' mind map: 	Teachers' mind map: 

	Dragasani School	Students' mind map: 	Teachers' mind map: 
	Mioveni School	Students' mind map: 	Teachers' mind map: 
	Pitesty University	Students' mind map: 	Teachers' mind map: 

The analysis of the mind maps shows the following results:

Primary school students emphasise the natural factors that are affected by human impact (such as climate, fauna, flora, etc.), as well as the specific factors that cause the impact (waste, pollution, consumption, etc.). They also believe that technological innovation has an important role to play in addressing these impacts. However, they rarely mention the role of public authorities and even less the role of private entities such as companies or industrial groups.

Instead, high school and university students, as well as teachers and staff, additionally emphasize elements such as the role of institutions (municipalities, ministries, etc.) and companies (that exploit nature or dump their waste), as well as the importance of the lack of resources (economic and time) and adequate infrastructure to live sustainably.

Somehow, teachers and students in higher age groups are aware of these constraints and of the influence of political and economic institutions on sustainability.

The fact that primary school pupils do not mention these types of factors suggests that they are rarely included in the curriculum. They do not seem to be part of what is taught at primary school, and probably not at secondary school or university, or at least very little of it. They seem to be things that are learned outside the classroom. Teachers probably learn them in their daily management of school subjects. Pupils in older age groups may learn them in contexts other than education. This could be seen as an obstacle to the acquisition of sustainability education competences in the sense suggested by the GreenComp.

The results of the mind mapping on 'connections' are consistent with our previous findings on drivers and barriers to individual and collective competences. Most of the drivers and barriers also appear in the mind mapping, confirming the plausibility of the previous findings.

The mind maps help to visualise their interrelationships and, most importantly, help students, teachers and staff to have a global and shared vision of what makes it possible to move towards sustainability in their school. In this sense, it is a very useful technique to collectively understand the factors and dynamics that serve to promote educational competences for sustainability. According to the SCT-4 reports, the mind maps enabled a highly focused and very productive brainstorming process.

The "Connections" exercise encouraged reflection on the interdisciplinary nature of most of our interventions, inviting further thinking on how to integrate them into different subjects or create interdisciplinary educational activities.

For example, in the case of Dragasani School (Romania), the intervention chosen was the installation of solar panels, and the group discussion among the teachers allowed them to consider suitable subjects for the integration of solar energy. The proposal included:

- Physics, to explain how PV works, photovoltaic effect, conversion into electricity, global efficiency of panels, solar flux and related parameters;
- Environmental Science, to discuss the impact of renewable energy on reducing carbon footprint and mitigating climate change;
- Geography, to discuss solar irradiance, weather patterns and their impact on solar energy production, variability of solar energy with the region, distribution during the day;

- Technology, to learn about different types of solar panels, system components and advances in solar technology;
- Mathematics, to understand the design and optimal angles for solar panel installation to maximise sun exposure, formulate problems to estimate energy production and consumption, including financial savings over time;
- Economics, to evaluate the financial viability of solar energy projects, including initial investment, maintenance costs and long-term savings;
- Social Sciences, to discuss government policies, incentives and regulations that promote the adoption of solar energy and the role of renewable energy in achieving sustainable development goals;
- Arts, to create informational posters about the benefits of solar energy

Thinking collectively about 'connections' has made it easier to imagine ways of connecting different subjects with the above intervention, helping to institutionalise a way of approaching sustainability from concrete cases and in a participatory way. Doing it collectively (in this case with several teachers) can be a way of breaking down isolation, overcoming the individualism and segmentation to which teachers are conditioned by curricula, and moving towards more global visions of sustainability challenges and ways of addressing them in the educational context.

Finally, one of the patterns that seems to emerge in the networks of 'connections' by SCT-4 participants is that interventions can be seen as pilot tests that can later be disseminated and serve as examples for other schools and other settings. If they prove effective, they may be transferable to other educational or social contexts. In this sense, participants have included in their overall vision of the interventions how they can contribute to transforming the wider social and institutional environment. In this sense, in several cases, both parents and community members are targeted as vectors of dissemination processes, potentially acting as replicators of the interventions. Other schools and local/regional educational institutions/organisations interested in capturing good practices are also identified as key actors for sustainability in a broader sense.

5.5. The gender dimension

Although the research team provided explicit guidelines to partners regarding gender balance in Sustainable Competence Teams (SCTs) and Committees (SCCs), the data from SCT3, SCT4, SCC3, and SCC4 indicate disparities in gender distribution across countries and educational levels.

→ **Gender distribution across countries**

In SCT3, females dominate overall, with 136 participants compared to 80 males. The gender imbalance is particularly evident in Portugal and Finland, where women make

up a substantial majority (39 females to 7 males in Portugal, and 38 females to 11 males in Finland). Romania, however, shows a more balanced distribution, with 43 males and 39 females, while Spain exhibits near parity, with 19 males and 20 females.

