GreenEDU

Closing the gaps between HE and the green economy

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GreenEDU Curriculum: Comprehensive framework for green skills in higher education (WP3)

Vives UAS (Belgium)

Input from all partners

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General introduction

Main idea of the curriculum

The GreenEDU curriculum is an interactive journey through the 12 GreenComp skills, enhanced with other applicable frameworks for green skills enhancement within Higher Education Institutions: the SDGs, the EntreComp4Transition, and the Green Business framework.

During this journey we progress from values to actions, from analysis to innovation, and from individual reflection to collective impact. Augmented Reality (AR) supports these transitions as an augmented and experience-oriented learning environment.

Design of the curriculum

Content frameworks

Based on the GreenComp framework, the curriculum is divided into 4 large modules related to the 4 GreenComp areas:

- **Embodying Sustainability Values** (Domains 1-3)
- **Embracing Complexity in Sustainability** (Domains 4-6)
- **Envisioning Sustainable Futures** (Domains 7-9)
- **Acting for Sustainability** (Domains 10-12)

Each domain comprises 3 skills, forming the core of each lesson package. In the lesson packages, we refer to other frameworks and concepts that enhance the adoption and implementation of green skills within HEI:

- **Sustainable Development Goals (SDGs, see Figure 5)**[1]
- **EntreComp4Transition**[2]
- **EU Council Recommendation on learning for the green transition**[3]

Didactical frameworks

First principles of instruction (Merrill, 2002; 2012)

Merrill's framework focuses on how people learn. It is based on the idea that learning is most effective when it is problem-centered and when learners are actively engaged in solving real challenges.

[1] THE 17 GOALS | Sustainable Development

[2] EntreComp4Transition – Co-funded by the European Union

[3] Learning for the green transition and sustainable development | European Education Area

Five key principles:

- **Activation of prior knowledge** - Connect new content to existing knowledge
- **Demonstration** - Show examples and present information
- **Application** - Engage learners in solving problems and practicing
- **Integration** - Support the integration of learning into life
- **Problem-centered learning** - Organize all instruction around solving relevant problems

This model provides a logical, evidence-based sequence that helps learners connect new knowledge to what they already know, practice skills, and transfer them to authentic contexts.

Design thinking (Brown, 2008; Razzouk & Shute, 2012)

Design Thinking brings a non-linear, creative, and human-centered approach to educational design. It follows phases such as:

- **Empathize** - Understand users' needs and contexts
- **Define** - Clearly articulate the problem
- **Ideate** - Generate creative solutions
- **Prototype** - Create tangible representations
- **Test** - Gather feedback and iterate

This process encourages educators and learners to deeply understand users' needs, explore ideas collaboratively, and experiment with possible solutions. It values iteration, reflection, and empathy; qualities essential in complex, real-world learning environments.

Integration of both frameworks with AR

First principles of instruction	Design Thinking	AR Curriculum
Activation of prior knowledge	Empathize	Students explore real contexts via AR, matched with the SDGs
Demonstration	Define / Ideate	AR visualizations concretize abstract concepts
Application	Prototype	Students create sustainable solutions in AR
Integration	Test	Students reflect and present to stakeholders or companies

Table 1 Integration of Merrill's first principles and Design thinking linked to AR Curriculum

When these two frameworks come together, they create a powerful and coherent backbone for the GreenEDU curriculum. Design Thinking offers a creative, human-centred approach to exploring meaningful sustainability problems, while Merrill's principles provide a solid didactic structure for how learning around those problems should unfold. The empathize and define stages in Design Thinking align closely with Merrill's ideas of task-centred learning and activation, whereas the prototype and test stages mirror application and integration, where learners actively apply their knowledge and reflect on their learning journey. Table 1 illustrates how these phases can be combined and how AR can be used to support each step in practice.

In concrete terms, this integration can make learning experiences both structured and exploratory. Design Thinking keeps the process open, iterative, and responsive to learners' needs, while Merrill's framework ensures that the learning remains purposeful, scaffolded, and evidence-based. Together, they create a space where innovation and instruction meet, enabling students to engage deeply with sustainability challenges, take ownership of their learning, and connect what they learn to real contexts in and beyond the campus.

1. Task-centred × Empathize

The first step is to understand the real task learners must perform. Rather than starting from abstract theory, teachers begin from an authentic sustainability problem that matters in students' lives or communities. Students explore who is affected, what is at stake, and how the issue appears in real contexts. They identify authentic tasks and learner challenges, observe users or stakeholders in their everyday environments, and gather insights into needs, motivations, and constraints. This leads to a clearly formulated "real-world problem" that the learning task aims to address.

2. Activation × Define

The next step is to clarify what learners already know and where gaps exist. Here, teachers invite students to surface prior knowledge, misconceptions, and disciplinary perspectives related to the identified problem. Essential prerequisites are made explicit, and clear learning goals are formulated in direct connection with the task. At the same time, the design team translates learner needs into a focused problem definition, ensuring that the challenge is neither too broad nor too narrow. This phase helps align expectations and gives students a shared sense of purpose.

3. Demonstration × Ideate

Once the problem is defined and prior knowledge activated, the focus shifts to deciding how best to show the desired performance and to open up possible solutions. Teachers select and present meaningful examples, models, cases, or simulations that illustrate how similar problems have been approached elsewhere. These demonstrations highlight critical steps, decision points, and success criteria, and are aligned with the real-world context of the task. In parallel, students engage in ideation: they generate multiple solution ideas without judging them too early, compare options, and begin to see how different approaches might play out in practice. Using national and local examples supports relevance and helps students connect global frameworks to their own context.

4. Application × Prototype

In this phase, learners move from ideas to action. The goal is to build rich opportunities for guided practice in a safe but authentic environment. Teachers design practice activities that gradually increase in complexity and provide scaffolding based on the new knowledge and skills to be developed. Feedback mechanisms such as checklists, rubrics, automated feedback, and oral suggestions support students as they experiment with different approaches. Teams create first versions of exercises, scenarios, or interventions and refine them through iterative prototyping. Design Thinking principles guide the brainstorming and experimentation process, while Merrill's application principle ensures that practice remains clearly tied to the intended performance.

5. Integration × Test

Finally, learners are supported in transferring and personalizing what they have learned. Real-world application tasks such as projects, portfolio pieces, or living lab interventions provide a context in which students can test their solutions beyond the classroom. Structured reflection moments help them internalize key insights, recognize how their understanding has evolved, and connect the experience to future professional or civic roles. Activities are tested with learners and, where possible, with external stakeholders, who provide feedback that can be used to refine tasks, materials, and prototypes. In this way, the integration and test phases complete the cycle, turning learning outcomes into sustainable competences that students can carry into other modules, programmes, and real-world challenges.

Guiding pedagogical principles

The curriculum is designed around:

- **Problem-centered learning** - All content connects to real sustainability challenges
- **Active engagement** - Students are constructors of knowledge, not passive recipients
- **Authentic contexts** - Learning happens in real-world contexts (campus, community, organization)
- **Diverse methodologies** - Blending lectures, discussions, field work, simulations, design thinking, and AR
- **Reflection and iteration** - Continuous reflection on learning and adaptation
- **Stakeholder engagement** - Connection with real practitioners and decision-makers

Implementation recommendations

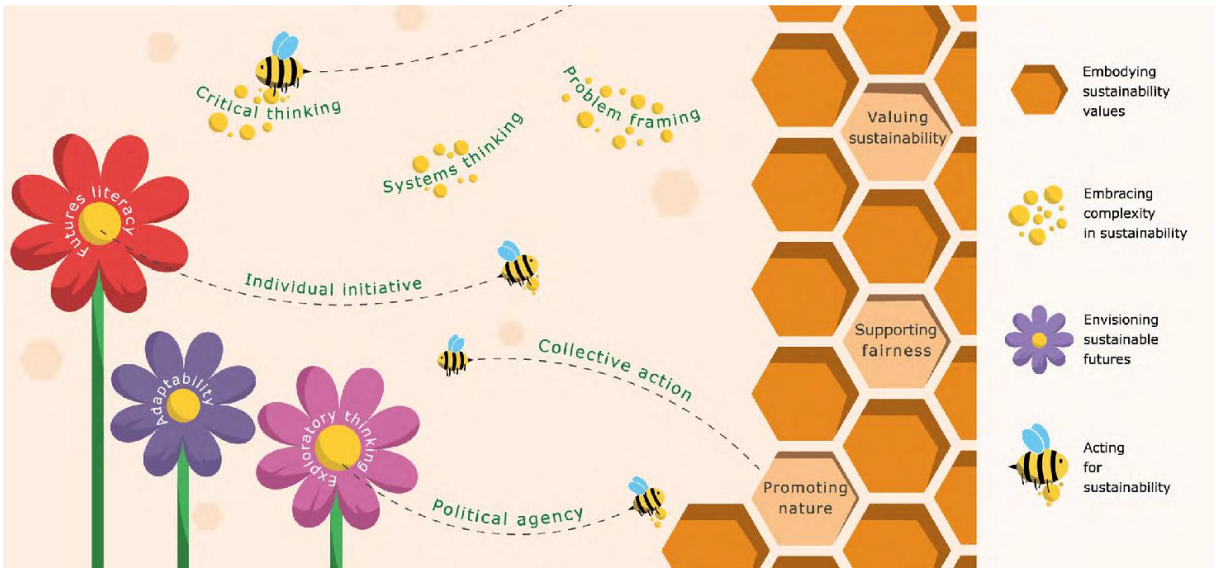
Area 1 should be mandatory for all students, as Domains 1–3 provide the essential foundation for the rest of the curriculum and introduce the core sustainability values on which later modules build. Each domain is designed as a compact learning unit of approximately 7 hours, combining a limited number of contact moments with structured individual and group assignments. In practice, this means that students alternate between attending targeted sessions (e.g. lectures, workshops, AR-supported explorations) and working on concrete tasks such as analyses, reflections, design activities, or small projects that consolidate and apply what they have learned.

Areas 2–4 can then be followed flexibly and in parallel, rather than in a strict sequence, allowing programmes to select and combine domains in ways that best fit their profile and scheduling. Teachers are encouraged to make explicit connections across domains and with other university courses, so that the time investment per module (again roughly 7 hours of blended activities) contributes to broader programme outcomes. The curriculum adopts a living lab approach, using the campus and surrounding community as learning spaces and actively involving local organizations, businesses, and government in authentic learning activities that extend beyond the classroom.

Assessment is designed to support learning and growth by helping students reflect, improve, and deepen their understanding, rather than only measuring achievement at a single point in time. Short, domain-level modules of about 7 hours lend themselves well to formative assessment moments, such as reflective journals, intermediate products, or feedback sessions on AR-based prototypes. In the inspiration guide, example tasks are presented so that teachers—based on the amount of time

they wish to invest in the GreenEDU curriculum—can select suitable assignments and tailor the balance between contact hours and self-directed work, ensuring that students are actively engaged and put to work in every module.

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Visual representation of GreenComp (Bianchi et al., 2022)

AREA 1: EMBODYING SUSTAINABILITY VALUES

Area overview

The first area focuses on developing foundational sustainability values and ethical responsibility. This area is mandatory for all students as these three domains provide the fundamental values and perspectives necessary for understanding and engaging with the remaining 9 domains.

Area 1 establishes:

- **Value-based thinking** about sustainability across people, planet, prosperity, peace, and partnership
- **Ethical responsibility** toward both natural systems and human communities
- **Foundation for action** in all subsequent domains

The competence area 'Embodying sustainability values' encourages us to reflect on and challenge our own personal values and worldviews in terms of unsustainability, and sustainability values and world-views. This area advocates equity and justice for current and future generations, while supporting the view that humans are a part of nature. Socioecological problems are wicked problems, because they involve interlinked complex systems, such as the natural systems and the social systems including technological, political and economic systems. Our understanding of such complex problems lies, at least in part, in normative assumptions of the world, and in how we interpret social, political and ethical decisions (Carolan, 2006). Knowledge is often seen as value-free (Sipos, Battisti & Grimm, 2008), which is based on the idea that it only stems from rigorous evidence-based processes that lead to objectivity, precision, acceptability and universality (Phelan, 2004). Yet, our rationality is limited as our values and world views shape our perception and understanding of the world at all times, including our perception and understanding of sustainability problems23. While descriptive knowledge explains reality through facts, normative knowledge on sustainability aims to identify how the world should look (Remington-Doucette, et al., 2013). Sustainability competences such as systems thinking and futures literacy are useful when linked to sustainability values, as otherwise such competences could be used for unsustainable actions (Sleurs, 2008; Jickling & Sterling, 2017). By fostering sustainability values such as equity Intra- and intergenerational equity and justice. and justice for current and future generations and preservation and restoration of nature (Churchman, 1967), learning for environmental sustainability can help shape a more sustainable future for communities and so cities. When learners are encouraged to reflect and question knowledge acquisition, assimilate it, and put it into practice, transformative learning takes place (Mezirow, 1997). Such learning involves cognitive (head), psychomotor (hands) and affective (heart) domains (Phelan, 2004) and encourages reflection, questioning and action. Trans formative learning is learner-centered, therefore promoting student agency (OECD, 2018).

DOMAIN 1: VALUING SUSTAINABILITY

General information

TOPIC	Valuing Sustainability: Value Creation for People, Planet, Peace, Prosperity, and Partnership - The Quintuple Bottom Line
GREENCOMP AREA	Embodying Sustainability Values
GREENCOMP SKILL	Valuing Sustainability
LINK TO OTHER GREENCOMP SKILLS	• Supporting Fairness (Social Justice and Equity) • Promoting Nature (Respecting Ecosystems)

OTHER FRAMEWORKS	SDG	All goals, with emphasis on SDG 12 (Responsible Consumption and Production)
	EC4T	Value-driven sustainability transition
	GT	Sustainable value creation, ethical consumption
LEARNING GOALS	By the end of this module, learners will be able to: ● **Recognize** the importance of sustainability for themselves and society through the lens of the "Five Ps" (People, Planet, Prosperity, Peace, Partnership) ● **Analyze** ethical consumption and global footprints using concepts like Doughnut Economics ● **Reflect** on their own consumption behavior and its ecological footprint ● **Apply** AR technology to visualize the life cycle and ecological impact of a product	
SOURCES	● GreenEDU E-Toolkit ● GreenEDU Curriculum documentation ● Doughnut Economics (Kate Raworth) ● Patagonia mission statements and case studies ● UN Sustainable Development Goals framework	
DURATION	Number of hours needed to complete this module: 7 hours	

About domain 1: valuing sustainability

Valuing sustainability is about recognizing that people hold different views on what should be sustained, why and for whom, and understanding how these value positions shape debates, decisions and behaviors. It invites learners to explore perspectives ranging from human-centered to nature-centered and to reflect on their own assumptions and priorities. The competence encourages aligning everyday choices with explicitly sustainability-oriented values and being able to explain and justify these choices to others.

Main content: from personal footprint to planetary boundaries

This module explores the fundamental shift in values required for the transition to a sustainable society. It moves beyond abstract environmentalism to show how sustainability is core to human prosperity, justice, and collaboration.

1. The foundation: The quintuple bottom line (The 5 P's framework)

The **5 P's framework** (People, Planet, Prosperity, Peace, Partnership, see Figure 1) links sustainability directly to the United Nations Sustainable Development Goals (SDGs). It provides a comprehensive lens for measuring value creation that goes beyond simple financial profit.



Figure 1. The five key elements that underpin the SDGs (Nassar & Al Haddadin, 2017)

- **People:** Social justice, equity, well-being, and poverty eradication (linking to Domain 2).

The People dimension places human well-being, equity, and social justice at the center of sustainable development. In higher education, this means creating inclusive learning environments that respect diversity, promote equal opportunities, and support the well-being of students and staff. Sustainability education, through this lens, encourages critical reflection on issues such as inequality, access to education, and ethical responsibility. Beyond the academic setting, the People dimension translates into everyday practices that value fairness, social inclusion, and respect for others, highlighting the strong links between social cohesion and sustainable societies. By addressing these issues, educators help learners understand that sustainability is fundamentally about improving quality of life for present and future generations.

- **Planet:** Protection of natural resources, climate action, and biodiversity (linking to Domain 3).

The Planet dimension focuses on environmental protection, climate action, and the responsible use of natural resources. Higher education institutions play a dual role in this area: they generate knowledge about environmental challenges while also operating as organizations with a significant

environmental footprint. Integrating environmental literacy into curricula, promoting interdisciplinary approaches to climate change, and using campuses as living laboratories for sustainable practices are key ways in which this dimension can be operationalized. In daily life, the Planet perspective supports more conscious choices related to energy use, consumption, mobility, and waste, reinforcing the idea that individual and collective actions contribute directly to environmental sustainability. This dimension strongly supports the GreenEDU objective of strengthening green skills and environmental awareness across all fields of study.

- **Prosperity:** Ensuring economic growth is inclusive, sustainable, and generates decent work.

Prosperity, within the Quintuple Bottom Line, redefines economic success by focusing on sustainability, inclusion, and long-term value creation. It challenges traditional models of growth that overlook social and environmental costs, encouraging economic systems that generate decent work, innovation, and resilience. In higher education, this translates into preparing learners for emerging labor markets shaped by the green and digital transitions, fostering entrepreneurship, and supporting research and innovation that address societal and environmental needs. In everyday life, the Prosperity dimension encourages informed economic choices, such as supporting sustainable businesses and recognizing sustainability as a driver of opportunity rather than a limitation. This perspective aligns closely with GreenEDU's emphasis on employability and skills development for a sustainable economy.

- **Peace:** Promoting peaceful, just, and inclusive societies.

The Peace dimension highlights the ethical and governance aspects of sustainability, recognizing that environmental degradation, inequality, and resource scarcity can undermine social stability and justice. Higher education has a key role in promoting critical thinking, ethical awareness, and global citizenship, helping learners understand the complex relationships between sustainability, democracy, and social cohesion. In daily life, this dimension encourages respectful dialogue, civic engagement, and awareness of global interdependencies, reinforcing the idea that sustainable development cannot be achieved without just, peaceful, and inclusive societies.

- **Partnership:** Mobilizing global partnerships to achieve the goals.

Finally, the Partnership dimension underscores the importance of collaboration in addressing complex sustainability challenges. No single institution or sector can achieve systemic change alone. Higher education institutions act as hubs that connect education, research, industry, policymakers, and communities. Through partnerships, sustainability knowledge is co-created and translated into practice, amplifying impact at local, national, and international levels. In everyday contexts, this dimension highlights the value of cooperation, shared responsibility, and active participation in community and professional networks. Partnership is the enabling force that allows the other dimensions of the Quintuple Bottom Line to move from theory into meaningful action.

2. Redefining prosperity: doughnut economics

Doughnut Economics (Figure 2), developed by Kate Raworth (2017), offers a powerful framework for rethinking prosperity in ways that are directly relevant to higher education and the transition towards a sustainable, green economy. Rather than measuring success solely through economic

growth, this model encourages a balance between meeting human needs and respecting the ecological limits of the planet. Within the context of the GreenEDU project, Doughnut Economics provides learners and educators with a practical and accessible lens for understanding sustainability as a matter of both social justice and environmental responsibility.

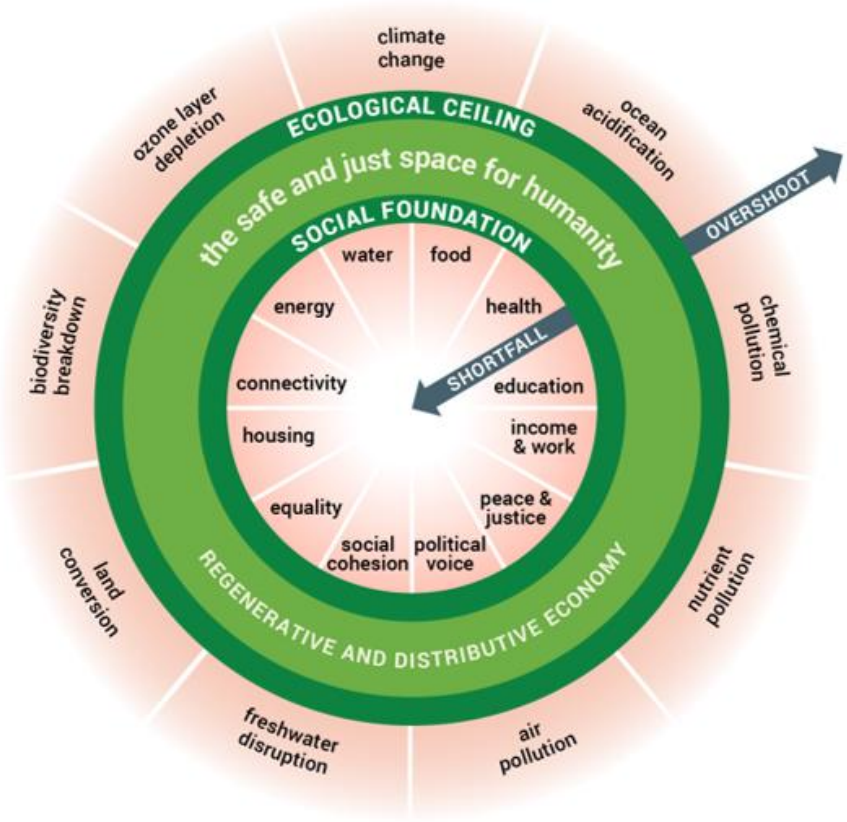


Figure 2 The Doughnut of social and planetary boundaries (Raworth, 2025)

- The "Doughnut" represents a safe and just operating space for humanity.
- The inner boundary is the **Social Foundation** (no one should fall short on essentials like food, water, housing).
- The outer boundary is the **Ecological Ceiling** (planetary boundaries that should not be overshot, e.g., climate change, biodiversity loss).

At the core of the model is the image of the “doughnut,” which represents a safe and just operating space for humanity. This space lies between two critical boundaries. The inner boundary, known as the social foundation, defines the minimum conditions required for a dignified life. These include access to essentials such as food, clean water, housing, health care, education, and social participation. Falling below this foundation means that basic human needs are not being met, leading to inequality, exclusion, and reduced well-being. For higher education institutions, this highlights the importance of equitable access to education, student support services, fair working conditions, and the broader social role of universities in contributing to inclusive development.

The outer boundary of the doughnut is the ecological ceiling, which reflects the planetary boundaries that human activity must not exceed if Earth's life-support systems are to remain stable. Issues such as climate change, biodiversity loss, pollution, and resource depletion illustrate the consequences of overshooting these limits. In higher education, this boundary encourages institutions to critically reflect on their environmental impact, from energy consumption and infrastructure to procurement practices and research priorities. It also reinforces the need to equip learners with the knowledge and skills required to address complex environmental challenges across disciplines.

Doughnut Economics is particularly valuable in educational settings because it makes abstract sustainability concepts tangible and relatable. By applying the model to real-world contexts, learners are encouraged to analyze how organizations, industries, or entire economic systems perform in relation to both social and ecological boundaries. For example, assessing the operations of a higher education institution through the doughnut lens can reveal tensions between social goals, such as expanding access and inclusion, and environmental challenges, such as carbon emissions or resource use. Similarly, analyzing sectors like fashion or food production helps learners understand how everyday consumption choices are linked to global sustainability challenges.