Similarly, SCT4 reflects a comparable trend. The total number of female participants (88) surpasses that of males (82). Finland (15 females to 8 males) and Portugal (16 females to 14 males) show a skewed ratio favouring female, while Romania maintains near equality (42 males to 38 females). Spain also shows a slight imbalance (19 females to 18 males).

For SCC3, the gender gap becomes even more pronounced, with 38 females compared to just 16 males. The disparity is significant in Portugal (14 females to 3 males) and Finland (9 females to 2 males). Romania and Spain exhibit less skewed distributions, with 6 females to 5 males and 9 females to 6 males, respectively.

SCC4 demonstrates a continuation of this pattern, with females outnumbering males (26 to 10). Finland shows the largest discrepancy (14 females to 4 males), while Romania's figures are more balanced (7 females to 6 males). Data from Spain and Portugal are incomplete, but the available numbers align with the overall trend of female predominance.

→ **Gender distribution across educational levels**

The analysis of gender distribution across different levels of education in SCT3, SCT4, SCC3, and SCC4 also highlights significant trends and imbalances.

In SCT3, females dominate at the primary education level across most countries. In Finland, females account for 74% of participants in primary education (23 females to 6 males) and 87% in secondary education (13 females to 2 males), with males slightly outnumbering females at the university level (3 males to 2 females). Portugal shows a stark imbalance in primary education, with 39 females to 7 males and no representation at the university level. Romania demonstrates a more balanced or male-dominated distribution, with 23 males and 26 females at the primary level, 12 males and 8 females at the secondary level, and 8 males to 5 females at the university level. Spain exhibits a similar trend, with females slightly outnumbering males at the primary level (9 females to 5 males), males predominating at the secondary level (14 males to 11 females), and no representation at the university level. Across all countries in SCT3, females dominate the primary education level, while Romania and Spain exhibit more balanced or male-dominated distributions in secondary and university levels.

In SCT4, a similar pattern emerges. Finland maintains female predominance at the primary level (12 females to 2 males), while males outnumber females at the secondary

level (6 males to 3 females). Portugal displays a relatively balanced distribution at the primary level, with 16 females to 14 males, while Romania shows males slightly outnumbering females at the primary level (23 males to 26 females) and maintaining a lead at the secondary (11 males to 8 females) and university levels (8 males to 4 females). Spain continues the trend of female dominance in primary education (9 females to 4 males) and male predominance at the secondary level (14 males to 10 females), with no representation at the university level. Overall, females dominate primary education, while male representation increases at secondary and university levels, particularly in Romania and Spain.

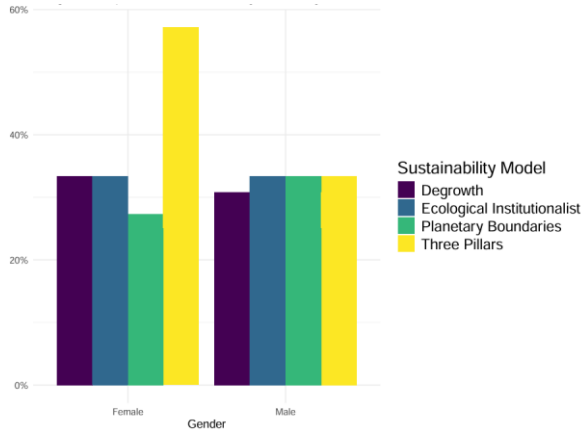
In SCC3, the gender distribution is more imbalanced, with females overwhelmingly dominating across most levels of education. In Finland, females account for 6 participants in primary and secondary education, with no males, and 3 females to 2 males at the university level. Portugal follows a similar pattern, with 14 females to 3 males at the primary level. Romania exhibits more balance, with equal representation in primary education (3 males to 3 females) and near-equal numbers in secondary and university levels. Spain shows a slight male dominance at the primary level (5 males to 4 females), but females predominate in secondary education (5 females to 1 male), with no university-level representation. Across SCC3, the gender imbalance leans heavily toward females, with males having limited representation, especially in higher education levels.

In SCC4, Finland shows female predominance at all levels, with 12 females to 2 males in primary and secondary education and equal representation at the university level (2 females to 2 males). Romania exhibits male dominance at the primary level (5 males to 1 female) but shifts to female predominance at the secondary level (4 females to 1 male), with females again being underrepresented at the university level (2 females and no males). Spain provides limited data, showing female dominance at the secondary level (5 females and no males), with no data for primary or university levels. Portugal lacks representation in SCC4. Overall, females continue to dominate, with occasional male predominance at the primary level in Romania.

This analysis reveals consistent patterns across datasets. Females dominate overall, both by country and by educational level. Thus, females overwhelmingly dominate primary education levels, particularly in Finland and Portugal, while male representation increases in secondary and university education levels, especially in Romania and Spain. Within this context, the gender dimension will be addressed in the monitoring of interventions (monitoring templates in WP5) and will be specifically considered in the evaluation of interventions (WP6).

At this stage of the project, we are analysing gender differences through the **short survey on sustainability conceptions.**

Figure 18. Sustainability models by gender



Analysing sustainability models through a gender lens reveals remarkable differences in preferences, which are characterised by different perspectives on socio-ecological issues. Male participants show a balanced preference with a slight rejection of the degrowth model. This pattern indicates a more balanced consideration of the different sustainability models.

While the female participants also have different preferences, they have a stronger bias towards the three-pillar model. This preference underlines the emphasis on an approach that harmonises economic, social and environmental goals. Models such as degrowth and Planetary Boundaries receive comparatively fewer responses from female participants, reinforcing a leaning towards frameworks that offer more inclusive solutions. These differences highlight the importance of considering gender perspectives when developing inclusive sustainability strategies

6. CONCLUSIONS

The findings from Task 5.3 reveal the significant potential of the hybrid participatory approach in achieving the project's objectives. Firstly, the participatory process has shown **a high potential for fostering meaningful engagement within the participating educational communities**. This methodology successfully engaged diverse educational communities—students, teachers, staff, and external stakeholders—by fostering collaboration, dialogue, and reflection. Evidence collected from participants and research teams underscores the transformative value of this approach in empowering individuals and groups to develop sustainability competences. Despite challenges such as time constraints, participant turnover, and resistance to change, the participatory process provided a platform for meaningful engagement and action.

The participatory method demonstrated its effectiveness through **deliberative workshops, short surveys, open debates, concept mapping, visual tools like mind mapping, and structured feedback mechanisms**. These tools facilitated interdisciplinary thinking, collaborative problem-solving, and systems-based approaches. For instance, interventions like solar panel installations were connected to academic disciplines such as physics, geography, sociology and economics, enabling participants to understand their broader systemic relevance. Small-group discussions created safe spaces for open expression, fostering trust and engagement, particularly among younger students.

From participants' perspectives, **the hybrid approach empowered students to become active agents of change**. Tangible, hands-on interventions—such as second-hand markets and biodiversity projects—helped connect abstract sustainability concepts to real-world outcomes, enhancing students' sense of agency and responsibility. Younger students found outdoor activities particularly engaging and motivational, while older students were harder to engage due to academic pressures and competing priorities. **Teachers valued** the interdisciplinary nature of the interventions, which allowed sustainability to be integrated into diverse subjects, but many-faced challenges in overcoming entrenched routines and rigid institutional structures. Strong leadership from school principals proved critical, as their commitment often determined the success and sustainability of interventions.

As for the second objective—generating preliminary evidence on barriers and facilitators to sustainability competences—our participatory approach produced **rich empirical insights.** At the individual level, experiential learning, teamwork, and participation in decision-making emerged as key drivers of engagement. Students felt empowered when they saw the tangible results of their efforts, and group discussions enhanced their critical thinking and collaboration skills. However, individualistic thinking, an age-related decline in engagement, and teacher resistance to change were

notable barriers. At the organisational level, motivated leadership, interdisciplinary teacher cooperation, and membership in networks such as Eco-Schools were crucial enablers. Participatory frameworks like SCTs and SCCs provided structure for reflection and planning, helping schools institutionalise sustainability practices. Structural factors, such as policy alignment and municipal support, also played a critical role, while resource scarcity, social inequalities, and competing priorities sometimes relegated sustainability to a secondary concern.

The participatory approach not only highlighted drivers and barriers but also validated the project's roadmap by collecting **valuable reflections on engagement and connections**. The flexibility and adaptability of the methodology were crucial in tailoring interventions to local contexts, allowing schools to overcome compartmentalisation and adopt integrated approaches to sustainability education. These findings mark an important first step toward broader systemic action and transformative change in educational communities.

7. DISCUSSION & NEXT STEPS

To date, the hybrid participatory process comprising sessions 3 and 4 has effectively achieved its objectives and generated a high level of satisfaction among participants. By fostering an iterative process of continuous learning, the project has successfully identified challenges and adapted to the specific contexts and capacities of each demonstration site. This adaptability has proven to be one of the key strengths of the methodology, allowing it to tackle the complexity of applied transdisciplinary research and tailor interventions to local needs.

Building on these successes, the next phases of the consultation process will focus on evaluation. The experience and knowledge gained will help to refine the tools, improve the participatory processes and ensure the continued relevance and impact of the interventions. Through this commitment to continuous reflection and adaptation, Task 5.3 will deepen its contribution to the promotion of sustainability skills and systemic change in educational communities.

Ultimately, the findings emphasise that sustainability is not just a subject to be taught, but a practise to be lived, with schools serving as incubators for a more sustainable and equitable future. These principles will guide the project's continued efforts on SCT5 & 6 to build resilient, engaged and forward-thinking educational communities.

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ANNEX: SUSTAINABILITY CONCEPTIONS

Our survey of sustainability concepts looks at four models of sustainability: 1) the conventional three-pillar model, 2) the planetary boundaries concept, 3) the bio-economy model, which is particularly promoted by ecological and institutional economists, and 4) degrowth thinking, which is closely linked to grassroots degrowth movements at the local level.