In daily life, the Doughnut Economics framework supports more conscious decision-making by highlighting the consequences of choices that either undermine social foundations or exceed ecological limits. It encourages individuals to reflect on how their lifestyles, consumption patterns, and professional practices contribute to or detract from a just and sustainable future. This perspective aligns closely with the GreenEDU project's emphasis on empowering learners to connect academic knowledge with real-life actions and responsibilities.

Activity: Use the Doughnut model to critically assess a typical HEI's operations or a specific industry (e.g., fashion, food production).

3. Ethical consumption and life-cycle visualization

Ethical consumption and life-cycle visualization offer a concrete entry point into sustainability by focusing on personal responsibility and everyday decision-making. This section moves sustainability from abstract principles to lived experience, helping learners understand how individual choices are embedded within complex global systems of production, distribution, and consumption. In line with the GreenEDU project, the emphasis is on developing awareness, critical thinking, and practical competences that support more sustainable behaviors in both personal and professional contexts.

A key element of this approach is the analysis of ecological and carbon footprints. By calculating and reflecting on their own footprints, learners are encouraged to connect daily habits—such as food consumption, mobility, energy use, and purchasing decisions—to measurable environmental impacts. This process helps demystify sustainability metrics and reveals how cumulative individual actions contribute to broader environmental challenges. In higher education, footprint analysis also supports reflective learning by enabling students to identify areas where change is possible and meaningful, reinforcing the link between knowledge and action.

Understanding ethical consumption further requires examining the life cycle of products, from raw material extraction to manufacturing, distribution, use, and eventual disposal. This "cradle to grave"

perspective exposes the often-invisible environmental and social costs embedded in everyday products, including resource depletion, carbon emissions, labor conditions, and waste generation. Within educational settings, life cycle thinking fosters systems awareness and helps learners recognize that sustainability challenges rarely occur at a single point in the value chain. For example, comparing a fast-fashion garment with a product from a company committed to the quintuple bottom line highlights how design choices, sourcing practices, and business models influence both social and environmental outcomes.

In everyday life, life-cycle awareness encourages more informed and responsible consumption. It supports decisions that prioritize durability, repairability, ethical sourcing, and reduced environmental impact over short-term convenience or low cost. This perspective is particularly relevant for future professionals who will influence procurement, design, policy, and management decisions within their respective fields.

The use of digital tools, such as Augmented Reality (AR), further enhances learning by making complex supply chains visible and tangible. AR applications allow learners to visualize the full life cycle of a product and the associated ecological footprint in an interactive and immersive way. By virtually tracing a product's journey across regions and stages of production, abstract concepts such as global supply chains, resource flows, and environmental externalities become easier to grasp. In higher education contexts, this experiential approach supports deeper engagement and helps bridge the gap between theoretical knowledge and real-world application.

Exercise for AR Application: Use Augmented Reality (AR) to visualize a product's entire life cycle and the ecological footprint associated with design and consumption decisions. This makes the abstract concept of a supply chain tangible: https://prism.sustainability-directory.com/scenario/augmented-reality-and-virtual-try-on-sustainability-impact/

By combining ethical consumption, life-cycle analysis, and innovative digital tools, this section supports a transformative learning experience that aligns closely with GreenEDU's goals. It empowers learners to critically assess the impact of their choices, understand the systemic nature of sustainability challenges, and adopt practices that contribute to a more just, responsible, and environmentally sustainable economy.

4. Inner development and action

Inner development and action form the concluding and integrative dimension of the module, shifting the focus from understanding sustainability challenges to actively engaging with personal responsibility and transformative change. Sustainable transitions are not driven by technical solutions alone; they also require the development of internal capacities, values, and mindsets that enable individuals to act with intention, responsibility, and collaboration. Within higher education, this perspective supports a more holistic approach to sustainability education, one that connects cognitive learning with personal reflection and purposeful action.

The **Inner Development Goals (IDGs) framework** (see Figure 3) provides a useful reference for understanding the internal skills and dispositions needed to address complex sustainability challenges. These include qualities such as self-awareness, ethical purpose, critical thinking,

empathy, and the ability to collaborate across differences. By engaging with the IDGs, learners are encouraged to reflect on how personal values, beliefs, and behaviors shape professional practice and societal outcomes. In educational settings, this reflection supports the development of sustainability competences that go beyond knowledge acquisition, fostering attitudes and capabilities that are essential for long-term change.

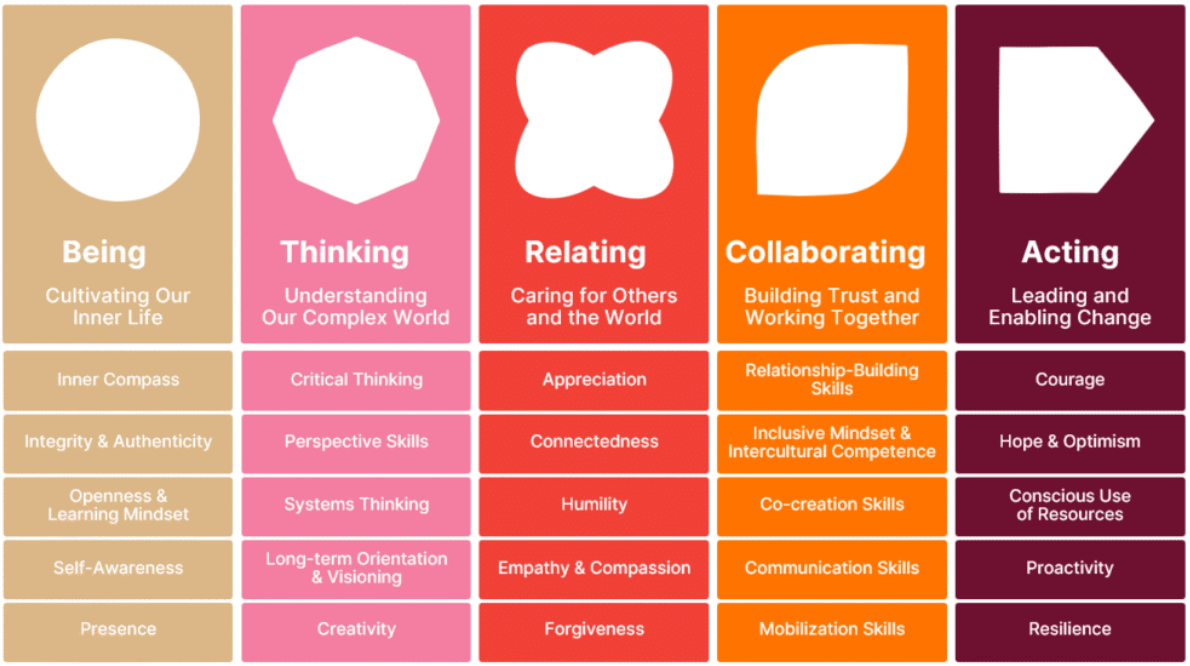


Figure 3 Inner development goals (Ankrah, Bristow, Hires & Henriksson, 2023)

Reflection: How do my values align with the need for a just and sustainable transition?

The module culminates in an integration challenge that brings together the conceptual frameworks explored throughout the learning experience. Learners are invited to develop a micro-proposal to redesign a commonly consumed product, such as a smartphone or a takeaway cup, using both the Doughnut Economics model and the Quintuple Bottom Line as guiding frameworks. This applied task encourages systems thinking by requiring consideration of social needs, ecological limits, economic viability, ethical implications, and collaborative approaches. It also supports creativity and problem-solving, demonstrating how sustainability principles can inform practical design and innovation.

Through this combination of inner development, reflection, and applied action, learners are supported in moving from awareness to engagement and from intention to implementation. In line with the GreenEDU project, this approach reinforces the idea that meaningful progress towards a sustainable and green economy depends not only on external structures and technologies, but also on the internal capacities of individuals to lead, collaborate, and act in alignment with shared values and long-term societal goals.

- **Exercise for Integration Challenge:** Develop a micro-proposal to redesign a commonly consumed product (e.g., a smartphone, a takeaway cup) to align with Doughnut Economics and 5 P's frameworks.

5. Personal carbon and ecological footprints

To truly value sustainability, one must first understand their personal impact. This module deepens that understanding by distinguishing between two vital metrics: the **Carbon Footprint** and the **Ecological Footprint**.

Concept Refinement: The **Carbon Footprint** specifically measures greenhouse gas (GHG) emissions, primarily carbon dioxide (CO^2), resulting from an individual's activities (e.g., driving, heating, flying). In contrast, the **Ecological Footprint** is a broader measure, quantifying the demand on natural capital—the amount of biologically productive land and sea area required to support one's lifestyle and absorb their waste. This demand is typically measured in **global hectares**.

Hidden Impacts: Your footprint is often much larger than you realize, dominated by consumption categories with the highest hidden or embedded impacts. We analyze these areas:

- **Food:** The carbon cost of meat production, transportation, and waste.
- **Travel:** Emissions from flights, cars, and daily commuting.
- **Housing:** Energy use for heating, cooling, and the embedded carbon in construction materials.
- **Goods/Services:** The entire supply chain impact of clothing, electronics, and other consumer items.

Self-assessment exercise: To transform this abstract data into actionable insight, guide students to conduct a personal self-assessment to estimate their carbon foodprint using online calculator tools (e.g., https://footprint.conservation.org/en-gb/) to generate their *starting data*.

Detailed lesson plan - domain 1

Time / Goals	Content / Element(s)	Teaching method	Point(s) of attention / AR application
Activation of prior knowledge / Empathize	**Topic: The Hidden Cost of Convenience** Core idea: Students explore real contexts and consumption habits matched with the SDGs. Key Element: Self-assessment of personal carbon or ecological footprint. Introduction to the 5 P's (People, Planet, Prosperity, Peace, Partnership).	**Interactive Quiz:** "What kind of consumer are you?" **Individual Activity:** Students use an online calculator (e.g., carbon footprint calculator) to assess their personal impact. **Group Discussion:** What surprised you? Where are the biggest impacts? **Introduction to the 5 P's** and the 17 SDGs.	**AR Application: Footprint Visualization** **Empathize:** Students use a mobile AR app to place a 3D model of their calculated footprint (e.g., a digital cloud or large abstract shape) into their real environment (e.g., their

			classroom/home) to make the abstract data *tangible*.
Demonstration / Define – Ideate	**Topic: Redefining Value and Impact** Core Idea: Doughnut Economics (Kate Raworth): balancing social and planetary boundaries. Key Element: Ethical Consumption and the Quintuple Bottom Line. Case Study Comparison: Patagonia vs. Fast Fashion.	**Lecture/Webinar:** Detailed explanation of the Doughnut Model and Planetary Boundaries. **Case Study Analysis:** Group analysis of the Patagonia mission statement and a fast-fashion company's public report. Define the difference between *true* sustainability and marketing claims. **Ideate:** Brainstorm how a traditional product/service could be redesigned to fit within the Doughnut's limits.	**AR Application: Life Cycle** Visualization **Demonstration:** Use a dedicated AR case study to visualize the **life cycle of a product** (e.g., a smartphone or plastic bottle). Students can tap on stages (extraction, transport, use, disposal) to reveal associated data on CO2, water use, and labor practices. **Define:** Students use the AR data to identify the stage with the largest negative impact (the "bottleneck") to formulate their redesign problem.
Application / Prototype	**Topic: Redesigning for the 5 P's** Core Idea: Apply newly acquired knowledge to redesign a product. Key Element: Ethical considerations in product supply chains. Inner Development Goals (IDGs) reflection.	**Individual Design Challenge:** "Redesign a Product for the Quintuple Bottom Line." Learners select a product and propose changes across all 5 Ps. (e.g., raw materials, energy source, labor policy, community investment). **Peer Review (Prototype):** Students provide feedback on the feasibility and	**AR Application: Redesign Prototype Application:** Students use a simple AR tool (e.g., a modeling app) to create a low-fidelity **AR prototype/mockup** of their redesigned

		alignment of their peers' proposals with the Doughnut model.	product. They use the tool to annotate their model with text and media explaining how the new design meets the "Social Foundation" and "Ecological Ceiling".
Integration / Test	**Topic: Can Growth Ever Be Sustainable?** Core Idea: Reflection on own consumption behavior and defending a position on sustainable economic models. Key Element: Debate on "Can growth ever be sustainable?" Integration: Reflection on the personal transition needed for a sustainable society.	**Socratic Seminar/Debate:** Structured debate on the controversial question: "Can economic growth (Prosperity) truly align with the Planet's boundaries?". Groups argue for/against concepts like Degrowth or Circular Economy. **Individual Reflection (Test):** Learners write a short reflective essay: "My personal commitment to the Quintuple Bottom Line." This requires them to integrate the knowledge into their values.	**AR Application: Debate Context Integration:** The moderator uses the AR life-cycle visualization tool (from the Demonstration phase) on-screen to quickly pull up real-time data to support or challenge points made during the debate, adding an evidence-based layer to the discussion. **Assessment:** Evaluation focuses on the quality of argumentation and the depth of the final reflection.

DOMAIN 2: SUPPORTING FAIRNESS

General information

TOPIC	Supporting Fairness: Social Justice in Green Transitions
GREENCOMP AREA	Embodying Sustainability Values
GREENCOMP SKILL	Supporting Fairness
LINK TO OTHER GREENCOMP SKILLS	• Valuing Sustainability • Promoting Nature • Political Agency
OTHER FRAMEWORKS	SDG 5 (Gender Equality), 8 (Decent Work and Economic Growth), 10 (Reduced Inequalities) EC4T Mobilizing others for inclusive change GT Fair Trade; Inclusive supply chains
LEARNING GOALS	By the end of this module, learners will be able to: • **Understand** the core principles of intergenerational and global equity within the green economy • **Analyze** Just Transition frameworks to ensure environmental policies do not exacerbate social inequalities • **Identify and map** global inequalities within modern supply chains, specifically focusing on resource use • **Evaluate** the impact of sustainable development decisions on diverse stakeholders through experiential storytelling and role-play
SOURCES	• GreenEDU E-Toolkit • GreenEDU Curriculum documentation • GreenComp Framework • European Commission Just Transition Mechanism • Environmental Justice literature • UN Just Transition principles
DURATION	Number of hours needed to complete this module: 7 hours

About domain 2: supporting fairness

Supporting fairness focuses on the close links between environmental quality, human wellbeing and social justice, now and in the future. Learners consider how environmental harms and benefits are distributed within and between societies, and how this relates to issues such as poverty, discrimination and health. The competence involves using principles of equity and justice—also for future generations—when assessing situations and when proposing or evaluating sustainability-related decisions.

Main content

This module shifts the focus from individual environmental metrics to the broader human, social, and ethical dimensions of sustainability. While tools such as carbon footprints and life-cycle analysis are important, they are insufficient on their own to guide a fair transition towards a green economy. Sustainable development requires attention to who benefits, who bears the costs, and whose voices are included in environmental decision-making. In this context, the transition to climate neutrality must be designed in ways that reduce—rather than reproduce—existing social, economic, and global inequalities.

Grounded in sustainability science, environmental justice theory, and political economy, this module explores how concepts of equity, justice, and participation are central to the green transition. It aligns with the GreenEDU approach by linking systemic analysis with experiential learning, enabling learners to connect global challenges with lived realities.

1. Equity in the green economy: intergenerational and global perspectives

Sustainable development has long been defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Report, 1987). This definition highlights **equity** as a core principle and can be understood through two complementary lenses: intergenerational equity and global equity.

Intergenerational equity refers to the ethical responsibility of the present generation towards those who will inhabit the planet in the future. Scholars such as Edith Brown Weiss argue that future generations should inherit environmental conditions and resources that are no worse than those enjoyed today. In higher education, this principle encourages learners to examine the long-term consequences of current economic models, energy systems, and consumption patterns. Climate change, biodiversity loss, and resource depletion are not only environmental issues, but also moral questions about responsibility across time.

Global equity addresses inequalities across countries and regions. Although climate change is a global phenomenon, its causes and impacts are unevenly distributed. High-income countries have historically contributed the most to greenhouse gas emissions, while many low- and middle-income countries experience the most severe consequences, including extreme weather events, food insecurity, and displacement. This imbalance raises questions of fairness in responsibility-sharing, access to resources, and participation in decision-making. Within the Quintuple Bottom Line, global equity ensures that prosperity is understood as shared and inclusive, rather than concentrated in already advantaged contexts.

2. The just transition framework: fairness in climate action

The concept of **Just Transition** emerged from labor movements and was later integrated into international climate policy through institutions such as the International Labor Organization (ILO). A Just Transition recognizes that while environmental policies are necessary, they can produce social disruptions if not carefully designed. Workers and communities dependent on carbon-intensive industries may face job losses, economic decline, and social instability if transitions are abrupt or unsupported. At the European level, the **Just Transition Mechanism** reflects this concern by providing financial and structural support to regions most affected by decarbonization.

A "Just Transition" is a framework developed to ensure that the shift to a sustainable economy happens in a way that is as fair and inclusive as possible to everyone concerned. It acknowledges that while greening the economy creates new opportunities, it can also threaten livelihoods in traditional carbon-intensive industries. However, a Just Transition extends beyond economic compensation. It also includes principles of environmental justice, participatory governance, and social inclusion. Environmental justice scholars emphasize that environmental harms and benefits are not distributed equally and that marginalized communities are often excluded from decision-making processes.

- **Environmental justice:** This involves the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development and enforcement of environmental laws.
- **Social inclusion:** In the context of GreenEDU, educators help learners understand that green skills must be accessible to all social groups, ensuring that the labor market transition does not exacerbate poverty or exclusion.

In the context of GreenEDU, Just Transition thinking (see Figure 4) highlights the importance of **equitable access to green skills, education, and employment opportunities**. Without inclusive education systems, the green transition risks reinforcing existing inequalities rather than addressing them.

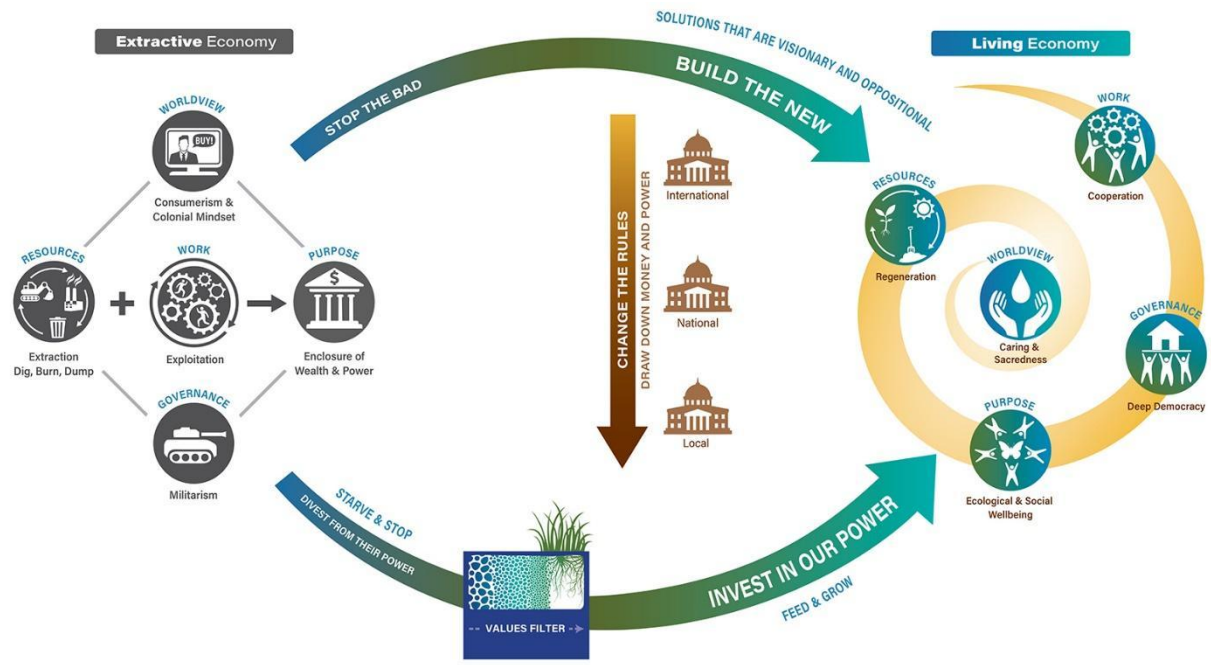


Figure 4 Just transition framework[4]

3. Mapping global inequalities in supply chains

To fully understand equity in the green economy, learners must move beyond final products and examine the **global supply chains** that underpin modern consumption and green technologies. Research in global political economy and sustainability studies shows that many supply chains reflect long-standing power imbalances rooted in colonial histories and unequal trade relations.

Critical raw materials used in renewable energy technologies—such as cobalt, lithium, and rare earth elements—are often extracted in regions with weak labor protections and limited environmental regulation. While these materials enable low-carbon technologies in the Global North, they may be associated with environmental degradation, unsafe working conditions, or child labor elsewhere. This creates a paradox in which "green" solutions may externalize social and environmental costs.

- **Mapping exercise**

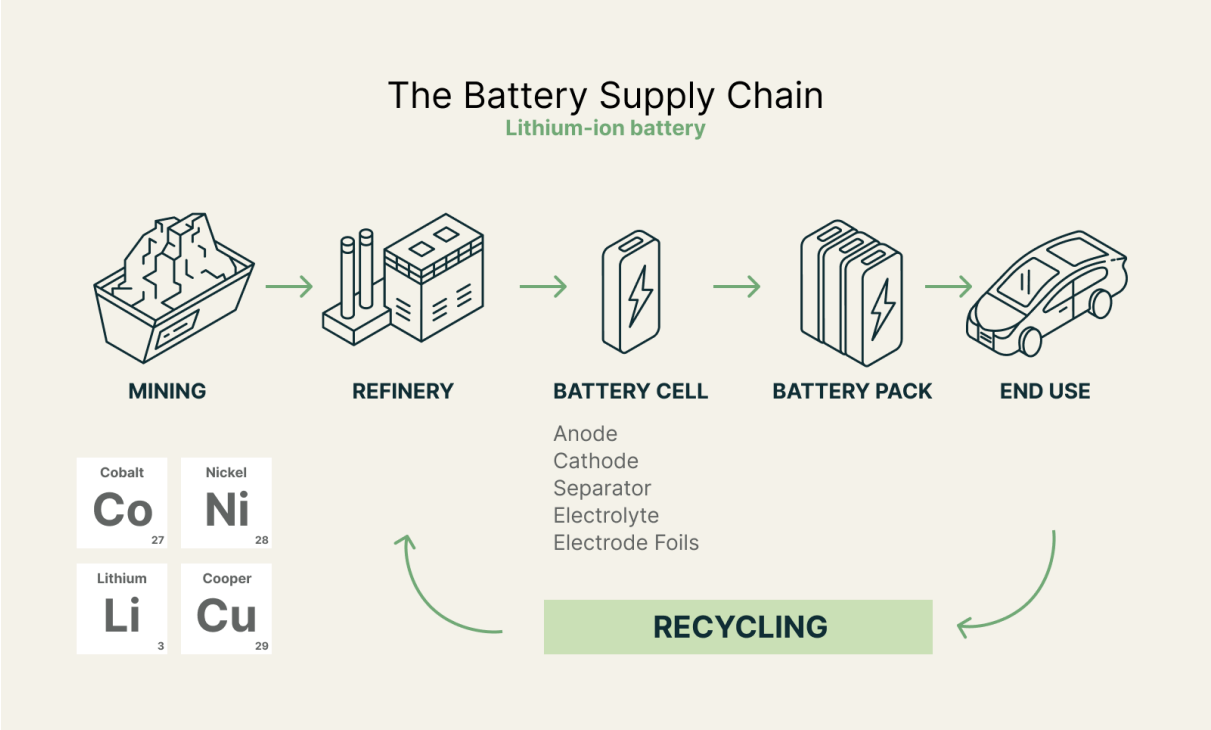
Guide students to trace the life cycle of a sustainable product across three key stages -*resource extraction, manufacturing,* and *end use*- identifying actors, impacts, and power asymmetries, and reflecting on responsibility for equitable governance.

Decide which product you will investigate and search for the countries and companies involved in resource extraction, where key parts are manufactured, and how and where the product is used, reused, or recycled.

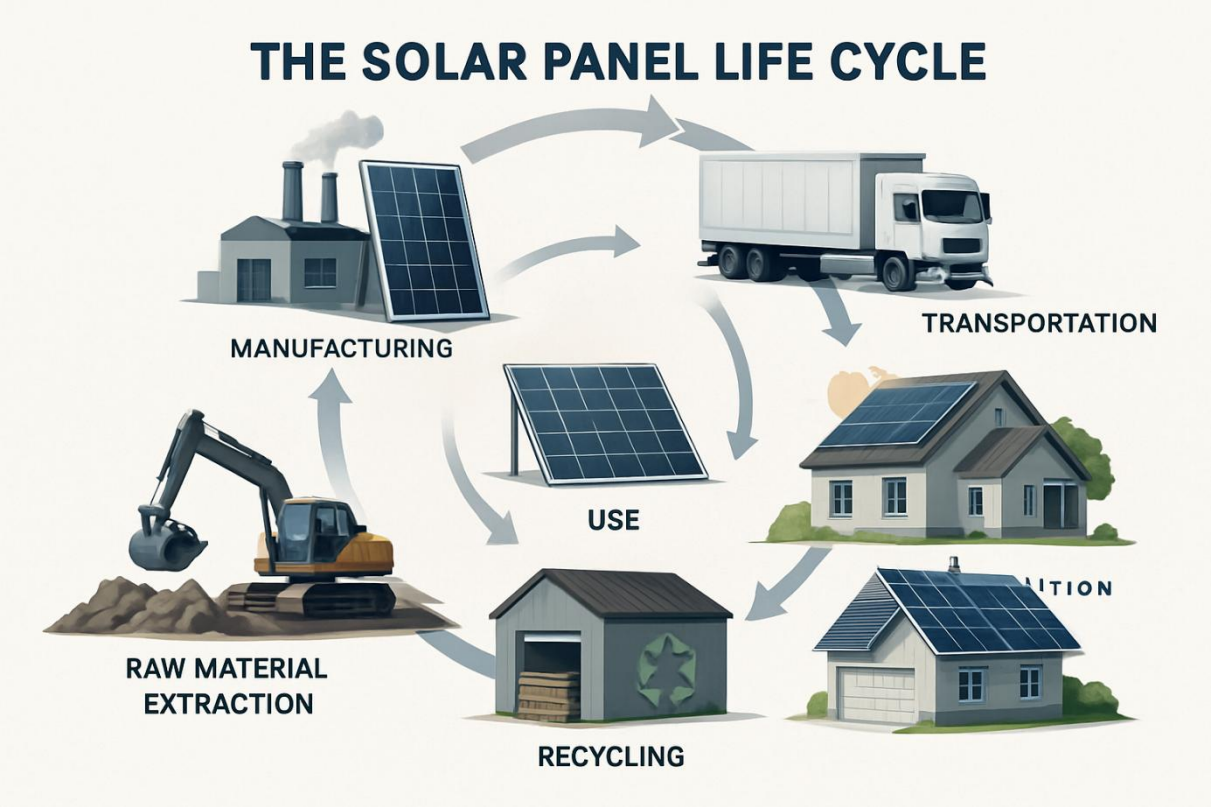
[4] Retrieved from https://climatejusticealliance.org/wp-content/uploads/2025/03/Just-Transition-Framework.jpg on April 8th, 2026

Products and the supply chain and lifecycle:

- **EV Batteries:** https://www.minespider.com/battery-ebook (Chapter 2 The Battery Value Chain)



- **Solar Panels:** https://www.anernstore.com/blogs/diy-solar-guides/map-solar-panel-life-cycle-steps?srsltid=AfmBOoocSwvEYe9v7G1OZoDxfbLvXtDAqLeiwaNtg6cOREra3w5P090A



Then, guide learners using Google maps to identify:

- Key countries and actors involved at each stage: add pins to these layers:
  - Resource extraction
  - Manufacturing
  - End use
- Potential environmental and social risks

Stage	Location (City/Country)	Key Actors	Resource / Component	Main Risks (Environmental & Social)	Power Asymmetries
1. Resource Extraction					
2. Manufacturing					
3. End Use & Disposal					

Reflection

1. *Which stage has the greatest environmental impact? Why?*
2. *Which actors hold most power? Producers? Brands? Consumers? Regulators?*
3. *Where do inequities appear in the supply chain?*
4. *What governance or consumer actions could reduce inequities?*

4. Experiential learning: storytelling and role-play for systems thinking

Justice-related sustainability concepts often remain abstract unless learners engage with the **lived experiences of affected communities**. Experiential learning theories, particularly those developed by Kolb and Mezirow, emphasize the role of reflection and perspective-taking in transformative learning. GreenEDU builds on this tradition by using storytelling and role-play to foster empathy and systems thinking.

- **Augmented reality (AR) storytelling:** Through Augmented Reality (AR), students can "witness" the impact of climate decisions on different communities world-wide, such as coastal farmers facing rising sea levels or urban workers in transitioning energy sectors. This immersive technology helps students acquire relevant green skills by connecting data to human stories.

- **Role-play simulation:** Learners participate in a sustainable city planning board simulation. In this activity, they must represent different stakeholders—such as a local resident, a business owner, or an environmental activist—and negotiate a climate policy that balances economic goals with social equity and environmental health.

Exercise: Watch this video with your peers and discuss the questions below:

- Which stakeholders benefited most from the proposed decisions, and which faced trade-offs?
- How were power and voice distributed in the decision-making process?
- What compromises were necessary to achieve a more just outcome?



5. Collaborative Action for Inclusive Change

The transition towards a just and sustainable green economy depends not only on sound analysis and effective policies, but also on the capacity to mobilize collective action. Sustainability challenges are

inherently complex and systemic, cutting across sectors, institutional boundaries, and social groups. Addressing them therefore requires cooperation, shared responsibility, and the ability to translate knowledge into coordinated action. This perspective is strongly aligned with the EntreComp4Transition (EC4T) framework, which emphasizes social innovation, ethical entrepreneurship, and collective agency as key drivers of sustainable change.

Within this context, sustainability is understood not merely as a technical or environmental issue, but as a societal transformation process. Inclusive change emerges when environmental goals are pursued alongside social justice, democratic participation, and institutional accountability. Collaboration between education, policy, industry, and civil society becomes essential for ensuring that the benefits of the green transition are distributed fairly and that no social group or region is left behind.

Application

A practical way to operate collaborative action is through the development of concise advocacy or policy-oriented proposals that address equity-related challenges identified throughout the module. These challenges may relate to ethical procurement practices, inequalities embedded in global supply chains, access to green skills and employment opportunities, or the social implications of environmental policies at institutional or community level. Framing such proposals requires integrating analytical insight with normative considerations of justice and responsibility.

Effective proposals clearly articulate the equity issue at stake, situate it within established frameworks such as Just Transition or global equity, and outline feasible actions that can be implemented through partnerships. Emphasis is placed on realistic pathways for change, recognizing institutional constraints while identifying opportunities for cooperation across stakeholders. This approach reflects the Partnership dimension of the Quintuple Bottom Line, highlighting collaboration as a foundational condition for systemic transformation.

Exercise

Experiential engagement further supports understanding of collaborative change by making abstract policy tensions visible. The Just Transition Augmented Reality storytelling module provides immersive insight into how environmental and economic decisions affect different social groups in uneven ways. By presenting contrasting stakeholder perspectives, the resource illustrates the trade-offs and negotiations inherent in sustainability governance, particularly where environmental protection intersects with social inclusion and economic security.

Access to the AR storytelling scenario:
https://www.jetknowledge.org/news/tales-of-carbonia-role-play-game-helps-stakeholders-negotiate-just-transition/



Figure 5 Sustainable Development Goals[5]

[5] Source: Sustainable development goals | European Court of Auditors (accessed April 9th, 2026)

Detailed lesson plan – domain 2

Write down in a detailed way the content, the teaching methods and the AR applications.

Time / Goals	Content / Element(s)	Teaching method	Point(s) of attention / AR application
Activation of prior knowledge / empathize	**Global equity & intergenerational justice** • understanding that sustainability is about improving quality of life for current and future generations. • identifying how decisions in wealthy nations impact the global south.	• **digital mapping exercise**: students identify a "green" product and trace its supply chain origins. • **group discussion**: "Who pays the price for our green transition?"	**AR application: storytelling** Learners use an AR app to "witness" the impact of climate decisions on different global communities (e.g., coastal farmers vs. Urban workers). [9]this fosters empathy as a foundation for fairness.
Demonstration / define – ideate	**The just transition framework** • analysis of the European just transition mechanism. • understanding environmental justice and social inclusion.	• **interactive lecture**: explaining how green policies can accidentally threaten livelihoods in carbon-intensive industries. • **stakeholder mapping**: identifying vulnerable groups in local and global contexts.	**AR application: policy impact** Use an AR visualization to demonstrate how a specific policy (e.g., carbon tax) impacts different socio-economic groups. [17171717]this concretizes the need for inclusive design.
Application / prototype	**Supply chain analysis & redesign** • identifying "hotspots" of inequality in resource use. • applying the entrecomp4transition mindset to inclusive change.	• **role-play simulation**: students represent different stakeholders (resident, business owner, activist) on a city planning board. • **brainstorming**: developing inclusive alternatives to current supply chain practices.	

Integration / test	**Global equity & intergenerational justice** • understanding that sustainability is about improving quality of life for current and future generations. • identifying how decisions in wealthy nations impact the global south.	• **digital mapping exercise**: students identify a "green" product and trace its supply chain origins. • **group discussion**: "Who pays the price for our green transition?"	**AR application: storytelling** Learners use an AR app to "witness" the impact of climate decisions on different global communities (e.g., coastal farmers vs. Urban workers). [9]this fosters empathy as a foundation for fairness.

DOMAIN 3: PROMOTING NATURE

General information

TOPIC	Promoting Nature: Biodiversity, Ecosystems, and Human Connection
GREENCOMP AREA	Embodying Sustainability Values
GREENCOMP SKILL	Promoting Nature
LINK TO OTHER GREENCOMP SKILLS	• Valuing Sustainability (ethical responsibility toward nature) • Systems Thinking (understanding interactions in nature) • Critical Thinking (evaluating human impacts on nature) • Futures Literacy (safeguarding nature for future generations) • Collective Action (coordinated efforts for nature conservation)
OTHER FRAMEWORKS	SDG 14 (Life Below Water), 15 (Life on Land) EC4T Visioning a green future GT Nature-based solutions
LEARNING GOALS	By the end of this module, learners will be able to: • **Recognize** global patterns of biodiversity across ecosystems, regions, and spatial gradients • **Analyze** how habitat requirements and human disturbance shape species distribution and biodiversity • **Reflect** on personal and regional connections to biodiversity in natural and urban contexts • **Apply** species identification, fieldwork, and digital/AR tools to assess biodiversity at multiple scales • **Apply** ecological principles to propose strategies for enhancing biodiversity in anthropogenic landscapes
SOURCES	• Biodiversity mapping: https://biodiversitymapping.org/ • GIS and biodiversity: https://www.giscourse.com/worlds-biodiversity-mapping-to-observe-endangered-species/ • Biodiversity hotspots mapping • Jenkins, C.N. & K. Van Houtan (2016). Global and regional priorities for marine biodiversity protection. *Biological Conservation* • Jenkins, CN, SL Pimm, LN Joppa (2013) Global Patterns of Terrestrial Vertebrate Diversity and Conservation. *PNAS* 110(28): E2602-E2610
DURATION	Number of hours needed to complete this module: 7 hours

About domain 3: promoting nature

Promoting nature is about seeing humans as part of nature, not separate from it, and feeling care and responsibility for other species and ecosystems. Learners come to understand how their lives and economies depend on healthy ecosystems and biodiversity, and how current practices threaten these life-support systems. This competence fosters emotional connection with nature and motivates concrete actions to conserve, restore and regenerate the natural world in daily life and in professional or civic roles.

Detailed lesson plan - domain 3

Time / goals	Content / element(s)	Teaching method	Point(s) of attention / AR application
Activation of prior knowledge / empathize	**Topic: global patterns of biodiversity** **Core idea:** biodiversity is not evenly distributed across the globe. Some regions and ecosystems are more diverse. **Activation of prior knowledge:** activation of knowledge on what the students know about biodiversity in the world. **Empathy:** reflective essay on personal connection to biodiversity.	**Interactive quiz:** students will guess what species live in which continents (tiger, lion, elephant, kangaroo, pinguin, cactus, baobab, sequoia). **Group discussion:** what do you know about biodiversity in your home region? Students can compare their home regions. **Essay:** students write a reflective essay on the personal connection to biodiversity (biodiversity in their homes, in places they have travelled).	**AR on world scale:** students look on the **world map** with AR. AR shows them a layer of **ecosystems**. Another AR layer shows **biodiversity hotspots**. Biodiversity is displayed in heatmap colors: more intense colors indicate higher biodiversity. Yet another AR layer visualizes which **species** live in which regions/ecosystems, with species photos and names.
Demonstration / define – ideate	**Topic: how is biodiversity created?** **Core idea:** not all species can live everywhere but species have different habitat requirements. Biodiversity is the result of species´ distribution. **Demonstration:** demonstration of biodiversity in ecosystems, along latitude and altitude, in biodiversity hotspots, and in natural areas vs cities.	**Lecture/webinar:** biodiversity in different ecosystems (boreal, desert, rainforest, coral reefs); biodiversity decreases with latitude and altitude; biodiversity hotspots; extinct, relict, endemic, rare, common and invasive species. Species habitat requirements (vast undisturbed habitats vs fragmented or disturbed habitats).	**AR on regional scale:** students look on the **regional map** of their country/town/university campus and see which species live where (plants, animals, birds, insects, fungi).

		Only species that tolerate disturbance can live in urban environments with the help of natural corridors for distribution, connected patches or steppingstones. **Analysis:** students are given species lists (plants, animals, birds, insects, fungi, etc.) of various ecosystems, latitudes, latitudes, biodiversity hotspots, and they are required to compare the biodiversity numbers.	
Application / prototype	**Topic: natural vs urban biodiversity** **Core idea:** students learn to know species and apply newly acquired knowledge about species distribution and habitat requirements to see the difference between natural and urban biodiversity. **Application:** hands-on field work on species determination and biodiversity in natural forest vs. urban park.	**Field work (case study) in natural forest vs urban park:** students collect species lists (plants, animals, birds, insects, fungi, etc.), using digital keys for species determination, in a natural forest and in an urban park, and compare the biodiversity numbers.	**AR on local scale:** students determine species (plants, animals, birds, insects, fungi) during field work in a **natural forest** and an **urban park**, using digital keys or AR, if available.
Integration / test	**Topic: what are the best solutions for biodiversity in anthropogenic world?** **Core idea:** students try to find solutions to how to sustain the possible maximum biodiversity in anthropogenic world. **Integration of knowledge:** students realize that there are species which can only live in undisturbed natural habitats (e.g. big mammals, rare species) and these habitats must be protected. Yet some other species tolerate human disturbance and are suitable for	**Seminar/debate:** students try to find solutions to sustain biodiversity amid anthropogenic landscapes and urban spaces. Is it possible to maintain natural biodiversity? Can all species live everywhere? Which species suit where? **Campus as a living lab:** students are required to model the landscape in and around the university campus to maximize biodiversity,	The moderator tests with **AR** whether the species picked by students fit in the landscape they created around the university campus, based on species´ local distribution, ecological and habitat requirements.

	anthropogenic/urban space (e.g. Sparrow, hedgehog, squirrel). **Test:** university campus as a living lab to maximize biodiversity.	based on the previous knowledge.	

AREA 2: EMBRACING COMPLEXITY IN SUSTAINABILITY

Area overview

Area 2 focuses on developing analytical and systems-thinking skills to understand the complex interconnections within sustainability challenges. This area is critical for moving beyond simplistic solutions toward sophisticated understanding of trade-offs, feedback loops, and systemic change.

Embracing complexity in sustainability is about learning to see sustainability challenges as interconnected, multi-layered and systemic, rather than as isolated issues. In this domain, learners are supported to look at how environmental, social, cultural and economic dimensions interact across time and space, and how human activities drive or amplify ecological crises such as climate change and biodiversity loss. The aim is to move beyond linear cause and effect explanations and develop the capacity to work with feedback loops, cascade effects and tradeoffs.

"Systems thinking" in this area invites learners to approach sustainability questions holistically, mapping how elements within and between systems influence each other and using life cycle thinking to understand the impacts of human action. "Critical thinking" focuses on assessing information and arguments, identifying biases and greenwashing, and questioning dominant narratives and the status quo that sustain unsustainable patterns. "Problem framing" helps learners to formulate current or potential challenges explicitly as sustainability problems—clarifying who is affected, what the spatial and temporal scales are, and what level of change in existing systems might be required—so that appropriate preventive, mitigating or adaptive responses can be identified.

DOMAIN 4: SYSTEMS THINKING

General information

TOPIC	Systems Thinking: Systems thinking in urban sustainability and smart cities
GREENCOMP AREA	Embracing Complexity in Sustainability
GREENCOMP SKILL	Systems Thinking
LINK TO OTHER GREENCOMP SKILLS	Critical Thinking; Problem Framing; Acting for Sustainability
OTHER FRAMEWORKS	SDG 11 (Sustainable Cities and Communities) EC4T Systems innovation for sustainability GT Chain thinking: from raw material to end user
LEARNING GOALS	By the end of this module, learners will be able to: ● Understand the interconnections between energy, mobility, water, and waste systems within urban environments. ● Analyze complex systems using the Planetary Boundaries framework and causal loop diagrams. ● Simulate the impacts of climate policies using advanced modelling tools to observe feedback loops. ● Apply AR technology to visualize and deconstruct complex urban networks for sustainable optimization.
SOURCES	GreenEDU E-Toolkit; GreenEDU Curriculum; GreenComp Framework; En-ROADS
DURATION	**7 Hours**

About domain 4: systems thinking

Systems thinking means understanding sustainability challenges as parts of complex, interconnected systems rather than as isolated problems. Learners identify elements, relationships and feedback loops within and across ecological, social, cultural and economic systems, and they look at how changes in one place can create effects elsewhere and over time. The competence includes using tools such as mapping, life-cycle thinking and scenario building to analyze these systems and to anticipate indirect and long-term consequences of actions.

Main content: navigating complexity through systems thinking

This module focuses on the ability to recognize and understand the interconnections and feedback loops within complex systems. In the context of the green economy, systems thinking is essential for moving beyond "siloed" solutions to holistic, regenerative strategies.

Sustainability challenges in the green economy are not isolated problems with single solutions; they are complex, interconnected systems shaped by feedback loops, time delays, and unintended consequences. Systems thinking provides the conceptual and analytical tools needed to understand this complexity and to design interventions that are regenerative rather than fragmented. Instead of addressing symptoms in isolation, systems thinking focuses on relationships, patterns, and leverage points where meaningful change can occur.

1. Theory of systems mapping

Systems thinking is grounded in the idea that systems are composed of **interacting elements whose behavior cannot be understood by analyzing parts in isolation**. This perspective draws on the work of scholars such as Donella Meadows and Jay Forrester, who demonstrated how feedback loops and delays shape system behavior over time.

In urban sustainability, a city can be understood as a metabolic system in which energy, water, food, waste, and mobility flows are interconnected. Understanding these interconnections requires moving beyond reductionist, linear cause-and-effect thinking toward embracing complexity and recognizing emergence – the phenomenon where system-level properties arise from interactions that cannot be predicted by examining individual components alone.

1.1 From reductionism to systems thinking: a paradigm shift

The Western scientific tradition, particularly since the Enlightenment, has been dominated by reductionist thinking—the belief that complex phenomena can be understood by breaking them down into smaller, manageable parts. This Newtonian-style approach emphasizes linear cause-effect relationships and seeks to control variables to isolate specific factors. While this methodology has yielded tremendous advances in fields like physics and medicine, it proves inadequate when addressing sustainability challenges characterized by complexity, uncertainty, and interconnectedness.

Systems thinking represents a fundamental paradigm shift from this reductionist worldview. Rather than viewing the world as a collection of separate, analyzable parts (like a bicycle that can be dismantled and reassembled), systems thinking recognizes that many phenomena, particularly social-

ecological systems, are more like living organisms (such as an elephant) where the whole is greater than the sum of its parts. In complex systems, relationships, feedback loops, and context matter as much as, or more than, individual components.

This shift is particularly critical for sustainability education. Traditional educational approaches that compartmentalize knowledge into discrete disciplines fail to prepare students for the interconnected nature of environmental, social, and economic challenges. Climate change, biodiversity loss, resource depletion, and social inequality are not separate problems but manifestations of deeply interconnected systems. Addressing them requires what scholars call "sustainability transitions" – large-scale, disruptive societal changes that unfold over decades and fundamentally alter how we organize economies, technologies, and social structures.

Systems thinking enables learners to:

- **Recognize interconnections**: understand how actions in one part of a system create ripple effects elsewhere
- **Anticipate emergence**: expect unexpected outcomes that arise from complex interactions
- **Identify feedback loops**: distinguish between reinforcing loops (that amplify change) and balancing loops (that stabilize systems)
- **Appreciate time delays**: recognize that causes and effects may be separated by significant time lags
- **Establish appropriate boundaries**: define system boundaries thoughtfully while acknowledging that all systems exist within larger contexts

1.2 Architecture of complex systems: key concepts

To effectively apply systems thinking to sustainability challenges, learners must understand several foundational concepts that distinguish complex systems from simple or complicated ones:

Interconnectedness and Interdependence

Complex systems are characterized by dense networks of relationships where elements influence one another in multiple ways. In urban sustainability contexts, energy systems connect to transportation networks, which link to land use patterns, which affect water consumption, which influences waste generation. These interconnections mean that interventions in one area inevitably affect others—sometimes in unexpected ways. For example, promoting electric vehicles (transportation) increases electricity demand (energy), which may require expanded grid infrastructure (resources), potentially affecting land use (environment) and requiring rare earth minerals (supply chains and social justice).