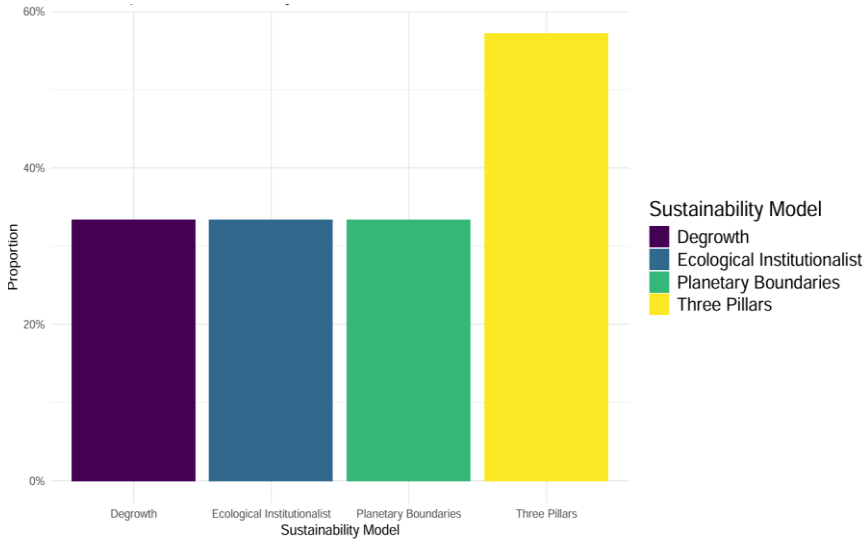
The data analysis classified survey responses into predefined sustainability models, creating binary indicators (dummies) to facilitate statistical analysis. Binary variables represented the four main sustainability models, enabling clear visualization of their prevalence across respondent groups, such as countries, genders, and education levels. Proportions were calculated by dividing the count of each model within a group by the total responses for that group, ensuring meaningful comparisons. Missing data was excluded dynamically during processing to maintain accuracy, particularly in visualizations for gender and education level. This approach provided a nuanced and comprehensive representation of the survey results while addressing the complexity of overlapping sustainability models.

It should be noted that our main aim was not to create sustainability profiles, but to encourage participants to reflect and explore possible changes in their visions from one SCT session to the next one.

- **Sustainability models in our SCTs participants**

In our sample, the three-pillar model was the most widely represented model with almost 60 % of responses. In contrast, the other three models (Degrowth, Ecological Institutionalist and Planetary Boundaries) had similar proportions, each accounting for around 20%. This indicates a clear general preference for an approach that integrates the three most important dimensions of sustainability: social, economic and environmental.

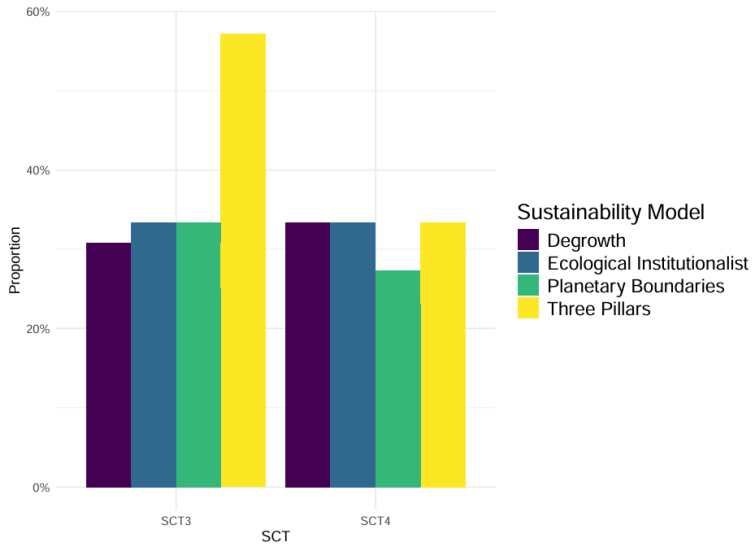
Figure 14. Sustainability models in our SCTs participants



- **Sustainability Models by SCT Level**

SCT3 and SCT4 participants exhibit differences in their alignment with sustainability models. SCT3 participants show a stronger preference for the Three-Pillars Model, reflecting an emphasis on balancing economic growth, environmental preservation, and social equity. Conversely, SCT4 participants show a more diverse distribution, with a significant proportion compared to SCT3 of degrowth models, indicating a shift towards critical perspectives on ecological constraints, although the Planetary Boundaries model diminishes somewhat as the perspective of the Three Pillars model diminishes greatly.