Feedback loops: reinforcing and balancing

Feedback loops are circular chains of cause and effect that either amplify change (reinforcing/positive feedback) or dampen it (balancing/negative feedback). Understanding feedback dynamics is essential for predicting system behavior and identifying leverage points for intervention.

Reinforcing feedback loops create exponential growth or decline. In sustainability contexts, these can be virtuous or vicious cycles:

- Virtuous example: Increased adoption of renewable energy → reduced costs through economies of scale → greater affordability → further adoption
- Vicious example: Deforestation → reduced rainfall → crop failure → economic pressure → more deforestation

Balancing feedback loops create stability and resistance to change. They often explain why well-intentioned interventions fail to produce expected results:

Example: Urban sprawl policies aim to limit development → housing prices increase → political pressure mounts → policies are relaxed → sprawl continues

In urban sustainability, a city can be understood as a **metabolic system** in which energy, water, food, materials, and people flow continuously. Changes in one part of this metabolism often produce ripple effects elsewhere. To visualize these interactions, **Causal Loop Diagrams (CLDs)** are used. CLDs identify:

- **Reinforcing loops**, which amplify change (e.g. increased car use leading to more road infrastructure, which further encourages car use),

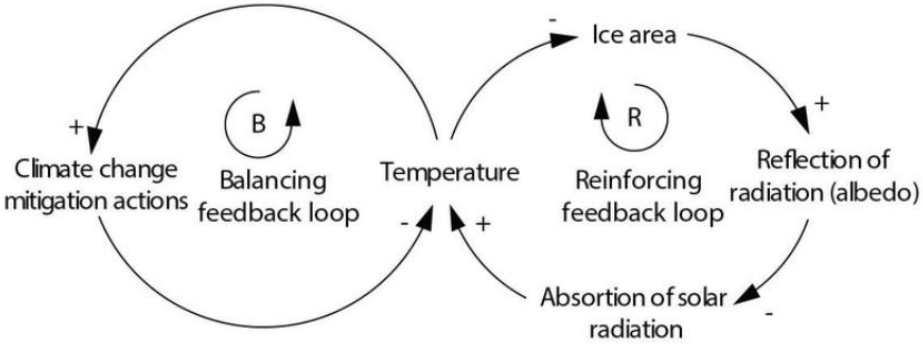


Figure 6 Reenforcing loops (Laurenti 2016)

- **Balancing loops**, which stabilize systems (e.g. congestion discouraging further car use).

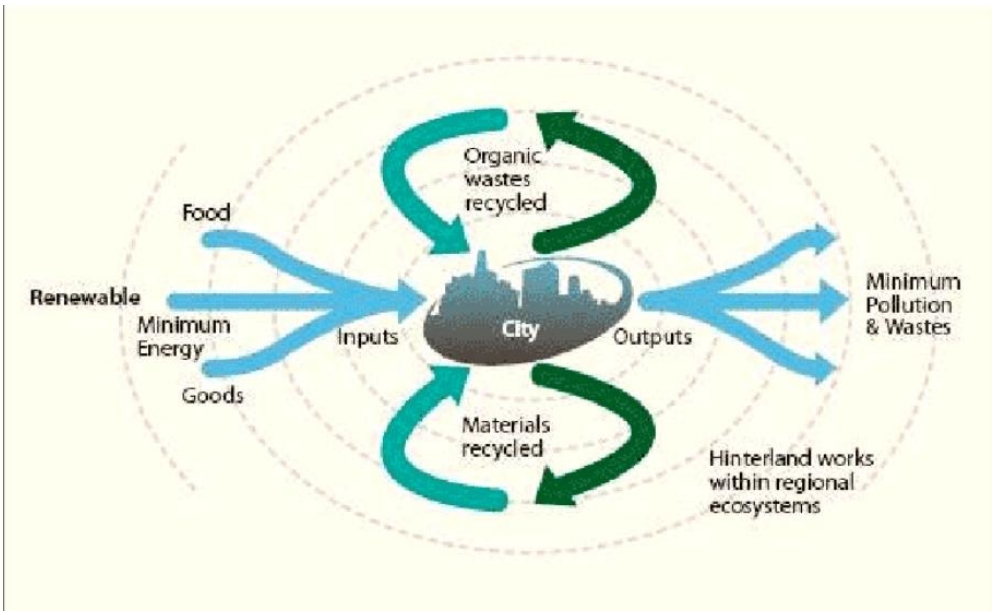


Figure 7 Balancing loops (Lechman et al., 2013)

Mapping these loops helps reveal **leverage points**—strategic places where small interventions can lead to significant system-wide improvements.

Exercise:

Choose one everyday system (e.g. campus cafeteria or commuting). Draw a simple loop showing **one action**, **one consequence**, and **one feedback effect**.

action	consequence	feedback effect

Time delays and non-linear dynamics

One of the most challenging aspects of complex systems is that causes and effects are often separated by significant time delays. Carbon emissions today will affect climate patterns for decades or centuries. Educational investments take years to influence workforce capabilities. Infrastructure decisions lock in resource consumption patterns for generations.

These delays create several problems:

- **Delayed feedback** makes it difficult to learn from experience
- **Overshoot and collapse** patterns emerge when corrective actions come too late
- **Policy resistance** occurs when short-term thinking fails to account for long-term consequences

Non-linear dynamics mean that small changes can sometimes produce disproportionately large effects (tipping points), while large interventions may produce surprisingly modest results if they work against system structure.

Emergence and self-organization

Emergence refers to system-level properties that arise from interactions among components but cannot be predicted by examining those components in isolation. Traffic jams, market crashes, ecosystem resilience, and cultural norms are all emergent phenomena.

Self-organization describes how complex systems can spontaneously develop order and structure without central control. Cities, ecosystems, and economies all exhibit self-organizing properties. Understanding emergence and self-organization helps sustainability practitioners:

- Recognize that top-down control is often ineffective or counterproductive
- Design interventions that work with system dynamics rather than against them
- Appreciate that sustainable solutions often emerge from enabling conditions rather than imposed mandates

System boundaries and nested systems

All systems analysis requires establishing boundaries—deciding what is "inside" the system and what is "outside" (the environment). However, boundaries are analytical constructs, not objective realities. The food system, for example, can be bounded narrowly (farm to table) or broadly (including agricultural inputs, climate impacts, health outcomes, cultural practices, and economic structures).

Moreover, systems are nested within larger systems. A city's energy system is nested within regional grids, national energy policies, global fuel markets, and planetary climate systems. This nested structure means that:

- local interventions are constrained by larger system dynamics
- solutions must often address multiple system levels simultaneously
- unintended consequences frequently arise from interactions across system boundaries

1.3 Systems thinking methodologies and tools

Translating systems thinking principles into practice requires specific methodologies and analytical tools. Several approaches have proven particularly valuable for sustainability education and green economy applications:

Causal Loop Diagrams (CLDs)

Causal loop diagrams are visual tools for mapping feedback relationships within systems. They use arrows to show causal connections between variables, with "+" or "-" signs indicating whether the relationship is positive (variables change in the same direction) or negative (variables change in opposite directions). Loops are identified as reinforcing (R) or balancing (B).

CLDs help learners:

- visualize complex relationships that are difficult to describe verbally
- identify feedback loops that drive system behavior
- communicate system structure to diverse stakeholders
- generate hypotheses about system dynamics and intervention points

For example, a CLD of urban transportation might reveal how:

- More cars → more congestion → longer commute times → pressure for road expansion → more cars (reinforcing loop)
- More cars → more pollution → health problems → political pressure → investment in public transit → fewer cars (balancing loop with delays)

Stock and flow diagrams

Stock and flow diagrams extend causal loop diagrams by explicitly representing accumulations (stocks) and rates of change (flows). Stocks are quantities that accumulate over time (carbon in the atmosphere, housing inventory, skilled workforce). Flows are rates that increase or decrease stocks (emissions, construction, education).

This distinction is crucial for understanding system dynamics because:

- Stocks create inertia and time delays in systems
- Flows can change quickly, but stocks change slowly
- Many sustainability challenges involve managing stocks (carbon, biodiversity, resources)

System dynamics modelling

System dynamics uses computer simulation to model complex systems quantitatively. Tools like En-ROADS (Energy Rapid Overview and Decision Support) allow learners to test policy interventions and observe their effects over time, including feedback loops, delays, and unintended consequences.

System dynamics modelling enables:

- Testing "what-if" scenarios without real-world experimentation
- Observing long-term consequences of short-term decisions
- Understanding how multiple interventions interact
- Communicating complex dynamics to policymakers and stakeholders

2. Planetary boundaries framework

A key extension of systems thinking at the global scale is the **Planetary Boundaries framework**, developed by Rockström and colleagues. This model identifies nine critical Earth system processes that regulate planetary stability, including climate change, biodiversity loss, freshwater use, and land-system change. When human activity pushes these processes beyond safe limits, the risk of irreversible environmental change increases.

The framework highlights that **local actions accumulate into global impacts**. Urban decisions about construction materials, food sourcing, or energy use are therefore not neutral; they are embedded

within global systems of resource extraction, emissions, and waste. Systems thinking encourages "chain thinking", tracing impacts from local choices through supply chains to planetary consequences.

This framework provides a systems-level perspective on sustainability by:

- defining safe operating spaces for human activity
- highlighting interconnections between environmental processes
- establishing science-based targets for sustainability transitions
- demonstrating that local actions have planetary consequences

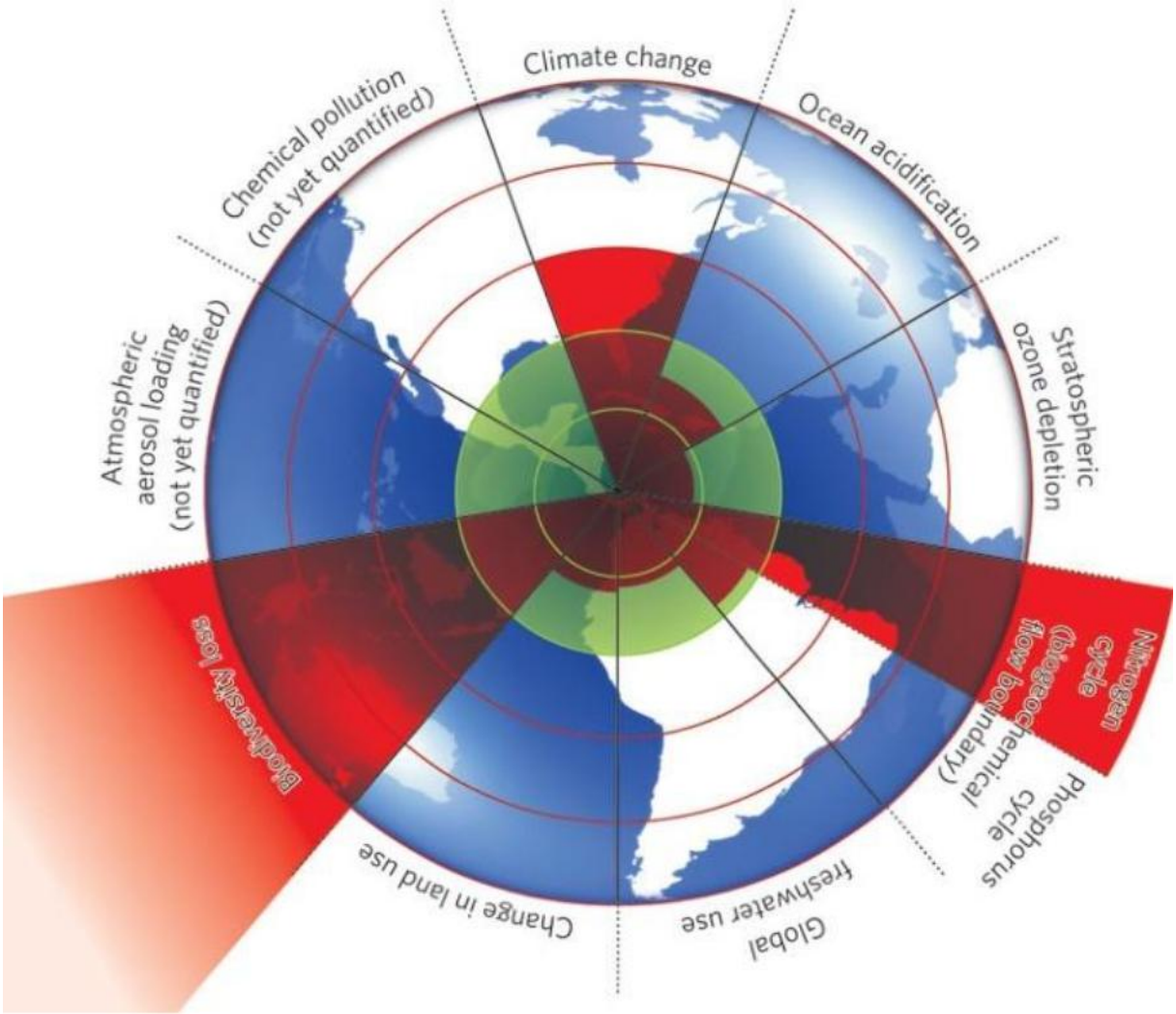


Figure 8 Planetary Boundaries Framework (Rockström et al., 2009)

Exercise:

After watching this video, identify **one planetary boundary** affected by urban lifestyles and write **one example** of a local activity that contributes to its pressure: **What are the planetary boundaries?**

3. Systems thinking in urban sustainability and smart cities

Urban environments provide particularly rich contexts for applying systems thinking to sustainability challenges. Cities are complex adaptive systems where social, economic, technological, and environmental subsystems interact continuously. Understanding urban metabolism, the flows of energy, water, materials, and information through cities, requires systems thinking capabilities.

Urban systems as interconnected networks

Modern cities function through multiple interconnected infrastructure networks:

Energy systems include electricity generation and distribution, heating and cooling networks, and increasingly distributed renewable energy and storage. These systems interact with building design, industrial processes, transportation electrification, and behavioral patterns.

Mobility systems encompass public transit, private vehicles, cycling and pedestrian infrastructure, logistics and freight, and emerging technologies like autonomous vehicles and mobility-as-a-service platforms. Transportation choices affect energy consumption, air quality, land use, social equity, and economic productivity.

Water systems involve supply (extraction, treatment, distribution), use (residential, commercial, industrial, irrigation), and wastewater management. Water systems connect to energy (pumping and treatment require significant electricity), land use (affecting runoff and quality), and climate (precipitation patterns and drought risk).

Waste systems include collection, sorting, recycling, composting, incineration, and landfilling. Waste management intersects with consumption patterns, circular economy initiatives, energy recovery, and environmental justice (as waste facilities are often located in disadvantaged communities).

These systems do not operate independently. Decisions in one domain create cascading effects across others. For example:

- Promoting urban density (land use) can reduce transportation emissions (mobility) but may increase energy demand for cooling (energy) and strain water infrastructure (water)
- Installing green roofs (buildings) can reduce stormwater runoff (water), lower cooling needs (energy), and improve air quality (health)
- Expanding recycling programs (waste) can reduce resource extraction (materials) but requires collection infrastructure (mobility) and processing facilities (energy)

Smart cities and digital systems thinking

Smart city initiatives use digital technologies, sensors, data analytics, artificial intelligence, and connectivity, to optimize urban systems. However, technology alone cannot solve sustainability challenges; it must be guided by systems thinking to avoid unintended consequences.

Digital tools enable new forms of systems analysis:

- **Real-time monitoring** of energy, water, air quality, and traffic flows
- **Predictive analytics** to anticipate system stress and optimize resource allocation

- **Digital twins** that simulate urban systems for scenario testing
- **Participatory platforms** that engage citizens in sustainability decision-making

Yet smart city approaches also introduce new complexities:

- data privacy and surveillance concerns
- digital divides that exclude disadvantaged populations
- energy consumption of digital infrastructure itself
- cybersecurity vulnerabilities in critical infrastructure
- risk of technological lock-in that limits future flexibility

Systems thinking helps navigate these tensions by:

- considering social equity alongside technical efficiency
- anticipating rebound effects (where efficiency gains lead to increased consumption)
- designing for resilience and adaptability rather than optimization alone
- engaging diverse stakeholders in defining "smart" and "sustainable"

Circular economy and urban metabolism

The circular economy framework applies systems thinking to material flows, aiming to eliminate waste by designing products and systems for reuse, repair, remanufacturing, and recycling. In urban contexts, this means:

- industrial symbiosis where one facility's waste becomes another's input
- urban mining to recover valuable materials from buildings and infrastructure
- sharing economy platforms that increase utilization of underused assets
- regenerative design that restores rather than merely sustains ecosystems

Implementing circular economy principles requires understanding:

- material flows across supply chains and consumption patterns
- economic incentives that currently favor linear "take-make-dispose" models
- technological capabilities for material recovery and processing
- behavioral and cultural factors affecting consumption and disposal
- policy frameworks that enable or constrain circular business models

4. Simulating complexity and feedback loops

Complex systems often behave in **non-linear and counter-intuitive ways**. Interventions that seem effective in the short term may create new problems elsewhere in the system. Simulation models help explore these dynamics by allowing experimentation without real-world risk.

Tools such as **En-ROADS**, developed by Climate Interactive and MIT Sloan, simulate the global climate–energy–economy system. By adjusting policy levers, such as carbon pricing, renewable energy deployment, or efficiency improvements, it becomes possible to observe how changes interact across sectors and over time. These simulations illustrate why **single-policy solutions are rarely sufficient** and why integrated strategies are essential for a just green transition.

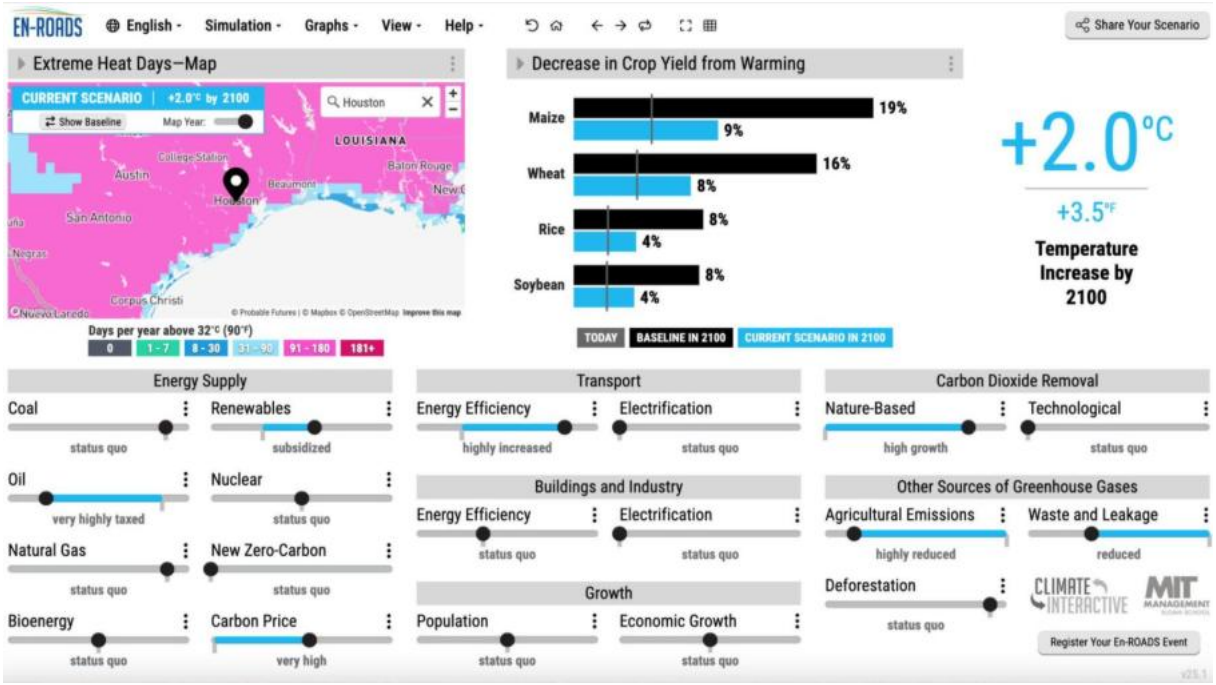


Figure 9 En-ROADS simulator[6]

Simulation Exercise

Tool: En-ROADS Climate Simulator: https://en-roads.climateinteractive.org

Exercise: Adjust **one policy lever** (e.g. energy efficiency). Observe the temperature outcome and note **one unexpected effect** elsewhere in the system.

5. AR as a lens for urban metabolism

Many urban systems – energy flows, emissions, waste streams—remain invisible in daily life. **Augmented Reality (AR)** enhances systems thinking by overlaying data onto physical spaces, making abstract flows visible and spatially grounded.

Through AR, mobility patterns, energy consumption, or pollution hotspots can be visualized directly on maps or real-world environments. This approach supports **real-time sustainability audits**, helping identify inefficiencies, bottlenecks, and opportunities for intervention. AR also reinforces the idea that cities are dynamic systems, where changes in one network can rapidly influence others.

[6] Source: En-ROADS Simulator – TNFD (accessed April 9th, 2026)

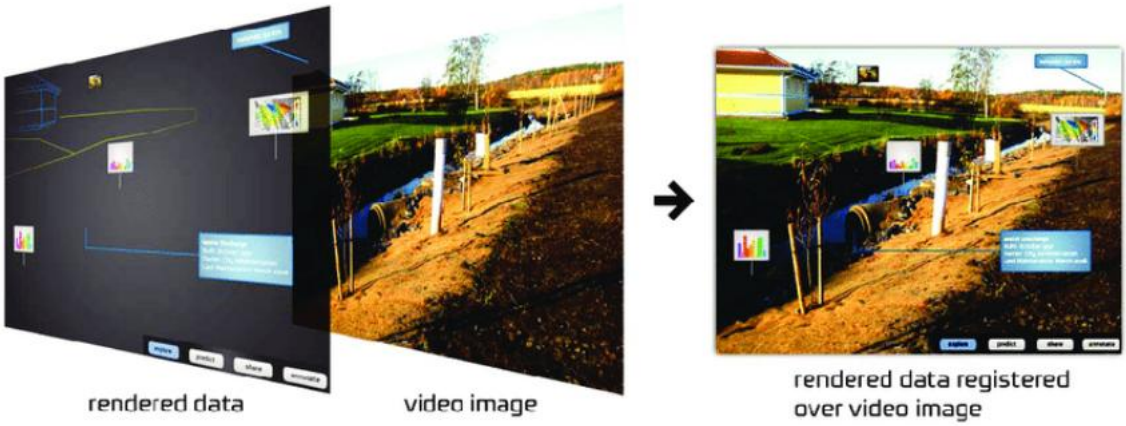


Figure 10 Visualization of augmented real world environments (Kruijff et al., 2010)

AR-supported observation exercise

Tool: Google Earth + data layers or local open-data portals: https://earth.google.com

Exercise: Explore your city or campus and identify one area where transport, land use, and air quality intersect. Note one system interaction you had not considered before.

6. Urban interconnection workshop: exercise

Purpose: To apply systems thinking by mapping interactions between everyday urban systems.

Activity

1. Select three interconnected systems in your institution or neighborhood (e.g. food services, transport, waste).
2. Draw a simple causal loop diagram showing how actions in one system affect the others.
3. Identify one bottleneck and one potential leverage point for sustainability improvement.

Optional Digital Support

- Online diagramming tool: https://www.diagrams.net
- Open urban data portals (local municipality websites)

Reflection

Why do sustainability solutions fail when systems interactions are ignored? How does systems thinking change the way problems and solutions are defined?

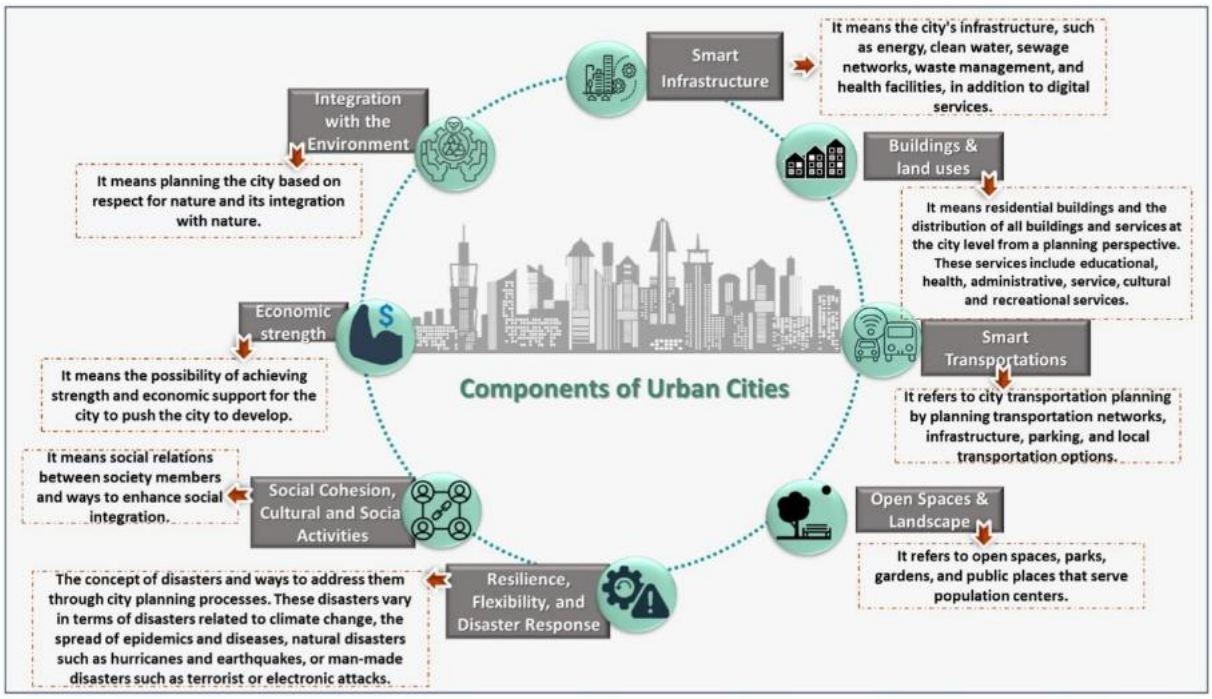


Figure 11 Components of urban cities (Alsayed, 2024)

7. Pedagogical approaches for teaching systems thinking

Developing systems thinking capabilities requires pedagogical approaches that go beyond traditional lecture-based instruction. Effective sustainability education for systems thinking incorporates:

Experiential and problem-based learning

Students learn systems thinking most effectively by applying it to real-world problems. Case studies of actual sustainability challenges, urban water management, renewable energy transitions, circular economy initiative, provide contexts for practicing systems analysis. Problem-based learning engages students in defining problems, mapping systems, identifying leverage points, and proposing interventions.

Simulation and gaming

Computer simulations (like En-ROADS for climate policy) and serious games allow students to experiment with complex systems in safe environments. By testing interventions and observing consequences, learners develop intuition for feedback dynamics, time delays, and unintended effects. Simulation-based learning makes abstract concepts concrete and memorable.

Collaborative and interdisciplinary learning

Sustainability challenges require integrating knowledge from multiple disciplines, environmental science, economics, engineering, social science, policy, and design. Interdisciplinary learning experiences help students appreciate different perspectives and develop capacity to work across boundaries. Collaborative projects mirror real-world sustainability work, which always involves diverse stakeholders.

Visual and spatial thinking

Systems thinking relies heavily on visual representation, diagrams, maps, models, and data visualizations. Developing visual literacy and spatial reasoning enhances systems thinking capabilities. Augmented reality (AR) technologies offer new possibilities for visualizing complex urban systems, allowing students to "see" invisible flows of energy, water, and materials overlaid on physical environments.

Reflective practice and metacognition

Learning to think systemically requires reflecting on one's own thinking processes. Metacognitive activities, journaling about systems insights, discussing how perspectives have shifted, examining assumptions, help students internalize systems thinking as a habit of mind rather than just a set of tools.

Connecting individual to systemic change

Sustainability education must help students connect personal actions to systemic dynamics. Understanding how individual consumption patterns aggregate into global environmental pressures, or how career choices contribute to economic transitions, makes systems thinking personally relevant and motivates engagement.

Detailed lesson plan – domain 4

Write down in a detailed way the content, the teaching methods and the AR applications.

Time / Goals	Content / Element(s)	Teaching method	Point(s) of attention / AR application
Activation of prior knowledge / Empathize	**Introduction to Urban Interconnection:** Analyzing how daily actions (eating, commuting) link to energy, water, and waste systems.	**Interactive Brainstorming:** Students map the "metabolism" of a typical day, listing every system they interacted with.	**AR Application (Urban Flows):** Students use AR to visualize complex urban networks (energy, mobility, waste) on a digital tabletop to analyze overlaps.
Demonstration / Define – Ideate	**The Architecture of Systems:** Introduction to Causal Loop Diagrams, feedback loops, and the Planetary Boundaries framework.	**Simulated Learning:** Using tools like En-ROADS to test climate policies and observe non-linear feedback across different sectors.	**AR Application (Boundary Exploration):** AR simulations where students "zoom out" from a city to see its impact on global planetary boundaries.
Application / Prototype	**Systems Innovation:** Designing circular economy models and identifying	**Design Workshop:** Creating a circular intervention for an urban system (e.g.,	**AR Application (System Prototyping):** Students design and simulate the impact

	"leverage points" for interventions.	a gray-water recycling loop).	of their circular intervention in AR, observing data flow changes.
Integration / Test	**Synthesizing Complexity:** Reflecting on how systems thinking applies to professional fields and the green economy.	**Group Presentation:** Teams explain their circular prototypes and the feedback loops created, followed by a peer-review session.	**AR Application (Final Audit):** A final AR presentation showing a "before and after" systemic redesign to campus or industry stakeholders.

DOMAIN 5: CRITICAL THINKING

General information

TOPIC	Critical Thinking: Greenwashing and critical analysis of sustainability claims	
GREENCOMP AREA	Embracing Complexity in Sustainability	
GREENCOMP SKILL	Critical Thinking	
LINK TO OTHER GREENCOMP SKILLS	Valuing Sustainability; Systems Thinking; Problem Framing	
OTHER FRAMEWORKS	SDG	12 (Responsible Consumption and Production), 13 (Climate Action)
	EC4T	Reflecting critically on impact
	GT	Real sustainability vs. marketing
LEARNING GOALS	By the end of this module, learners will be able to: ● Identify and deconstruct various forms of greenwashing in corporate communication and product labelling. ● Evaluate the validity of sustainability reports and eco-labels using evidence-based criteria. ● Analyze misinformation and media bias in environmental communication. ● Apply AR technology to research and visually expose the hidden environmental impacts of products.	
SOURCES	GreenEDU E-Toolkit; GreenEDU Curriculum; EU Green Claims Directive	
DURATION	**7 Hours**	

About domain 5: critical thinking

Critical thinking in sustainability is the ability to question information, assumptions and dominant narratives about environmental and social issues. Learners assess the reliability and relevance of sources, detect bias, greenwashing and misinformation, and compare competing explanations of a problem. This competence encourages them to challenge the status quo when it supports unsustainable patterns and to build well-reasoned arguments for more sustainable alternatives.

Main content: navigating misinformation and greenwashing

As the green economy grows, so does the risk of **greenwashing,** the practice of presenting products, services, or corporate policies as more environmentally friendly than they actually are. This module provides the conceptual frameworks, analytical tools, and interactive exercises necessary to critically evaluate sustainability claims, enhancing transparency and ethical decision-making.

1. Deconstructing greenwashing

Greenwashing often uses **vague language**, irrelevant or token environmental actions, and unverified eco-labels to create the perception of sustainability. The theoretical foundation comes from **media literacy** and **environmental communication studies**, which examine how cognitive biases and emotional cues influence consumer perception. By understanding framing effects, selective omission, and persuasive imagery, it becomes possible to spot deceptive sustainability messaging.

Read *The Six Sins of Greenwashing* by TerraChoice:
https://sustainability.usask.ca/documents/Six_Sins_of_Greenwashing_nov2007.pdf



Figure 12 How to spot greenwashing[7]

[7] Source: Greenwashing: Overview, How It Works, Examples | The Motley Fool (accessed April 9th, 2026)

Quick exercise: "Spot the greenwash"

- Search on the internet a product advertised as "eco-friendly."
- Identify **one vague claim**, **one irrelevant claim**, and **one unverified label**.
- Discuss with your peers how these might mislead consumers. Would you classify this 'green claim' as trustworthy, uncertain, or potentially misleading?

Greenwashing emerged as a significant phenomenon in the 1980s when environmental awareness began influencing consumer behavior and corporate reputation. The term itself was coined by environmentalist Jay Westerveld in 1986, who observed hotels asking guests to reuse towels "to save the environment" while making no other meaningful environmental efforts. Since then, greenwashing has evolved from simple false claims to sophisticated marketing strategies that exploit psychological vulnerabilities and information asymmetries.

Psychology behind greenwashing's effectiveness

Greenwashing succeeds because it exploits several well-documented cognitive biases and psychological mechanisms:

Confirmation Bias and Wishful Thinking: Consumers who want to believe they are making sustainable choices are predisposed to accept green claims at face value. This confirmation bias makes people less critical of environmental messaging that aligns with their self-image as responsible consumers. Research shows that people experience cognitive dissonance when their consumption habits conflict with environmental values, and greenwashing provides psychological relief by suggesting that consumption and sustainability are compatible.

The Halo Effect: When a product or company is associated with one positive environmental attribute (like recyclable packaging), consumers tend to assume other aspects are also environmentally responsible. A single green claim creates a "halo" that obscures less sustainable practices elsewhere in the product lifecycle or corporate operations.

Information Asymmetry and Complexity: Sustainability involves complex systems, supply chains, lifecycle impacts, carbon accounting, biodiversity effects, that are difficult for consumers to verify. Companies possess far more information about their environmental impacts than consumers can access, creating asymmetry that enables misleading claims. The technical complexity of environmental science makes it challenging for non-experts to evaluate claims critically.

Emotional Appeals and Nature Imagery: Greenwashing frequently uses nature imagery (leaves, forests, pristine landscapes), earth tones (green, brown, blue), and emotionally resonant language ("pure," "natural," "eco-friendly") to create positive associations. These visual and linguistic cues trigger emotional responses that bypass critical analysis. Research in environmental communication shows that nature imagery activates feelings of trust and authenticity, even when disconnected from actual environmental performance.

Authority and Certification Confusion: Consumers trust official-looking labels, certifications, and endorsements. Greenwashing exploits this by creating pseudo-certifications, using vague third-party endorsements, or displaying symbols that resemble legitimate eco-labels but lack meaningful

standards. The proliferation of genuine eco-labels (over 450 worldwide) creates confusion that green washers exploit.

Business case for greenwashing

Understanding why companies engage in greenwashing requires examining economic incentives and competitive pressures:

- **Market demand**: consumer surveys consistently show that significant percentages (60-80% in many markets) prefer sustainable products and are willing to pay premiums for them. This creates strong incentives to appear green without incurring the costs of genuine sustainability transformation.
- **Regulatory pressure**: as governments implement environmental regulations, companies face pressure to demonstrate compliance and environmental responsibility. Greenwashing allows companies to appear compliant while minimizing actual changes to business models.
- **Investor expectations**: the rise of ESG (Environmental, Social, Governance) investing means companies must demonstrate sustainability credentials to attract capital. Greenwashing enables companies to access ESG investment flows without fundamental operational changes.
- **Competitive positioning**: when competitors make environmental claims, companies feel pressure to match them to avoid appearing less sustainable, even if they cannot substantiate equivalent claims.
- **Cost avoidance**: genuine sustainability transitions often require significant capital investment, supply chain restructuring, and business model innovation. Greenwashing provides reputational benefits at a fraction of the cost.

2. Critical thinking frameworks for sustainability claims

Developing critical thinking capabilities for evaluating sustainability claims requires systematic frameworks that guide analysis and expose deceptive practices. Several complementary approaches provide structured methods for critical evaluation:

CRAAP test adapted for sustainability claims

The CRAAP Test (Currency, Relevance, Authority, Accuracy, Purpose) is a widely used information literacy framework that can be adapted for evaluating environmental claims:

Currency: When was the claim made? Is the information current or outdated? Environmental science evolves rapidly, and claims based on outdated research may no longer be valid. Example: Claims about "biodegradable plastics" may reference older materials that have been superseded by better alternatives or proven ineffective.

Relevance: Does the claim address the actual environmental impact of concern? Is it material to the product's overall sustainability? Example: Highlighting recyclable packaging while ignoring the product's carbon footprint during manufacturing and transport.

Authority: Who is making the claim? What are their credentials and potential conflicts of interest? Is the claim verified by independent third parties? Example: Industry-funded studies showing environmental benefits versus peer-reviewed independent research.

Accuracy: Can the claim be verified? Are sources cited? Is the methodology transparent? Example: "Reduces carbon emissions by 30%" should specify: compared to what baseline? Over what timeframe? Using what methodology?

Purpose: Why is this claim being made? Is it to inform, sell, or persuade? What are the underlying motivations? Example: Distinguishing between transparent sustainability reporting and marketing-driven green claims.

3. Evidence-based evaluation of sustainability reports

Beyond marketing, companies often publish **sustainability or ESG reports**. Critical evaluation requires checking for:

- **Data transparency**: Are environmental metrics clearly reported?
- **Third-party verification**: Are claims aligned with frameworks like GRI, SASB, or the EU Green Claims Directive?
- **Consistency**: Do reported actions match the company's overall environmental footprint?

This approach draws on **audit theory**, **corporate social responsibility literature**, and **peer review methodologies**, teaching how to triangulate claims with evidence.

Claim–Evidence–Reasoning (CER) exercise: greenwashing analysis

Instructions: Below are several statements related to sustainability. For each statement, decide whether it is a **Claim**, **Evidence**, or **Reasoning**, and briefly explain your choice in one line.

Statements:

1. "This company's bottled water is 100% eco-friendly."
2. "Independent testing shows that the production of this bottled water uses 5 liters of water per 1 liter produced."
3. "Reducing water use in production decreases environmental impact and aligns with sustainability goals."
4. "Our packaging is made from recycled plastic."
5. "Life-cycle assessments indicate that recycled plastic packaging reduces CO_2 emissions by 30% compared to virgin plastic."
6. "Using recycled materials demonstrates corporate responsibility and reduces the company's carbon footprint."

Claim	Evidence	Reasoning

4. Media literacy and the “nuclear vs. renewables” debate

Critical thinking about sustainability requires understanding how information flows through media ecosystems, how different actors shape environmental narratives, and how to navigate the complex landscape of environmental information sources.

Navigating the complex discourse around energy transitions requires not only factual knowledge but also **media literacy**, a set of skills that enables critical evaluation of information, identification of bias, and recognition of persuasive strategies in communication.

Media outlets frame issues in specific ways, emphasizing some aspects while ignoring others. For instance, nuclear energy may be framed as “clean and reliable” or as “dangerous and unmanageable,” depending on the source. Understanding frames helps readers see how narratives shape perceptions of risk and opportunity.

Consumers and citizens often rely on mental shortcuts, such as **availability bias** (judging risks based on memorable events like Fukushima) or **confirmation bias** (favoring sources that confirm existing beliefs about renewables). Recognizing these biases is essential to evaluate energy debates critically.

Messages are more persuasive if the source is perceived as credible. In energy debates, distinguishing between peer-reviewed research, think-tank reports, advocacy media, or corporate marketing is key to separating evidence from opinion.

Misinformation is common in public debates around energy and sustainability. Systems thinking and critical evaluation help to:

- Assess **credibility of sources** (peer-reviewed, governmental, NGO, media).
- Identify **oversimplifications** (e.g., “renewables are bad” or “nuclear is perfect”).
- Understand **ethical trade-offs** and stakeholder perspectives (environmental, social, economic).

Environmental information ecosystem

Environmental information reaches the public through multiple channels, each with distinct characteristics, incentives, and reliability:

Scientific Literature: Peer-reviewed research provides the most rigorous evidence but is often:

- inaccessible behind paywalls
- written in technical language
- slow to publish (months to years from research to publication)
- nuanced and uncertain in ways that resist simple messaging

Science Journalism: Translates scientific findings for general audiences but faces challenges:

- pressure for sensational headlines ("clickbait")
- limited space/time for nuance and uncertainty
- journalists may lack scientific expertise
- economic pressures reducing investigative environmental journalism

Corporate Communications: Companies communicate environmental performance through:

- sustainability reports (varying in transparency and rigor)
- marketing and advertising (optimized for positive perception)
- press releases (selective presentation of favorable information)
- social media (direct-to-consumer messaging with minimal oversight)

NGO and Advocacy Organizations: Environmental groups provide:

- watchdog functions exposing greenwashing
- simplified messaging to mobilize action
- potential bias toward alarmism to drive donations and engagement
- varying levels of scientific rigor

Government and Regulatory Sources: Official environmental data and reports offer:

- authoritative information on regulations and compliance
- environmental monitoring data
- potential political influence on framing and emphasis
- varying accessibility and transparency

Social Media and User-Generated Content: Platforms enable:

- rapid information spread (and misinformation spread)
- diverse voices and perspectives
- echo chambers and filter bubbles
- difficulty verifying sources and claims

Identifying bias and conflicts of interest

Critical evaluation requires recognizing how different actors' interests shape environmental communication:

Financial Conflicts: Who funds the research, report, or communication? Industry-funded studies are significantly more likely to reach conclusions favorable to funders. Questions to ask:

- Who paid for this research or report?
- Do authors have financial relationships with interested parties?
- Are funding sources disclosed transparently?

Ideological and Political Bias: Environmental issues are often politically polarized. Sources may frame information to support particular political positions. Consider:

- Does the source have a stated political orientation?
- Is the framing consistent with particular political narratives?
- Are alternative perspectives acknowledged?

Organizational Mission Bias: Organizations communicate in ways that support their missions:

- corporations emphasize positive environmental actions
- environmental NGOs emphasize problems and urgency
- government agencies may emphasize regulatory compliance

Confirmation Bias in Source Selection: People tend to seek and trust sources that confirm existing beliefs. Critical thinkers should:

- deliberately seek sources with different perspectives
- evaluate evidence independent of whether it confirms preferences
- distinguish between what we want to be true and what evidence supports

Recognizing logical fallacies in environmental arguments

Environmental debates frequently involve logical fallacies that undermine sound reasoning:

- *Appeal to Nature Fallacy*: Assuming that "natural" equals "good" or "sustainable." Many natural substances are toxic, and many synthetic materials are more sustainable than natural alternatives.
- *False Dichotomy*: Presenting only two options when more exist. Example: "Either we allow economic growth, or we protect the environment" ignores possibilities for sustainable development.
- *Slippery Slope*: Arguing that a small action will inevitably lead to extreme consequences without evidence. Example: "Any environmental regulation will destroy the economy."
- *Ad Hominem*: Attacking the person making an argument rather than the argument itself. Example: Dismissing climate science because researchers receive government funding.
- *Appeal to Authority*: Citing authority figures outside their expertise. Example: Celebrity endorsements of environmental products without scientific basis.
- *Hasty Generalization*: Drawing broad conclusions from limited examples. Example: "This winter was cold; therefore climate change isn't happening."
- *Red Herring*: Introducing irrelevant information to distract from the main issue. Example: Responding to criticism of plastic pollution by highlighting company charitable donations.
- *Straw Man*: Misrepresenting an opponent's position to make it easier to attack. Example: Characterizing environmental advocates as wanting to "return to the Stone Age."

Evaluating visual communication and data visualization

Environmental communication increasingly relies on visual elements that can inform or mislead:

Misleading Graphs and Charts:

- truncated y-axes that exaggerate changes
- cherry-picked time periods that show favorable trends
- inappropriate chart types that obscure patterns
- missing context or comparison baselines

Nature Imagery and Green Aesthetics:

- photographs of pristine nature unrelated to actual product impacts

- green color schemes suggesting environmental benefits
- natural textures and organic shapes creating "eco" associations

Infographics and Simplified Visualizations:

- can clarify complex information or oversimplify to the point of distortion
- may omit important caveats and uncertainties
- source and methodology often not visible

Critical visual literacy involves asking:

- What is this visualization showing and what is it hiding?
- Is the visual representation proportional to the underlying data?
- What context is missing?
- Does the imagery match the substance of the claim?

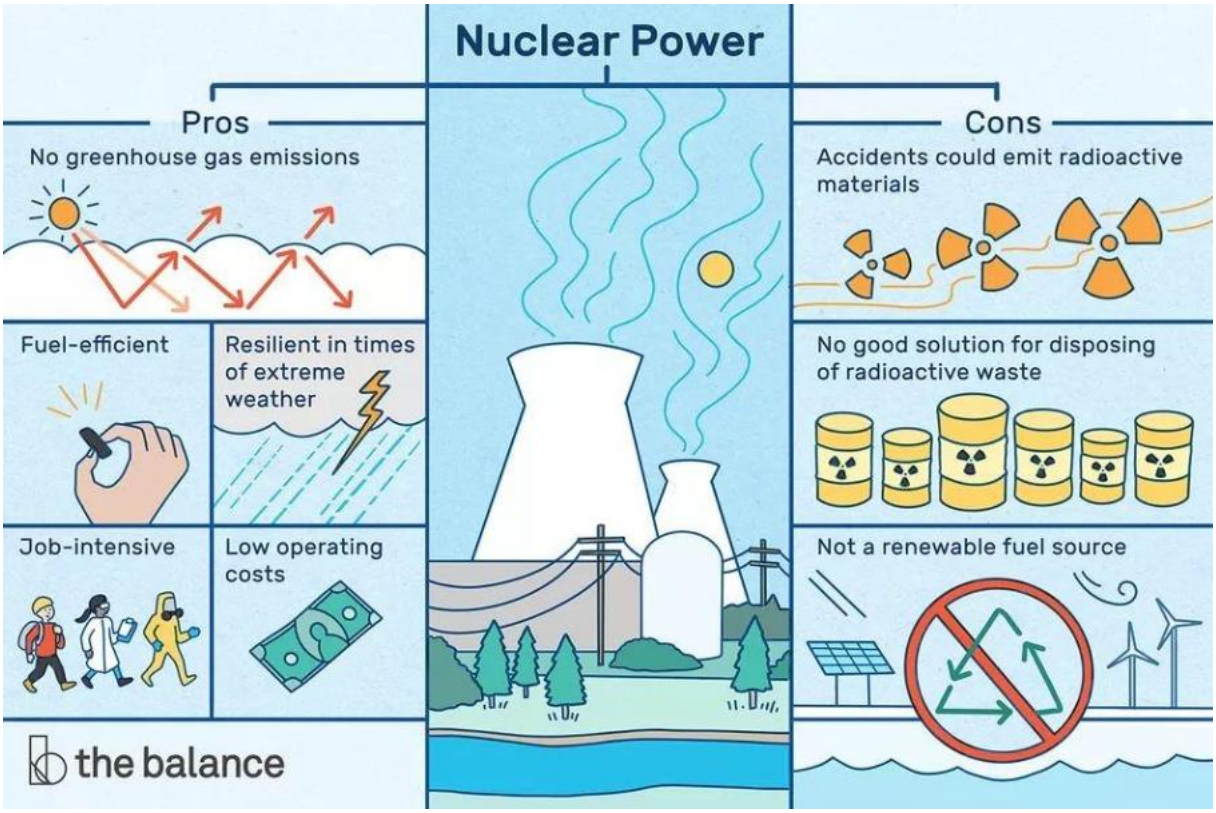


Figure 13 Nuclear power. Pros and cons[8]

Quick Exercise: "Debate Evidence Check"

Read this article: **Solar vs Nuclear Power: Which Is the Better Energy Source?** (or alternatively, watch this video: Nuclear Physicist Explains - Nuclear VS Renewable Energy) and:

- Pick one claim.
- Identify the **source type** and **evidence provided**.