Figure 15. Sustainability models by SCT level



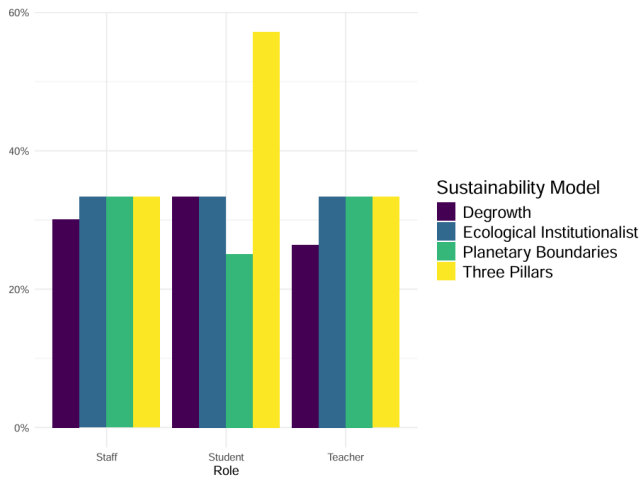
- **Sustainability Models by Professional Role**

Teachers and staff demonstrate a preference for the Three-Pillars Model as well as for Planetary Boundaries and Ecological Institutionalist. Their alignment with these models suggests a practical focus on balancing economic and environmental objectives while

respecting ecological constraints. This preference may be due to their role as facilitators and implementers of sustainability principles, where practical and actionable frameworks have a strong appeal, as the proportion of teachers and staff who embrace a transformative approach such as the degrowth model is lower.

Students show a strong inclination towards the three-pillar model. The perspective that emphasises technological progress, resource efficiency and the substitutability of different forms of capital is more widespread among students. This fact could be reinforced by the adoption of Planetary Boundaries, which state that it is important to stay within scientifically defined "safe operating spaces" to maintain balance in the Earth's biogeochemical systems.

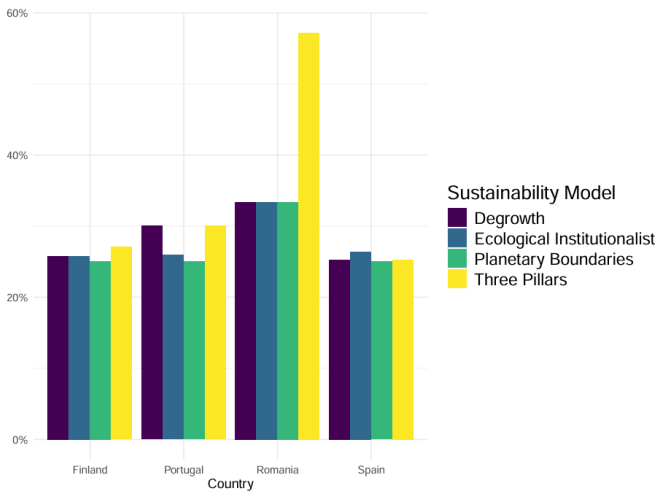
Figure 16. Sustainability models by professional role



- **Sustainability Models by Country**

Country-specific data reveals important regional differences in sustainability conceptions, influenced by cultural, economic, and policy contexts.

Figure 17. Sustainability models by country



Romania demonstrates a strong preference for the Three-Pillars Model. On the other hand, Portugal exhibits higher proportions of participants favouring Degrowth and Ecological-Institutionalist perspectives. These preferences could suggest a more critical engagement with sustainability, reflecting concerns over the socio-ecological impacts of traditional economic growth models. Participants from these countries appear more attuned to the limitations of resources and the need for systemic change, likely driven by differing historical and socio-economic experiences that shape their sustainability priorities.

Additional evidence on sustainability conceptions

Q1: Are economic growth and sustainability compatible with each other?

This question explores the perceptions of respondents regarding the compatibility between economic growth and sustainability. The results for SCT3 and SCT4 show differences across countries and genders, with notable trends emerging over time.

SCT3 Analysis

The overall average score for SCT3 is 3.76, reflecting moderate agreement that economic growth and sustainability are compatible. However, there are significant variations across countries and genders.

- **Finland**: With an average score of 2.4 (from unspecified genders), Finland demonstrates the lowest level of agreement among the countries.
- **Portugal**: The overall score of 4.0 reflects strong agreement. Female respondents score higher (4.06) than males (3.0), suggesting a stronger perception of compatibility among females.

- **Romania**: Romania's score of 4.11 indicates a high level of agreement. Female respondents rate compatibility slightly higher (4.24) than males (4.0).
- **Spain**: Spain has the lowest score among the countries (2.4). Female respondents rate compatibility particularly low (1.67), while males rate it significantly higher (3.5), revealing a notable gender gap.

SCT4 Analysis

In SCT4, the overall average increases to 4.15, indicating a stronger perception of compatibility compared to SCT3.

- **Finland**: The score rises slightly to 2.73, maintaining a relatively low perception of compatibility.
- **Portugal**: Scores increase to 4.4, with female respondents continuing to show unanimous agreement with the compatibility.
- **Romania**: The score rises to 4.38, with females rating higher (4.6) than males (4.2), reinforcing a consistent trend of agreement.
- **Spain**: The average score improves significantly to 4.54, with responses from unspecified genders only. This marks a dramatic shift from SCT3's low scores.

Comparison Between SCT3 and SCT4

The results indicate a positive shift in perceptions of compatibility between SCT3 and SCT4.

1. **Overall Trend**: The global average increases from 3.76 to 4.15, suggesting growing agreement on the compatibility of economic growth and sustainability.
2. **Country-Level Changes**:
    - Finland remains an outlier with relatively low scores, despite a slight increase in SCT4.
    - Portugal shows consistent improvement, with females consistently rating compatibility higher than males.
    - Romania maintains strong agreement, with slight increases across both genders.
    - Spain demonstrates the most significant improvement, with scores rising from 2.4 to 4.54.
3. **Gender Differences**: Gender gaps are evident in SCT3, particularly in Spain and Portugal, where females are more likely to agree. In SCT4, gender-specific data is incomplete for some countries, but female respondents in Romania and Portugal continue to show higher agreement.

The analysis shows a general trend towards greater consistency in the compatibility of economic growth and sustainability. While most countries show improvements, Finland

remains less optimistic and Spain shows the most significant positive change. Gender differences remain, with women often showing greater agreement, particularly in Portugal and Romania. These findings emphasise the importance of considering both regional and gender perspectives in the sustainability discourse.

Q2: How would you characterize the relative importance of the social, economic, and environmental dimensions of sustainability?

This question assesses the perceived importance of the social, economic, and environmental dimensions of sustainability. The results for SCT3 and SCT4 show clear preferences, with environmental sustainability consistently rated as the most important dimension across countries.

SCT3 Analysis

In SCT3, the overall averages are 4.38 (social), 4.26 (economic), and 4.73 (environmental). Environmental sustainability emerges as the highest-rated dimension across countries and genders, reflecting a broad consensus on its critical importance.

- **Finland**: Unspecified gender responses rate environmental sustainability the highest (4.7), followed by social (3.9) and economic dimensions (3.7). This demonstrates a strong focus on environmental concerns.
- **Portugal**: Respondents rate environmental sustainability highest (4.89), followed by social (4.67) and economic dimensions (4.17). Male respondents assign equal importance to all dimensions (5), while females prioritize the environment more strongly.
- **Romania**: Environmental sustainability leads with a score of 4.68, followed by economic (4.45) and social dimensions (4.40). Ratings are consistent across genders, though males slightly favour environmental sustainability over the other dimensions.
- **Spain**: Environmental sustainability is rated highest (4.6), followed by equal ratings for social and economic dimensions (4.0). Females prioritize environmental sustainability (5) and rate social dimensions slightly higher (4.33), while males assign equal importance to economic and environmental aspects (4).

SCT4 Analysis

In SCT4, environmental sustainability remains the highest-rated dimension, with averages of 4.08 (social), 4.02 (economic), and 4.38 (environmental). However, the importance of social and economic dimensions declines compared to SCT3.

- **Finland**: Environmental sustainability is again rated highest (4.53), followed by equal ratings for social and economic dimensions (3.47). This reinforces the country's strong focus on environmental issues, with less emphasis on other dimensions.
- **Portugal**: Environmental sustainability (4.8) continues to lead, with social and economic dimensions equally rated (4.4). Female respondents show consistent prioritization of environmental concerns while valuing the other dimensions equally.
- **Romania**: Environmental sustainability remains the highest-rated dimension (4.8), followed by social (4.62) and economic dimensions (4.51). Male respondents assign slightly higher importance to social dimensions (4.76), while females emphasize environmental sustainability slightly more.
- **Spain**: Scores decline significantly for all dimensions, with environmental, social, and economic aspects rated at 3.35, 3.38, and 3.38, respectively. This marks a notable departure from SCT3, where environmental sustainability was highly valued.

Comparison Between SCT3 and SCT4

The comparison reveals a general trend of stable or increasing emphasis on environmental sustainability, with declining ratings for social and economic dimensions in some countries.

1. **Overall Trends**: Environmental sustainability consistently receives the highest ratings across both surveys, emphasizing its critical importance. The social and economic dimensions decline slightly in SCT4, particularly in Spain.
2. **Country-Level Changes**:
    - Finland shows increasing prioritization of environmental sustainability, while the social and economic dimensions remain secondary.
    - Portugal maintains a strong emphasis on environmental sustainability, with stable ratings for the other dimensions.
    - Romania balances all three dimensions but consistently rates environmental sustainability the highest. Social dimensions gain slightly more attention in SCT4, particularly among male respondents.
    - Spain demonstrates a significant decline in all dimensions in SCT4, suggesting reduced prioritization compared to SCT3.
3. **Gender Differences**: In SCT3, females generally prioritize environmental sustainability over other dimensions, particularly in Portugal and Spain. In SCT4, gender differences persist but are less pronounced, with male and female respondents showing closer alignment in Romania and Portugal.