[8] Source: Solar vs Nuclear Power: Which Is the Better Energy Source? (accessed April 12th, 2026)

- Summarize in one line: Is this claim **supported, questionable, or misleading**?

FactCheck.org is a non-profit website that aims to reduce the level of deception and confusion in U.S. politics by providing original research on misinformation and hoaxes.

- FactCheck.org environmental section: https://www.factcheck.org/issue/climate-change/

5. AR as a tool for transparency

Augmented Reality (AR) is increasingly being used as a **powerful tool to visualize hidden environmental impacts** and combat greenwashing. While marketing often presents sustainability claims as simplified, idealized, or incomplete, AR enables users to explore the **full lifecycle of a product, service, or policy**, revealing data that might otherwise remain invisible.

AR in sustainability education draws on **experiential learning theory** (Kolb, 1984) and **visualization theory** in environmental communication. Experiential learning emphasizes that direct interaction with data and systems promotes deeper understanding and retention. AR provides this interactivity, allowing learners to **see, manipulate, and explore real-world systems** in ways that traditional text or charts cannot.

Key functions of AR in sustainability:

- **Lifecycle visualization:** Display raw material extraction, manufacturing, transportation, use, and disposal in an interactive, layered format.
- **Comparative analysis:** Contrast marketed claims with actual environmental footprints (carbon, water, energy).
- **Stakeholder perspective:** Highlight impacts on workers, communities, and ecosystems across supply chains.

Life cycle assessment & the EF methods



Figure 14 Life cycle assessment[9]

https://green-forum.ec.europa.eu/green-business/environmental-footprint-methods/life-cycle-assessment-ef-methods_en

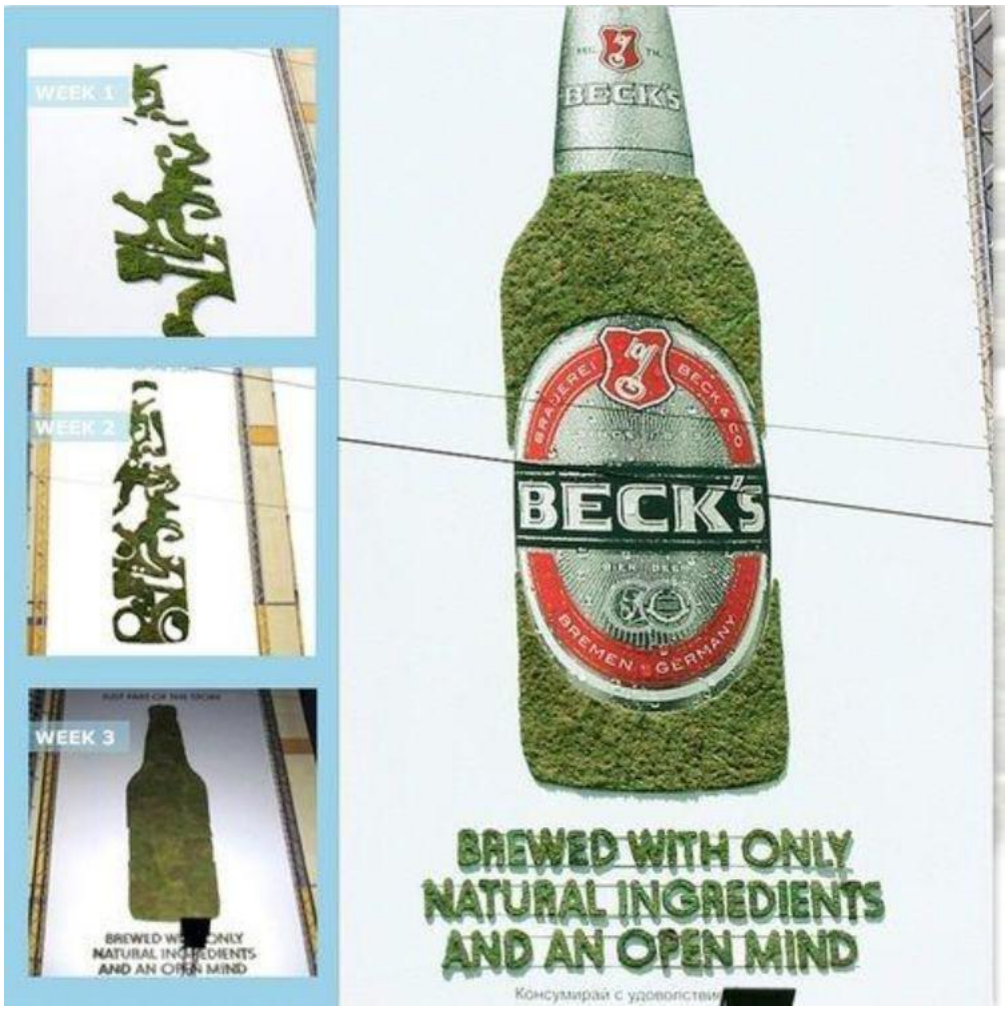
Exercise: "Greenwashing detective"

Objective: Explore hidden environmental impacts and practice transparent, evidence-based communication.

Instructions:

1. Check the sustainability claims of **Beck's**– "eco-friendly beer"

[9] Source: Life Cycle Assessment & the EF methods - Green Forum (accessed April 12th, 2026)



2. **Use this tool** to visualize the product's true environmental impact: Product Environmental Footprint (PEF): https://green-forum.ec.europa.eu/green-business/environmental-footprint-methods/pef-method_en and https://brewersofeurope.eu/our-priorities/environmental-footprinting/
3. **Compare the visualization to the marketing claim.**
4. **Rewrite the claim** in one clear sentence that accurately reflects the evidence.

Reflection

Why do companies exaggerate sustainability claims?

How can media literacy and AR visualization empower consumers and institutions to act ethically?

How can evidence-based evaluation of green claims improve trust in the green economy?

6. Pedagogical approaches for teaching critical thinking in sustainability

Developing critical thinking capabilities requires pedagogical approaches that move beyond knowledge transmission to active skill development and application.

Inquiry-based learning

Rather than presenting information about greenwashing, inquiry-based approaches engage students in investigating real sustainability claims:

Claim Investigation Projects: Students select products, companies, or campaigns making sustainability claims and conduct systematic investigations:

- Identify specific claims being made
- Research evidence supporting or contradicting claims
- Evaluate using critical thinking frameworks
- Present findings with recommendations

This approach develops research skills, analytical capabilities, and confidence in independent evaluation.

Case-based learning

Analyzing real-world greenwashing cases (like those in section 1.6) helps students:

- recognize patterns and tactics across different contexts
- understand consequences of greenwashing
- develop ethical reasoning about corporate responsibility
- apply theoretical frameworks to concrete situations

Case discussions should encourage students to:

- identify what they would have questioned as consumers or professionals
- propose how the deception could have been detected earlier
- consider systemic factors that enable greenwashing
- develop strategies for preventing similar cases

Debate and argumentation

Structured debates on controversial sustainability topics develop critical thinking by:

- requiring students to research and present evidence
- forcing consideration of multiple perspectives

- practicing constructive disagreement
- distinguishing between facts, interpretations, and values

Example debate topics:

- "Carbon offsets are an effective tool for climate action" (pro vs. con)
- "Individual consumer choices can drive sustainability transitions" (pro vs. con)
- "Voluntary corporate sustainability commitments are sufficient" (vs. regulation)

Media literacy exercises

Analyzing environmental communication across different media develops critical evaluation skills:

Advertisement Analysis: Students deconstruct green marketing campaigns:

- identify explicit and implicit claims
- analyze visual and linguistic techniques
- evaluate evidence and substantiation
- recognize emotional appeals and psychological tactics

News Article Comparison: Students compare coverage of the same environmental issue across different sources:

- identify framing differences
- recognize bias and perspective
- evaluate evidence quality
- synthesize information from multiple sources

Social Media Investigation: Students analyze environmental claims on social media:

- trace information to original sources
- identify misinformation and manipulation
- evaluate influencer credibility
- understand viral spread of environmental claims

Experiential learning with AR technology

Augmented Reality offers unique opportunities for critical thinking development:

Supply Chain Visualization: AR applications that overlay product supply chains on physical products, revealing:

- geographic origins of materials
- environmental impacts at each stage
- labor conditions and social impacts
- transportation distances and emissions

Students can compare marketing claims to visualized realities, developing critical awareness of hidden impacts.

- *eco-label decoder*: AR apps that scan product labels and provide:
- verification of certification legitimacy
- explanation of what certifications actually certify
- comparison to alternative products
- lifecycle impact data

This transforms abstract critical thinking into practical consumer skill.

Greenwashing Detection Game: Gamified AR experiences where students:

- scan products and advertisements
- identify greenwashing tactics
- earn points for accurate detection
- compete or collaborate with peers

Gamification increases engagement while developing pattern recognition.

Reflective practice and metacognition

Critical thinking development requires reflection on one's own thinking processes:

Belief Examination: Students reflect on their own environmental beliefs and consumption patterns:

- What do I believe about sustainability and why?
- What claims have I accepted without critical evaluation?
- How do my values influence my evaluation of evidence?
- Where might I be vulnerable to greenwashing?
- When evidence of an argument makes me feel defensive or uncomfortable, do I examine it more closely, or do I look for reasons to dismiss it?

Cognitive Bias Awareness: Students learn about cognitive biases affecting environmental judgment:

- confirmation bias (seeking information that confirms beliefs)
- availability heuristic (overweighting easily recalled information)
- optimism bias (believing problems will be solved without action)
- present bias (discounting future consequences)

Understanding these biases helps students recognize and counteract them.

Decision Journals: Students maintain journals documenting:

- sustainability-related decisions they make
- information they used to make decisions
- how they evaluated competing claims
- reflection on decision quality with hindsight

This develops metacognitive awareness and improves decision-making over time.

Collaborative learning and peer review

Critical thinking is enhanced through social interaction:

Peer Evaluation of Analyses: Students review each other's sustainability claim evaluations:

- identify strengths and weaknesses in reasoning
- suggest additional evidence or perspectives
- practice constructive criticism
- learn from diverse analytical approaches

Collaborative Investigations: Small groups investigate complex sustainability claims:

- divide research responsibilities
- synthesize findings collaboratively
- negotiate disagreements through evidence
- present collective analysis

This mirrors professional practice where sustainability evaluation is typically collaborative.

Connecting individual skills to systemic change

Critical thinking education should connect individual capabilities to broader change:

Professional Application: Students explore how critical thinking applies in green economy careers:

- sustainability consultants evaluating corporate claims
- journalists investigating environmental stories
- policymakers assessing industry commitments
- investors conducting ESG due diligence
- designers avoiding greenwashing in their own work

Civic Engagement: Students consider how critical thinking enables democratic participation:

- evaluating political candidates' environmental platforms
- assessing ballot initiatives on environmental issues
- engaging in public comment on regulations
- supporting or challenging corporate practices

Systems Change Perspective: Students understand that individual critical thinking, while valuable, must connect to collective action:

- How can critical consumers create market pressure for genuine sustainability?
- What role does transparency regulation play in enabling critical evaluation?
- How can professionals within organizations drive authentic sustainability?
- What systemic changes would make greenwashing less profitable and prevalent?

Detailed lesson plan – domain 5

Write down in a detailed way the content, the teaching methods and the AR applications.

Time / Goals	Content / Element(s)	Teaching method	Point(s) of attention / AR application
Activation of prior knowledge / empathize	**The lure of green marketing:** students bring examples of "green" advertisements they trust or find suspicious.	**Interactive gallery walk:** sharing and discussing the emotional impact of "green" imagery and terminology.	**AR application (marketing scan):** students scan ad images to see "hidden" environmental data overlays that either confirm or contradict the ad's claims.
Demonstration / define – ideate	**Deconstructing claims:** analysis of the EU green claims directive and deconstruction of common greenwashing tactics.	**Analytical workshop:** peer review of specific corporate sustainability claims and eco-label values.	**AR application (hidden impact):** AR simulations where students virtually peel back layers of a product's marketing to see the raw resource costs behind it.
Application / prototype	**From marketing to transparency:** redesigning corporate or institutional communication to be ethically sound.	**Design challenge:** rewriting a sustainability report or marketing campaign to meet strict transparency standards.	**AR application (transparent redesign):** students create a "transparency AR layer" for a product that provides consumers with verified data at the point of sale.
Integration / test	**The great transition debate:** engaging in structured debates on nuclear energy, renewables, or degrowth.	**Socratic seminar:** students debate ethical choices, using researched evidence to support or refute sustainability claims.	**AR application (evidence dashboard):** facilitators use AR to project real-time data visualizations during the debate to verify student arguments.

DOMAIN 6: PROBLEM FRAMING

General information

TOPIC	Problem Framing: Redefinition of sustainability challenges to opportunities for innovation	
GREENCOMP AREA	Embracing Complexity in Sustainability	
GREENCOMP SKILL	Problem Framing	
LINK TO OTHER GREENCOMP SKILLS	Systems Thinking; Critical Thinking; Collective Action	
OTHER FRAMEWORKS	SDG	9 (Industry, Innovation, and Infrastructure)
	EC4T	Framing challenges for creative solutions
	G	Design thinking for sustainable innovation
LEARNING GOALS	By the end of this module, learners will be able to: ● Define sustainability challenges by considering multiple perspectives and identifying root causes over symptoms. ● Analyze stakeholder ecosystems to understand how different disciplines approach environmental issues. ● Utilize Design Thinking methodologies to reframe local environmental problems as opportunities for green innovation. ● Develop low-fidelity prototypes using AR to visualize sustainable solutions within a local context.	
SOURCES	GreenEDU E-Toolkit; GreenEDU Curriculum; UN SDG Mapping	
DURATION	**7 Hours**	

About domain 6: problem framing

Problem framing is about defining and describing situations explicitly as sustainability problems so that they can be addressed appropriately. Learners identify who and what is affected, which dimensions (environmental, social, cultural, economic) are involved, and what time and spatial scales are at stake. The competence supports choosing suitable approaches—such as prevention, mitigation, adaptation or transformation—and clarifying where incremental improvements may suffice and where deeper systemic change is needed.

Main content: reframing challenges as innovation opportunities

Sustainability challenges are rarely straightforward. Often, environmental, social, and economic dimensions are deeply intertwined. This module focuses on **problem framing** – defining challenges from multiple perspectives to uncover root causes rather than treating superficial symptoms. In the context of GreenEDU, effective framing transforms complex environmental hurdles into **actionable opportunities for sustainable innovation**.

1. Root causes vs. symptoms

Problem framing involves differentiating **surface-level symptoms** from **underlying systemic causes**. The **Systems Thinking paradigm** (Meadows, 2008) asserts that complex issues such as waste generation, water scarcity, or urban pollution emerge from interacting social, ecological, and economic subsystems.

- **Systems perspective:** problems should be analyzed as part of a **network of interrelated factors**, where intervention at leverage points can trigger disproportionate positive outcomes.
- **Socio-technical lens:** environmental challenges can be reframed as design problems by integrating technical feasibility, social norms, and economic viability.
- **Root cause analysis:** tools like **the Five Whys** or **Causal Loop Diagrams** help identify the deeper drivers behind observed problems, revealing opportunities for structural rather than symptomatic solutions.

Example: Overflows in campus bins are not just a disposal issue, they reflect consumption patterns, packaging design, and behavioral incentives.

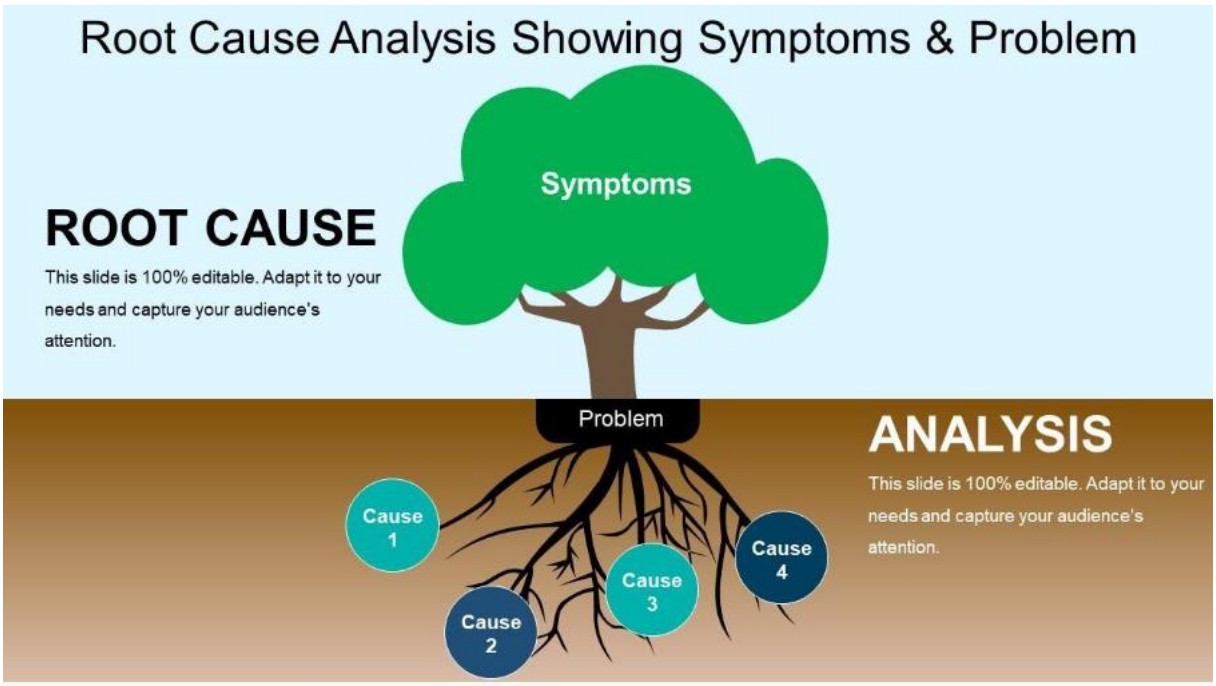


Figure 15 Tree diagram root cause analysis[10]

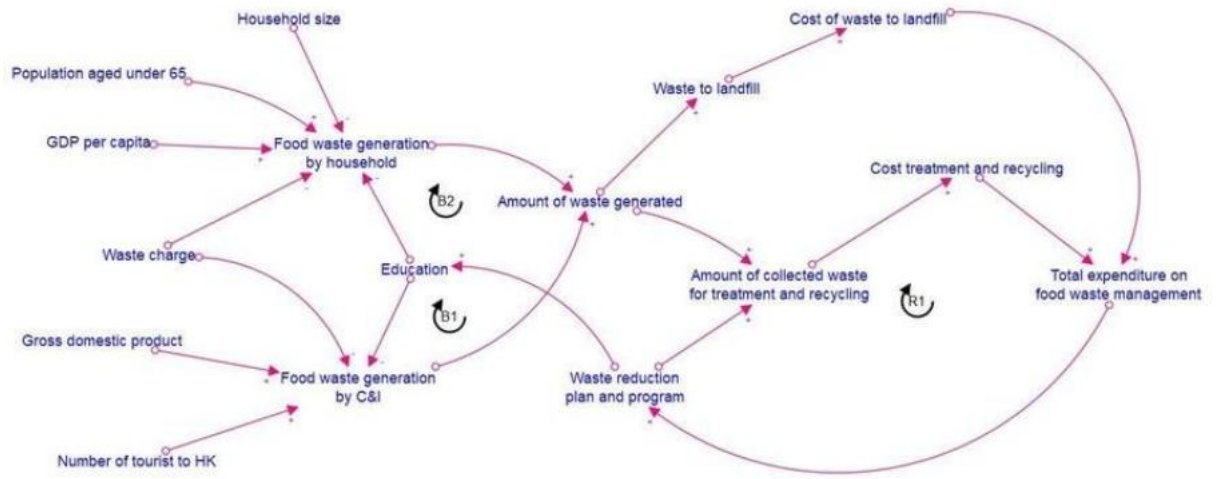


Figure 16 Root cause analysis (Lee et al., 2018)

[10] Source: Root Cause Analysis Showing Symptoms And Problem | Templates PowerPoint Slides | PPT Presentation Backgrounds | Backgrounds Presentation Themes (accessed April 12th 2026)

Exercise:

Take the visible local issue of “plastic bottle litter” and identify **three potential root causes** behind it.



Figure 17 Infographic plastic bottle litter[11]

2. Theory and practice of problem framing in sustainability

Problem framing is a foundational cognitive and social process that determines how challenges are understood, communicated, and ultimately addressed. In sustainability contexts, how a problem is framed, what aspects are emphasized, what boundaries are drawn, whose perspectives are included, fundamentally shapes the range of solutions considered possible or desirable. Effective problem framing is not merely about defining what the problem "is," but rather about constructing a shared understanding that enables productive action.

Cognitive dimensions of framing

Framing theory, originating in the work of sociologist Erving Goffman (1974) and further developed by communication scholars like Robert Entman (1993), describes how individuals and groups organize their experiences and interpret information. Entman defines framing as involving four key functions:

1. **Problem definition**: What is identified as the issue requiring attention
2. **Causal interpretation**: What is understood to cause the problem
3. **Moral evaluation**: What values and principles are invoked in judging the problem

[11] Source: The Dirty Truth: How Much Plastic Bottles Really Contribute to Polluti – SWOP - Shop Without Plastic (accessed April 12th, 2026)

4. **Treatment recommendation**: What solutions are proposed or implied

In sustainability education, these framing functions are critical because environmental challenges are inherently complex, multi-causal, and value laden. How students learn to frame problems determines whether they see isolated technical issues or interconnected systemic challenges; whether they identify individual behaviors or structural forces as primary causes; whether they prioritize economic efficiency or social justice; and whether they propose incremental adjustments or transformative change.