The results show that environmental sustainability is a high priority in all countries and for all genders, particularly in Portugal and Romania. However, the relative importance of social and economic dimensions decreases in SCT4, with Spain showing the most significant decrease. These findings emphasise the importance of considering the

broader context in sustainability discussions and ensuring that all three dimensions are considered in a balanced way. Environmental concerns continue to dominate, but efforts should be made to re-emphasise the social and economic aspects of sustainability to create a holistic approach.

Q3: Is sustainability an objective or a continuous process?

This question evaluates whether respondents perceive sustainability as a fixed objective or an ongoing, adaptive process. The results for SCT3 and SCT4 indicate a clear trend toward viewing sustainability as a continuous process, with variations across countries and genders.

SCT3 Analysis

In SCT3, the overall average score is 4.24, suggesting strong agreement that sustainability is best understood as a continuous process.

- **Finland**: With a consistent score of 4 (from unspecified genders), Finland aligns with the global average, reflecting a balanced perspective on the nature of sustainability.
- **Portugal**: The highest score among countries is observed here, with an average of 4.67. Female respondents rate this concept slightly higher (4.71) than males (4.0), reflecting a stronger inclination among females to view sustainability as an ongoing process.
- **Romania**: The average score is 4.08, with minimal gender differences. Females rate it at 4.05, while males rate it slightly higher at 4.12, showing balanced views across genders.
- **Spain**: Spain records the highest score among the countries at 4.6. Female respondents assign a perfect score of 5.0, emphasizing their strong belief in sustainability as a continuous process, while males rate it at 4.0, aligning with the global average.

SCT4 Analysis

In SCT4, the overall average increases to 4.48, indicating growing consensus on the concept of sustainability as a continuous process.

- **Finland**: The average score rises significantly to 4.73 (from unspecified genders), showing a stronger alignment with the idea of sustainability as an ongoing process.
- **Portugal**: Scores remain high, with an average of 4.8, reaffirming the country's strong support for this perspective. Female respondents continue to emphasize this view.

- **Romania**: The average increases slightly to 4.49, with negligible gender differences. Females rate it at 4.5, while males score it slightly lower at 4.48, suggesting growing agreement among genders.
- **Spain**: The average score declines slightly to 4.25, based on responses from unspecified genders, indicating moderate agreement but a slight reduction compared to SCT3.

Comparison Between SCT3 and SCT4

The comparison reveals an increasing emphasis on sustainability as a continuous process across most countries, with notable gender dynamics in some cases.

1. **Overall Trends**: The global average rises from 4.24 to 4.48, reflecting a growing consensus on sustainability's evolving and adaptive nature.
2. **Country-Level Changes**:
    - **Finland**: The score improves significantly, reflecting a stronger belief in sustainability as a continuous process.
    - **Portugal**: Consistently high scores reaffirm the country's strong emphasis on this perspective, with female respondents leading this trend.
    - **Romania**: Scores increase slightly, showing stability and minor gender differences.
    - **Spain**: The slight decline in SCT4 suggests reduced enthusiasm compared to SCT3, though scores remain favorable.
3. **Gender Differences**: In SCT3, females in Portugal and Spain demonstrate stronger agreement compared to males. By SCT4, gender differences diminish, particularly in Romania, indicating greater alignment across genders.

The results consistently emphasise the perception of sustainability as an ongoing process rather than a fixed goal. Portugal and Romania show a stable and strong agreement in both surveys, while Finland shows a remarkable improvement in SCT4. The slight decline in Spain warrants further investigation to understand the underlying factors. Gender dynamics show that women are often more supportive of this perspective, particularly in SCT3, although this trend is converging in SCT4. These findings emphasise the importance of promoting sustainability as an adaptive and ongoing process that cuts across cultural and gender contexts.

Q4: Are democracy and sustainability compatible?

This question examines perceptions of the relationship between democracy and sustainability. The responses in SCT3 and SCT4 show moderate to strong agreement on their compatibility, with variations across countries and genders.

SCT3 Analysis

In SCT3, the overall average score is 4.04, reflecting moderate agreement on the compatibility of democracy and sustainability.

- **Finland**: Finland has the highest score, with an average of 4.5 (from unspecified genders), indicating strong agreement with this compatibility.
- **Portugal**: The overall average is 4.28, with male respondents rating it higher (5.0) than females (4.24). This suggests a gender gap, with males showing stronger belief in the compatibility.
- **Romania**: With an average of 3.79, Romania records the lowest score among the countries. Males rate it slightly higher (3.88) than females (3.67), indicating some gender disparity.
- **Spain**: The second-highest score of 4.6 is observed in Spain. Female respondents rate the compatibility as perfect (5.0), while males provide a lower score (4.0), revealing a gender difference.

SCT4 Analysis

In SCT4, the overall average increases slightly to 4.06, indicating growing agreement on the compatibility of democracy and sustainability.