Framing as social construction

Problem framing is not an objective process of discovering pre-existing problems "out there" in the world. Rather, it is a social construction shaped by:

- **Disciplinary perspectives**: engineers, economists, ecologists, and sociologists frame the same sustainability challenge differently based on their training, methods, and values
- **Stakeholder interests**: different actors (corporations, communities, governments, NGOs) frame problems in ways that align with their interests and priorities
- **Cultural contexts**: what counts as a "problem" and what solutions are considered acceptable varies across cultures and societies
- **Power dynamics**: those with greater resources and authority often have disproportionate influence in defining how problems are framed in public discourse

Understanding framing as socially constructed helps students recognize that:

- there is no single "correct" way to frame a sustainability problem
- competing frames reflect different values, interests, and worldviews
- effective sustainability practice requires navigating and integrating multiple frames
- reframing can open new possibilities for action that were invisible within previous frames

Relationship between framing and action

How a problem is framed directly constrains and enables what actions are considered:

Narrow technical frames (e.g., "plastic pollution is a waste management problem") tend to generate technical solutions (better recycling technology) while obscuring systemic issues (overproduction, consumption patterns, material design).

Broad systemic frames (e.g., "plastic pollution reflects unsustainable production-consumption systems") open space for transformative interventions (circular economy redesign, consumption reduction, policy change) but can feel overwhelming and paralyzing.

Individual behavior frames (e.g., "climate change results from individual consumption choices") emphasize personal responsibility and lifestyle changes while potentially deflecting attention from structural and institutional drivers.

Collective action frames (e.g., "climate change requires coordinated policy, economic, and technological transformation") emphasize systemic change but may undervalue individual agency and immediate action.

Effective problem framing in sustainability education helps students understand these frame-action relationships and develop capacity to:

- recognize how different frames enable and constrain solutions
- deliberately choose frames appropriate to context and goals
- integrate multiple frames to address problems at multiple scales
- reframe problems when existing frames prove unproductive

Gain vs. loss framing

Prospect theory (Kahneman & Tversky, 1979) reveals that people respond differently to information framed as potential gains versus potential losses. Generally, loss frames are more motivating because people are loss-averse – they feel losses more intensely than equivalent gains.

In sustainability communication:

- **Loss frames** emphasize what will be lost without action (species extinction, ecosystem collapse, health impacts, economic costs)
- **Gain frames** emphasize what will be gained through action (clean energy jobs, improved health, economic opportunities, innovation)

Research shows mixed results on which is more effective, depending on context:

- loss frames can increase concern and urgency but may also trigger defensive responses, denial, or fatalism
- gain frames can inspire hope and engagement but may underestimate problem severity

Effective problem framing often combines both:

- acknowledging real losses and risks (credibility, urgency)
- highlighting opportunities and co-benefits (hope, agency)
- connecting individual and collective action to meaningful outcomes

3. Root cause analysis: moving beyond symptoms

One of the most critical skills in problem framing is distinguishing between symptoms (observable manifestations of problems) and root causes (underlying drivers that generate symptoms). Addressing symptoms without understanding root causes leads to ineffective interventions that may provide temporary relief while allowing fundamental problems to persist or worsen.

Symptom-cause hierarchy

Sustainability challenges typically manifest as observable symptoms that are actually effects of deeper causes:

Symptom level: Visible, immediate problems

- example: plastic waste accumulating in oceans
- typical response: beach cleanups, waste collection

Intermediate causes: Proximate drivers

- example: inadequate waste management infrastructure; consumer disposal behavior
- typical response: improved recycling systems; public education campaigns

Root causes: Fundamental systemic drivers

- example: linear "take-make-dispose" economic model; product design for disposability; externalization of environmental costs
- typical response: circular economy transformation; extended producer responsibility; true cost accounting

Effective problem framing requires working backward from symptoms to identify root causes, then designing interventions that address causes rather than merely managing symptoms.

Five whys technique

Developed by Sakichi Toyoda for quality management in manufacturing, the Five Whys technique is a simple but powerful tool for root cause analysis. It involves asking "why" repeatedly (typically five times, though the number varies) to drill down from symptoms to underlying causes.

Example application to urban air pollution:

1. **Problem**: Air quality in the city is poor
   - **Why?** High levels of particulate matter and nitrogen oxides
2. **Why are pollution levels high?**
   - Because of heavy vehicle traffic and industrial emissions
3. **Why is there heavy vehicle traffic?**
   - Because public transportation is inadequate and urban sprawl requires long commutes
4. **Why is public transportation inadequate?**
   - Because urban planning prioritized automobile infrastructure and underinvested in transit
5. **Why did urban planning prioritize automobiles?**
   - Because of post-war development paradigms, automobile industry influence, and zoning policies that separated residential and commercial areas

This progression reveals that addressing air pollution effectively requires not just emission controls (symptom management) but fundamental changes to urban planning, transportation policy, and land use patterns (root causes).

Causal loop diagrams for complex systems

For more complex sustainability challenges involving multiple interacting factors, Causal Loop Diagrams (CLDs) provide visual tools for mapping feedback relationships and identifying root causes.

CLDs show:

- **variables** (factors that change over time)
- **causal links** (arrows showing influence between variables)
- **polarity** (+ or - indicating whether variables change in the same or opposite direction)

- **feedback loops** (circular chains of causation that are reinforcing or balancing)

Example: Urban food waste

A CLD might reveal:

- Food waste → landfill methane emissions → climate change → agricultural disruption → food insecurity → pressure for increased production → more waste (reinforcing loop)
- Food waste → economic loss → pressure to reduce waste → composting programs → soil health → agricultural productivity → reduced pressure for expansion (balancing loop with potential)

This visualization helps identify leverage points:

- breaking the reinforcing loop (waste prevention, circular food systems)
- strengthening the balancing loop (composting infrastructure, regenerative agriculture)
- addressing root causes (overproduction, supply chain inefficiency, consumer behavior, food system design)

Distinguishing proximate from structural causes

Root cause analysis must distinguish between:

Proximate causes: Immediate, direct factors

- individual behaviors and choices
- specific technologies or practices
- local conditions and circumstances

Structural causes: Underlying systems, institutions, and paradigms

- economic incentives and market structures
- policy and regulatory frameworks
- cultural norms and values
- power relations and governance systems
- technological lock-in and infrastructure

Sustainability education should help students recognize that:

- proximate causes are easier to identify and address but often regenerate from structural causes
- structural causes are harder to change but offer greater leverage for transformation
- effective strategies typically address both levels simultaneously
- focusing only on proximate causes can lead to "blame the victim" narratives that ignore systemic drivers

4. Stakeholder mapping and ecosystem analysis

Sustainability challenges involve diverse stakeholders. **Stakeholder mapping** reveals who is affected, who has influence, and how interests interact. This process integrates local and global perspectives by

linking **micro-level issues** (e.g., departmental waste) to **macro-level goals** (e.g., SDG 12: Responsible Consumption and Production).

Frameworks like **UN SDG Mapping** and **Power-Interest grids** support identifying leverage points where interventions can maximize impact. Understanding interdependencies fosters inclusive, actionable solutions that gain support across the ecosystem.

Sustainability challenges are **embedded within complex social-ecological systems**. Stakeholder analysis draws on **actor-network theory (ANT)** (Latour, 2005) and **multi-level governance frameworks**, which highlight the interactions among government, industry, civil society, and individuals.

- **Mapping stakeholders:** identify actors' influence, interests, and interdependencies.
- **Global-local linkage:** connect local environmental problems (e.g., microplastics in rivers) to global sustainability goals (SDGs) to ensure relevance across scales.
- **Power dynamics:** use **Power-Interest grids** to identify potential champions or blockers of change.

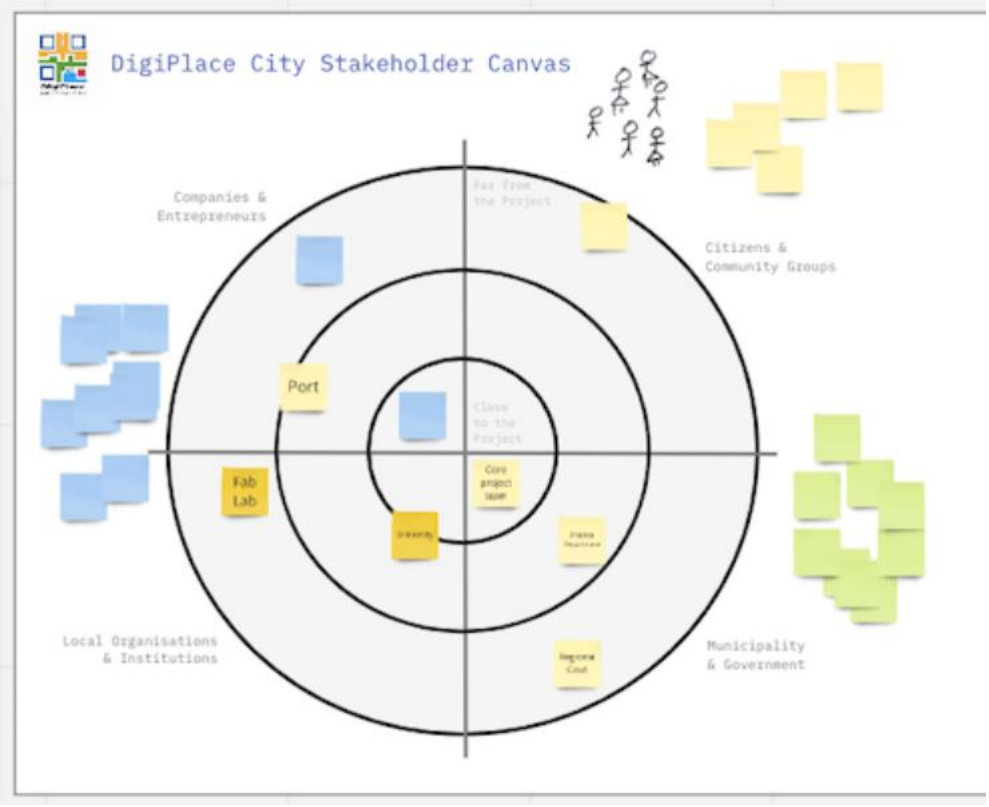


Figure 18 Digiplace city stakeholder Canvas[12]

[12] Source: Stakeholders Ecosystem Map | urbact.eu (accessed April 12th, 2026)

Exercise:

Map three stakeholder groups for municipal waste department using the source below. Note their interests, responsibilities, and potential contributions to solutions.

Source: https://urbact.eu/sites/default/files/1._stakeholders_ecosystem_map_0_0.pdf

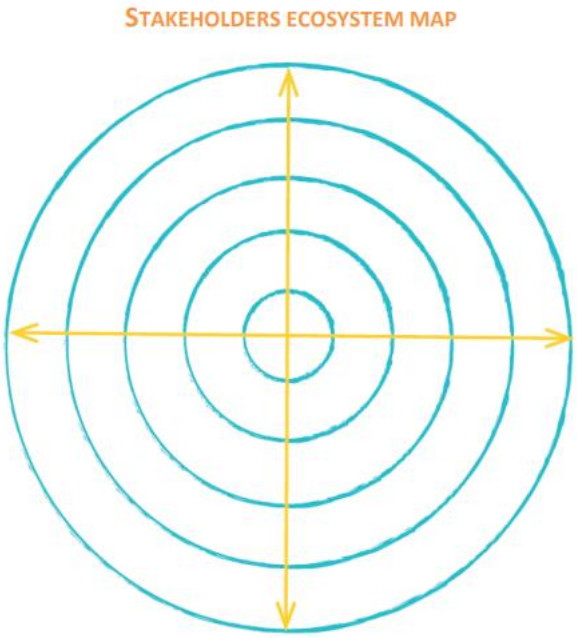


Figure 19 Stakeholder ecosystem map[13]

5. Design thinking for sustainability

Design Thinking provides a **human-centered, iterative approach** to problem framing. Its theoretical underpinnings come from **constructivist** and **experiential learning**.

- **Empathize:** Understand the needs, motivations, and constraints of those affected by the problem.
- **Define:** Create a problem statement that reflects the **complexity and context**.
- **Ideate, Prototype, Test:** Iterate solutions while integrating ecological, social, and economic dimensions.

This approach aligns with **Merrill's problem-centered learning**, emphasizing reflection, activation, and application in real-world contexts. By framing sustainability challenges as design opportunities, learners cultivate **creative problem-solving** skills that address both systemic and human factors.

Design Thinking provides a **structured, iterative framework** for reframing challenges. Core stages include:

- **Empathize:** Understand the needs of those affected
- **Define:** Formulate the problem statement based on insights

[13] Source: Stakeholders Ecosystem Map | urbact.eu (accessed April 12th, 2026)

- **Ideate:** Generate creative solutions
- **Prototype & test:** Try solutions quickly and learn from feedback

This approach aligns with **Merrill's principles of problem-centered learning** by emphasizing reflection, iteration, and active engagement. Human-centered design ensures solutions are contextually relevant, socially inclusive, and environmentally responsible.

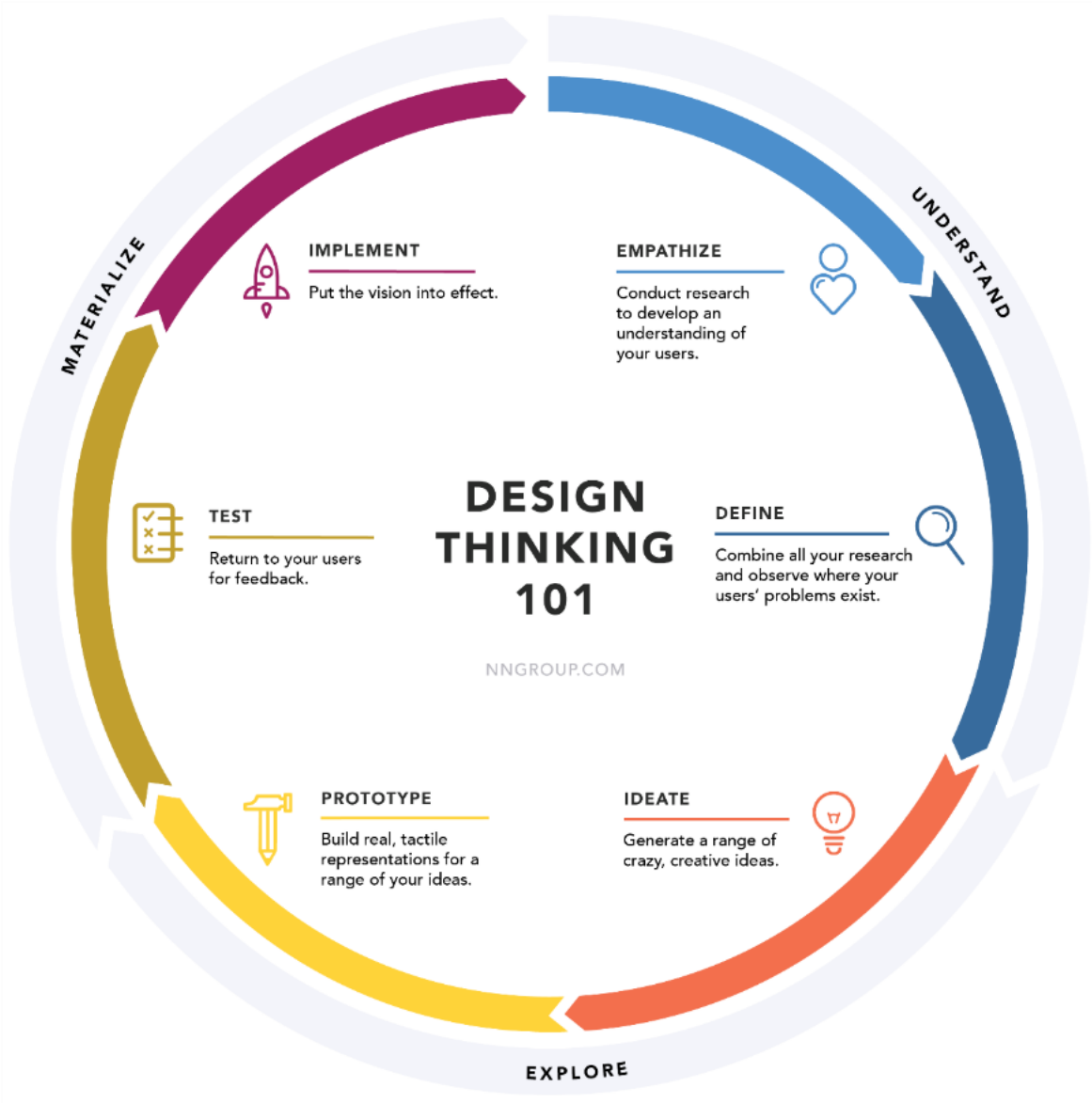


Figure 20 Principles and application processes of design thinking by Nielsen Norman[14]

Exercise:

- Regarding the plastic pollution: Write a **single-sentence problem statement** from the perspective of the affected community.

[14] Source: Design Thinking 101 - NN/G (accessed April 12th, 2026)

Resource: IDEO Design Thinking Toolkit: https://designthinking.ideo.com

6. Interdisciplinary and transdisciplinary problem framing

Sustainability challenges are inherently interdisciplinary, requiring integration of knowledge from natural sciences, social sciences, engineering, humanities, and other fields. Moreover, they are transdisciplinary, requiring collaboration between academic disciplines and non-academic stakeholders (communities, businesses, governments, civil society).

Disciplinary perspectives and their limitations

Different academic disciplines frame sustainability problems through distinct lenses:

Natural Sciences (ecology, climate science, chemistry):

- *frame*: biophysical processes and environmental impacts
- *methods*: measurement, modelling, experimentation
- *strengths*: rigorous understanding of environmental systems
- *limitations*: may underemphasize social, economic, and political dimensions

Engineering and Technology:

- *frame*: technical problems requiring design solutions
- *methods*: optimization, prototyping, systems design
- *strengths*: practical solutions and innovation
- *limitations*: may assume technical fixes without addressing social adoption or systemic barriers

Economics:

- *frame*: resource allocation, market failures, incentives
- *methods*: cost-benefit analysis, modelling, valuation
- *strengths*: understanding economic drivers and trade-offs
- *limitations*: may reduce complex values to monetary terms; assume rational actors

Social Sciences (sociology, political science, anthropology):

- *frame*: social structures, power relations, cultural practices
- *methods*: ethnography, surveys, institutional analysis
- *strengths*: understanding human behavior and social systems
- *limitations*: may lack technical depth on environmental processes

Humanities (philosophy, ethics, history):

- *frame*: values, meanings, narratives, historical context
- *methods*: interpretation, critique, normative analysis
- *strengths*: examining assumptions, values, and worldviews
- *limitations*: may lack empirical grounding or practical application

Need for integration

No single discipline can adequately frame complex sustainability challenges. Effective problem framing requires:

- **Multidisciplinary approaches**: multiple disciplines working in parallel, each contributing their perspective
- **Interdisciplinary approaches**: disciplines integrating their methods and concepts to create shared frameworks
- **Transdisciplinary approaches**: academic and non-academic knowledge co-produced through collaborative research

Challenges of interdisciplinary framing

Integrating disciplinary perspectives faces several obstacles:

Epistemological differences: disciplines have different standards for what counts as valid knowledge

- natural sciences prioritize replicability and prediction
- social sciences emphasize interpretation and context
- humanities value critical reflection and normative analysis

Methodological incompatibilities: research methods may be difficult to combine

- quantitative vs. qualitative data
- experimental vs. observational approaches
- objective vs. interpretive analysis

Linguistic barriers: disciplines use different terminology and concepts

- same words mean different things (e.g., "system," "model," "theory")
- specialized jargon creates communication challenges

Institutional structures: universities organize around disciplines

- departments, journals, and funding reinforce disciplinary boundaries
- career incentives favor disciplinary depth over interdisciplinary breadth

Power dynamics: some disciplines have greater status and resources

- natural sciences and engineering are often privileged over social sciences and humanities
- quantitative methods often valued over qualitative approaches

Strategies for effective interdisciplinary framing

Several approaches facilitate integration across disciplines:

Boundary objects: concepts, tools, or artifacts that are meaningful across disciplines

- example: maps, models, scenarios that different disciplines can interpret and contribute to
- function: enable communication without requiring full consensus on meaning

Trading zones: spaces where disciplines interact and develop shared language

- example: interdisciplinary workshops, collaborative research projects
- function: create opportunities for mutual learning and integration

Integrative frameworks: conceptual structures that organize contributions from multiple disciplines

- example: social-ecological systems (SES) framework integrating ecological and social dimensions
- example: planetary boundaries framework connecting earth system science with social science
- function: provide common structure while allowing disciplinary specificity

Toolbox approaches: explicit dialogue about disciplinary assumptions, methods, and values

- structured discussions revealing differences in: core concepts and definitions, methodological approaches, epistemological assumptions, values and goals
- function: make implicit disciplinary perspectives explicit for productive integration

Benefits of transdisciplinary framing:

- incorporates diverse knowledge types (scientific, local, traditional, experiential)
- increases relevance and usability of research
- builds capacity and empowers stakeholders
- addresses power imbalances in knowledge production
- creates more legitimate and socially robust solutions

Challenges of transdisciplinary framing:

- time-intensive and resource-demanding
- requires skills in facilitation and collaboration
- may face resistance from disciplinary gatekeepers
- difficult to evaluate by traditional academic standards
- power dynamics can persist despite participatory intentions

7. AR as a contextual framing tool

Augmented Reality (AR) enables **situated learning**, a theory from educational psychology, by overlaying invisible environmental data onto physical spaces. AR visualizations make abstract concepts tangible, facilitating **sensemaking** and enabling the identification of leverage points in real-world contexts.

- **Lifecycle and Flows:** Visualize waste streams, pollution hotspots, or energy flows directly on campus or local environments.
- **Scenario Testing:** Place virtual solutions in context to test feasibility and impact before implementation.
- **Stakeholder Empathy:** Experience the perspective of affected communities or ecosystems through interactive overlays.

Augmented Reality (AR) allows **visualization of invisible environmental data** in real-world contexts. For example:

- Overlay air pollution levels on streets
- Display waste flows in campus corridors
- Show projected flooding from climate scenarios

AR transforms abstract theory into **tangible problem definition**, allowing learners to identify precise intervention points. This approach combines **situated learning** with systems thinking, helping stakeholders understand the spatial and social context of environmental problems.