- **Finland**: The average score decreases to 3.8 (from unspecified genders), reflecting a shift toward a more cautious perspective.
- **Portugal**: Scores increase to 4.8, with strong support for the compatibility, particularly among female respondents.
- **Romania**: The average improves slightly to 4.07. Male respondents rate the compatibility higher (4.12) than females (4.0), maintaining a small gender gap.
- **Spain**: The average score declines slightly to 4.04, with responses from unspecified genders only. This indicates stable but slightly reduced agreement compared to SCT3.

Comparison Between SCT3 and SCT4

The comparison reveals subtle shifts in perceptions across countries, with overall trends remaining consistent.

1. **Overall Trends**: The global average rises slightly from 4.04 to 4.06, suggesting stable and moderate agreement on the compatibility of democracy and sustainability.
2. **Country-Level Changes**:
    - **Finland**: Scores decline from SCT3 to SCT4, indicating a more cautious perspective in SCT4.
    - **Portugal**: Scores increase significantly, reflecting growing agreement, particularly among females.

- **Romania**: Scores improve slightly, with males maintaining a stronger belief in the compatibility than females.
- **Spain**: A slight decline in SCT4 reflects reduced enthusiasm compared to SCT3, though agreement remains stable.

3. **Gender Differences**: Gender gaps are evident in SCT3, particularly in Portugal and Spain, where males and females show divergent ratings. In SCT4, these differences diminish, particularly in Romania, suggesting greater alignment across genders.

The results show stable to growing agreement on the compatibility of democracy and sustainability, with Portugal emerging as the country with the strongest belief in this relationship. Romania and Spain show slight improvements or stability, while Finland shows a decline in SCT4. Gender dynamics show that men often rate compatibility higher, although these differences decrease in SCT4. The results suggest that while the compatibility of democracy and sustainability is generally recognised, cultural and contextual factors influence the strength of this belief. To achieve a broader consensus, it is important to continue to pay attention to these factors.

Q5: Is technological development an impediment to or a precondition for sustainability?

This question explores perceptions of the relationship between technological development and sustainability, focusing on whether technology acts as a barrier or a facilitator for achieving sustainability. The results in SCT3 and SCT4 show moderate agreement that technological development is a precondition for sustainability, with some variations across countries and genders.

SCT3 Analysis

In SCT3, the overall average score is 3.93, indicating a moderate belief in the positive role of technological development in sustainability.

- **Finland**: The average score is 3.4 (from unspecified genders), suggesting a neutral stance toward the role of technology in sustainability.
- **Portugal**: With an average of 3.89, Portugal shows stronger support for technology as a precondition for sustainability. Male respondents rate it significantly higher (5.0) than females (3.82), indicating a notable gender difference.
- **Romania**: Romania records an average of 4.15, the highest among the countries. Female respondents score it slightly higher (4.24) than males (4.08), reflecting a balanced view with minor gender differences.
- **Spain**: With an average score of 3.0, Spain demonstrates the lowest level of agreement, with both male and female respondents aligned in their neutral stance.

SCT4 Analysis

In SCT4, the overall average increases slightly to 3.94, reflecting growing agreement on the positive role of technological development in sustainability.

- **Finland**: The score rises slightly to 3.5, maintaining a neutral perspective with a slight upward trend.
- **Portugal**: The average decreases to 3.4, reflecting reduced belief in the role of technological development. Female respondents drive this decline, as their ratings drop compared to SCT3.
- **Romania**: The average increases to 4.24, reaffirming Romania's position as the country with the strongest belief in technological development as a precondition for sustainability. Gender differences remain minimal, with females scoring it slightly higher (4.3) than males (4.2).
- **Spain**: The average improves to 3.75, indicating a shift toward greater agreement compared to SCT3. However, Spain still lags behind other countries in its level of agreement.

Comparison Between SCT3 and SCT4

The comparison reveals a stable or increasing emphasis on the positive role of technological development, with some country-specific changes.

1. **Overall Trends**: The global average rises slightly from 3.93 to 3.94, indicating stable agreement that technological development supports sustainability.
2. **Country-Level Changes**:
    - **Finland**: Scores remain neutral but show a slight improvement in SCT4.
    - **Portugal**: The decline in scores, particularly among females, suggests waning support for the role of technology in sustainability.
    - **Romania**: Consistently high scores across both surveys reaffirm Romania's strong belief in the positive role of technological development, with minimal gender differences.
    - **Spain**: A notable improvement in SCT4 suggests growing recognition of technology's role in sustainability, though scores remain below the global average.
3. **Gender Differences**: In SCT3, males in Portugal and Romania show stronger support for the positive role of technological development. By SCT4, gender differences diminish in Romania but persist in Portugal, where female respondents rate it lower.

The analysis shows a general consensus on the positive role of technological development for sustainability, with Romania consistently showing the strongest belief in this relationship. Portugal's declining scores in SCT4, particularly among women,

reflect lower confidence in this perspective, while Spain shows the clearest positive change. Finland remains neutral but shows a slight upward trend. These results suggest that perceptions of the role of technology in sustainability are shaped by cultural and gender dynamics, emphasising the need for tailored approaches to address these perspectives.