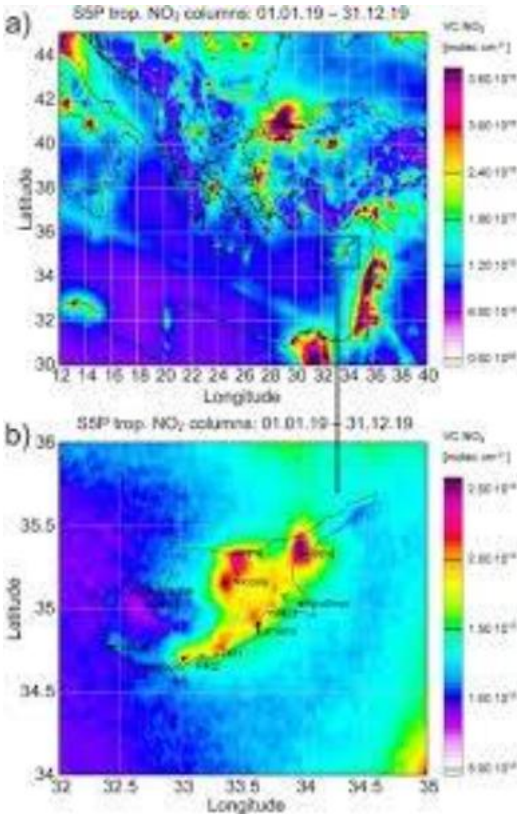


Figure 21 Local and regional air pollution characteristics in Cyprus: A long-term trace gases observations analysis (Vrekoussis et al., 2022)

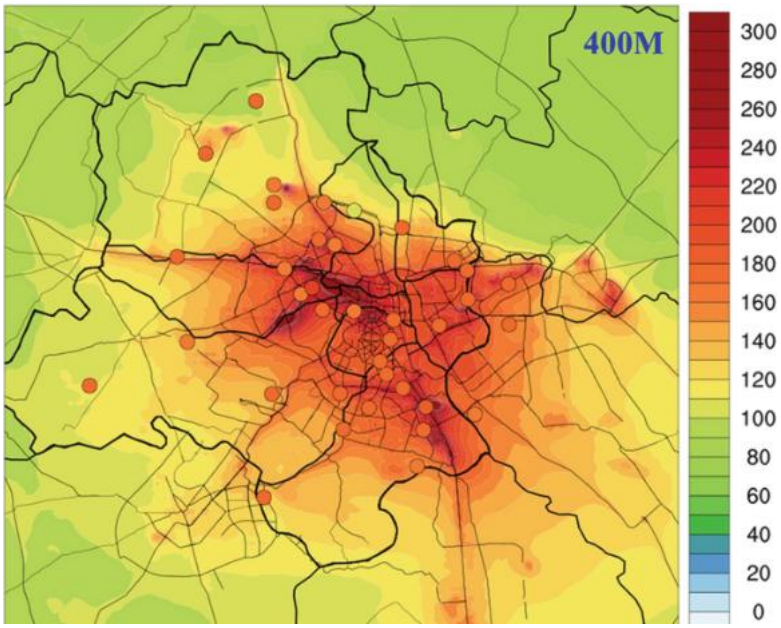


Figure 22Urban Air Quality Monitoring and Modelling Using Ground Monitoring, Remote Sensing, and GIS (Verma et al., 2023)

Exercise:

Problem: Unmanaged waste site near your town.

Discuss how Augmented Reality may help you overlay models on the site e.g. recycling bins and plants and check accessibility, aesthetics, and potential environmental/social benefits in order to:

- improve the area,
- engage stakeholders
- enhance community wellbeing?

8. Local innovation hackathon: exercise

Objective:
Develop creative solutions to a local environmental problem using multi-perspective analysis and AR prototyping.

Step 1 – Address a local issue: unmanaged waste in your University campus

Step 2 – Root cause analysis

Use the Five Whys technique:

- Write the problem statement.
- Ask “Why?” up to five times to uncover underlying causes.

Step 3 – Reframe the problem

Describe the problem from three perspectives:

Perspective	**Focus**	Describe
Business Manager	Resource efficiency and cost	
Social Worker	Community impact and equity	
Environmental Engineer	Technical feasibility and safety	

Step 4 – AR prototyping

Overlay your solution on the actual site.

- Observe:
  - Spatial fit
  - Accessibility
  - Environmental and social impact
- Use collaborative visual problem maps: Miro: https://miro.com/app/dashboard/
- Short AR video pitch of your proposed solution

Step 5 – Output & reflection

Presentation or screenshots to explain

- How well does the solution fit the space?
- What impact does it have on the environment and community?
- Which professional perspective was most influential?

9. Pedagogical approaches for teaching problem framing

Developing problem framing capabilities requires pedagogical approaches that move beyond knowledge transmission to active skill development through authentic practice.

Problem-based learning (PBL)

PBL organizes learning around complex, real-world problems that students investigate and address:

Characteristics:

- Ill-structured problems: no single correct answer; require framing and reframing
- Student-driven inquiry: learners identify what they need to know and pursue it
- Collaborative investigation: small groups work together to understand and address problems
- Authentic contexts: PROBLEMS drawn from real sustainability challenges
- Iterative process: frame, investigate, reframe based on learning

Application to problem framing:

- students practice framing problems from multiple perspectives
- discover how different frames lead to different solutions
- learn to identify root causes through investigation
- develop skills in stakeholder analysis and integration
- experience the iterative nature of effective framing

Example PBL scenario: "Your city is experiencing water shortages. How should this challenge be addressed?"

- Students must frame the problem (supply? demand? infrastructure? climate? equity?)
- Investigate from multiple disciplinary perspectives
- Analyze stakeholder interests and perspectives
- Propose solutions that address root causes
- Reflect on how their framing evolved through the process

Case-based learning

Analyzing real-world cases of sustainability challenges and solutions helps students:

- see how problems have been framed in practice
- understand consequences of different framing choices
- recognize patterns across contexts
- develop judgment about effective framing

Case selection criteria:

- Complexity: multiple stakeholders, competing values, systemic dimensions
- Authenticity: real situations with real consequences
- Diversity: different types of challenges, contexts, and scales
- Accessibility: sufficient information available for analysis
- Relevance: connected to students' interests and potential careers

Case analysis process:

1. Understand the context: What is the situation? Who are the stakeholders?
2. Identify how the problem was framed: What aspects were emphasized? What was excluded?
3. Analyze consequences: How did framing shape solutions? What worked? What didn't?
4. Explore alternatives: How else could the problem have been framed?
5. Extract lessons: What principles for effective framing emerge?

Design thinking workshops

Hands-on Design Thinking exercises develop reframing and innovation skills:

Structure:

- Empathize: interview stakeholders or conduct observations
- Define: synthesize insights into problem statements and HMW questions
- Ideate: brainstorm diverse solutions without judgment

- Prototype: create low-fidelity representations of solutions
- Test: gather feedback and iterate

Application to sustainability:

- students practice reframing environmental challenges as design opportunities
- develop skills in human-centered problem definition
- learn iterative, experimental approaches to complex problems
- create tangible prototypes that make abstract ideas concrete

Augmented reality for problem framing

AR technology offers unique opportunities for problem framing education:

Visualizing hidden systems: AR overlays showing invisible environmental flows (energy, water, materials, waste), students can "see" the systems underlying sustainability challenges, makes abstract systemic problems tangible and concrete

Multi-perspective visualization: AR layers showing the same space from different stakeholder perspectives, example: urban space viewed through lenses of mobility, ecology, economy, community, students experience how framing changes what is visible and valued

Scenario exploration: AR visualization of alternative futures based on different problem frames, students can compare outcomes of different framing and intervention choices, makes consequences of framing decisions tangible

Collaborative framing: multiple students using AR to collaboratively map and frame problems, shared visual workspace for integrating perspectives, real-time visualization of how collective framing emerges

Frame analysis exercises: students analyze how media, organizations, or disciplines frame sustainability issues, identify framing techniques and their effects, practice deliberately reframing from different perspectives, develop critical awareness of framing in communication

Cross-disciplinary teams: students from different majors work together on sustainability challenges, must negotiate different disciplinary frames, learn to integrate diverse knowledge and methods, experience challenges and benefits of interdisciplinary framing

Transdisciplinary projects: students collaborate with community partners, businesses, or government, integrate academic and practitioner knowledge, address real problems with real stakeholders, develop skills in participatory framing and co-production

Action research projects: students frame local sustainability challenges, design and implement interventions, reflect on how framing shaped their approach and outcomes, iterate based on experience

Community Engagement: students work with community organizations on sustainability initiatives, practice framing in authentic contexts with real stakeholders, contribute to actual sustainability transitions, develop professional skills and civic engagement

Career preparation: students explore how problem framing applies in green economy careers, analyze how professionals in different fields frame sustainability challenges, develop portfolios demonstrating framing capabilities, connect academic learning to professional practice

Detailed lesson plan – domain 6

Write down in a detailed way the content, the teaching methods and the AR applications.

Time / Goals	Content / Element(s)	Teaching method	Point(s) of attention / AR application
Activation of prior knowledge / Empathize	**Exploring Local Context:** Students analyze local environmental data and stakeholder needs.	**Stakeholder Interview:** Students conduct focus group interviews or surveys to identify community sustainability needs.	**AR Application (Data Overlay):** Students explore the local context using AR data layers to see "hidden" pollution or waste metrics.
Demonstration / Define – Ideate	**Identifying Root Causes:** Introduction to the "Five Whys" and stakeholder mapping tools.	**Reframing Exercise:** Teams are given a "symptom" and must work backward to define the root systemic failure.	**AR Application (Problem Viz):** Demonstration of how AR can visualize the "invisible" causes behind a physical problem.
Application / Prototype	**Designing for Opportunity:** Using Design Thinking to turn a defined problem into a concept for innovation.	**Prototyping Workshop:** Students build low-fidelity 3D models of their proposed sustainable innovations.	**AR Application (Solution Mockup):** Students place their digital prototypes in real-world locations using AR to assess visual and practical fit.
Integration / Test	**Testing the Reframe:** Evaluating how well the solution addresses the root cause identified in the "Define" stage.	**Community Showcase:** Students present their AR-enhanced projects to campus leaders or local industry partners.	**AR Application (Iterative Feedback):** Peers and stakeholders provide feedback directly through the AR interface to refine the proposed innovation.

AREA 3: ENVISIONING SUSTAINABLE FUTURES

Area overview

The environmental, social, and technological challenges we face today demonstrate that education requires a new language, a new imagination, and new competencies. The GreenEDU project was created to support the development of precisely this way of thinking—one that is more open, conscious, and capable of reflecting on the future and its multiplicity. In a world where change is a constant, traditional approaches to planning and forecasting are proving insufficient. We need tools that not only describe the future but, above all, teach how to use it.

We call this ability Futures Literacy—a competency that allows people to understand how they use the future in the present. Futures Literacy is not about predicting tomorrow. It's the ability to consciously recognize one's own assumptions, project alternative scenarios, understand uncertainty, and create new possibilities for action. It's a competency that can be practiced, developed, and implemented in education, management, change planning, and social action.

This curriculum was created as a practical guide to tools, methods, and examples of using Futures Literacy in the context of sustainable development. It aims to support universities working on education for the future—one that not only imparts knowledge but also expands the capacity to imagine other possible worlds. GreenEDU combines two key areas: education for sustainable development and future literacy, creating a space for experimentation, discovery, and critical thinking.

If we can imagine multiple futures, we can also create the tomorrow we want to achieve.

The importance of futures literacy in green transitions

The environmental, social, and technological challenges we face today demonstrate that education requires a new language, a new imagination, and new competencies. In a world where change is constant, traditional approaches to planning and forecasting are insufficient. We need tools that not only describe the future but teach how to use it.

Futures Literacy allows us to:

- **Identify anticipatory patterns** - ways of anticipating that often operate automatically
- **Deconstruct assumptions** - both individual and cultural/systemic
- **Create diverse scenarios** - expanding vision, imagination, and adaptability
- **Support innovation** - enabling future-proof competencies like adaptability, critical thinking, and creativity

Content frameworks

Building on the GreenComp framework, which organizes sustainability competencies into four key areas—Embodying Sustainability Values, Embracing Complexity in Sustainability, Envisioning Sustainable Futures, and Acting for Sustainability—the "Envisioning Sustainable Futures" module plays a unique role in developing the ability to imagine and design the future. This is where Futures Literacy becomes a key tool.

Futures Literacy, understood as the ability to consciously engage with future imaginings, strengthens the envisioning process, allowing students and teachers to consciously explore various possible scenarios for ecological transformation. Integrating this perspective with other frameworks used at GreenEDU—such as the SDGs, EntreComp4Transition, and green entrepreneurship concepts—allows for the creation of more coherent, interdisciplinary, and inspiring learning paths. As a result, each teaching package not only develops specific competencies but also opens up a space for future-thinking, which provides a foundation for sustainable action in higher education and beyond.

Futures Literacy is a framework that allows us to understand how we use our ideas about the future to make decisions in the present. It does not limit itself to forecasting what might happen, but focuses on the cognitive, cultural, and social processes that shape our expectations, hopes, and fears about the future. A key premise of Futures Literacy is that the future does not exist as an objective fact—it is created by how we think, interpret, and make meaning. In this sense, the future becomes a tool: a kind of "thinking laboratory" that reveals hidden assumptions and opens up new possibilities for action.

The Futures Literacy framework encompasses three fundamental elements. First, the ability to identify one's own anticipatory patterns—ways of anticipating and waiting that often operate automatically and remain unconscious. Second, the ability to discern and deconstruct the assumptions underlying our perceptions of the future—both individual and those rooted in culture, education, and social systems. Third, developing the competence to create diverse scenarios of possible futures, which are not about identifying a single "correct" solution, but about expanding one's field of vision, imagination, and adaptability.

In the context of education for sustainable development, Futures Literacy serves as a framework integrating content, methods, and practices that critically analyze the relationships between humans, technology, and the environment. This framework allows learners to shift from a linear, predictive approach to a more systemic, reflective approach, open to uncertainty. This becomes the foundation for creating innovative actions, making more responsible decisions, and consciously shaping the long-term consequences of our choices.

Integrating Futures Literacy into education—particularly in the area of ecological transition—enables the development of future-proof competencies such as adaptability, critical thinking, creativity, cognitive flexibility, and the ability to design change. In this way, Futures Literacy becomes not only a cognitive tool but also a practical curricular framework, supporting universities in creating learning environments prepared for the challenges of the coming decades.

Didactical frameworks

Project GreenEDU develops Futures Literacy in students, the ability to apply knowledge about the future to actions here and now. As part of the project students:

- learn to analyze environmental and technological trends,
- become familiar with forecasting tools and future scenarios,
- develop the ability to distinguish between possible, probable, and desired futures.

This allows them to consciously respond to changes and recognize the potential opportunities arising from ecological transformation.

Futures Literacy focuses on building future imagination, developing reflective thinking, exploring alternative scenarios, and challenging assumptions and perceptual limitations. The use of AR enhances all of these elements, allowing students to see possible futures literally "superimposed" on reality.

The use of AR enhances:

- decoding assumptions – different versions of the future can be visualized based on different sets of assumptions,
- awareness of the use of the future – participants see that the future is not one,
- experimentation – changing parameters affects the visualizations

Approaches used

Developing Futures Literacy—the ability to consciously use future ideas to make decisions in the present—employs a set of approaches that help broaden perspectives, challenge established patterns and better understand the complexities of the world. Each of these approaches opens a different kind of space for reflection, allowing students to see the future as a learning tool rather than as an attempt to predict it.

These methods: *Three Futures of Place*, *What If…?,* and *Design Fiction* offer complementary perspectives on how to work with futures. Together, they create a set of practices that help participants recognize that the future is not given but constructed by our beliefs, assumptions, and choices. They enable the exploration of both local contexts and broader systemic interdependencies, as well as the exercise of creative and critical thinking skills crucial to designing sustainable transformations.

Three Futures of Place allows us to look at a specific environment (e.g. campus, city, neighborhood) from three distinct perspectives, revealing how different interpretations of the present lead to different futures:

What if…? stimulates cause and effect thinking, analyzing the consequences of a single event or change.

Design fiction, in turn, materializes potential futures in the form of artifacts, making them more tangible and discussable.

Incorporating these approaches into education, particularly in the context of sustainability, strengthens students and teachers' ability to better understand uncertainty, think in scenarios, and test alternative options. This paves the way for more conscious future design, which is one of the key elements of the "Envisioning Sustainable Futures" area within GreenComp.

Approaches used – more detailed

Three Futures of Place	
What is it about?	This approach focuses on exploring possible futures related to a specific place (a campus, neighborhood, building, natural space, or community). Participants create three versions of the future of a given place: 1. An expected future – what will happen if we do nothing. 2. A changed future – what might happen if we implement new actions or policies. 3. An unobvious/unthinkable future – a complete break with current assumptions, the most innovative or unusual option.
Why is it done?	The method teaches students to recognize their own assumptions about the future and how our imaginations are limited by experiences, cultural norms, and established patterns. It helps them see that the future is not “one scenario”, but a space of many possibilities.
How does it help?	Understand how socially, educationally, and ecologically important places can evolve, ● design changes in a more conscious and systemic manner, ● develop adaptive thinking and environmental imagination.
What If? / Causal Scenario Exploration	
What is it?	In this method, we analyze the future starting with a single trigger or "wild card" – a conditional question that opens up a series of possible consequences. Example: “What will happen if the campus must transition to 100% renewable energy by 2035?” Participants explore first-, second-, and third-order consequences, considering how a single event might impact the system over time
Why is this done?	The method teaches us to view the future as a dynamic system – one event triggers a series of interconnected changes in the environment, technology, economics, and human behavior.
How does it help?	This approach allows us to: ● analyze the effects of strategic decisions, ● understand the connections between areas (energy, mobility, water management, education), ● practice creative and critical thinking about the future.
Design Fiction	
What is it?	Design fiction is a method of creating artifacts from the future – prototypes, documents, applications, devices, posters, announcements, or regulations that could exist in future scenarios. Instead of merely describing the future, participants create tangible “evidence” of it.

	For example, “Instructions for using the 2035 Student Green Card” or “a leaflet about the new transportation system”.
Why is it done?	Artifacts help us see the future as real, tangible, and not abstract. This strengthens creative thinking and facilitates conversations about technical, social, and ethical implications.
How does it help?	It allows us to: • stimulate imagination and innovation, • facilitates testing the "social acceptability" of future technologies, • supports systemic and interdisciplinary design.

Futures literacy method catalogue

Below is a description of the methods for the approach Three Futures of Place, What If? And Desing Fiction.

Adaptation scenarios			
Definition	Goal	Procedure	Example of application in GreenEDU
It involves creating scenarios that demonstrate how systems or institutions can adapt to various challenges and changes in their environment, such as climate, technology, or social changes.	• Preparing for uncertain future conditions. • Supporting strategic planning of adaptation actions. • Developing systems thinking and creativity in designing solutions.	1. Determining the adaptation area (e.g., campus or educational process). 2. Selecting key drivers of change (e.g., climate, technology, regulations). 3. Creating various system adaptation scenarios. 4. Analyzing the impacts of the scenarios on stakeholders and resources. 5. Drawing conclusions for ongoing decisions.	Students develop campus adaptation scenarios: for example, adapting hybrid learning spaces, green transportation, energy and water management. The scenarios help design actions that support environmental competence and institutional resilience.
Analysis of trends and weak signals / trend map / week signals map			
Definition	Goal	Procedure	Example of application in GreenEDU
Identifies and visualizes trends (long-term changes) and weak signals (early, subtle signs of upcoming	• Early detection of breakthroughs. • Better prediction of social, technological,	1. Select an area of analysis (e.g., education, campus,	Creating a trend map for the future of green competencies at universities. The map includes:

changes) that may impact the future of a given area or system.	and environmental changes.	green competencies). 2. Identify trends and signals. 3. Cluster trends (social, technological, environmental, etc.). 4. Map connections and reflect on their impact.	Environmental trend: pressure for climate neutrality on campuses, Technological trend: development of AR/VR and AI in education, Social trend: growing student expectations for practical and valuable education, Regulatory trend: integration of GreenComp and SDGs in curricula. The trend map becomes a starting point for further exercises, such as scenario building.
Anticipatory games			
Definition	Goal	Procedure	Example of application in GreenEDU
A method that uses game mechanics to simulate decisions and consequences in alternative futures.	• Learning through experience. • Testing decisions in a safe environment. • Increasing participant engagement.	1. Designing the game world and scenario. 2. Assigning roles and resources. 3. Decision-making gameplay. 4. Debriefing and reflection.	Students play a simulation game about managing a climate-neutral campus.
Anticipatory systems / anticipatory thinking			
Definition	Goal	Procedure	Example of application in GreenEDU
Thinking about the future as a tool for making better decisions now.	• Learning to predict the consequences of actions.	1. Identifying the future consequences of actions. 2. Evaluating alternative scenarios. 3. Discussing the ethical implications.	How the university's "green fleet" decision impacts future generations.
Assessment of breakthrough technologies			
Definition	Goal	Procedure	Example of application in GreenEDU
Analyzes the potential impact of disruptive technologies on society, the	• Critical evaluation of technological innovations.	1. Identification of disruptive technologies.	Students analyze the impact of AI and AR on environmental education and the

environment, and education.	• Identification of opportunities and threats. • Support for responsible technological decisions.	2. Analysis of social, environmental, and ethical impacts. 3. Discussion of possible futures. 4. Implementations for educational strategies.	development of future-proof skills.
Backcasting			
Definition	Goal	Procedure	Example of application in GreenEDU
Planning for the future, starting with a desired state (e.g., 2050), and then "regressing" to the present to determine the steps needed to achieve it.	• Creating a realistic path to achieving ambitious goals, • Supporting ecological and systemic transformation.	1. Defining a positive, desired future. 2. Stepping back and defining actions for the years: 2040 → 2030 → 2025 → now. 3. Defining resources, partners, and barriers.	Backcasting for the goal: Zero-emission university by 2050 → energy, mobility, and waste management transformation.
Behavior models for future generations			
Definition	Goal	Procedure	Example of application in GreenEDU
It involves analyzing and designing possible behavioral patterns for future generations in response to social, environmental, and technological changes.	• Understanding long-term changes in attitudes and values. • Designing education that meets future needs. • Developing intergenerational empathy.	1. Choosing a future scenario. 2. Analyzing the life context of future generations. 3. Modelling behaviors, decisions, and values. 4. Reflecting on the implications for education.	Students analyze how future generations of students might perceive environmental responsibility and how this will change learning models at universities
Competence projection			
Definition	Goal	Procedure	Example of application in GreenEDU
It involves identifying and designing competencies that will be needed in various future scenarios. The method focuses not on predicting professions, but on adaptive,	• Developing awareness of changing competency needs. • Supporting education based on future skills.	1. Selecting future scenarios (e.g., ecological transition, resource crisis).	Analyze what competencies graduates will need in a future climate-neutral campus (e.g., systems thinking, environmental ethics, interdisciplinary work) and then design educational activities to

cognitive, and value-added capabilities.	• Combining future envisioning with curriculum design. • Strengthening *Futures Literacy* and *Adaptability*.	2. Analyzing roles and challenges in a given scenario. 3. Identifying key competencies (cognitive, social, green). 4. Mapping competencies to frameworks (e.g., GreenComp). 5. Reflection: how to develop these competencies today.	support their development.
Design futures / speculative design			
Definition	Goal	Procedure	Example of application in GreenEDU
Creating prototypes, artifacts, or visualizations of future worlds to stimulate reflection, dialogue, and change.	• Engaging emotions and imagination. • Collaboratively creating a vision of the future.	1. Developing a futuristic scenario. 2. Creating a prototype (mock-up, visualization, conceptual application). 3. Testing with a target audience. 4. Discussing implications.	Project: Student 2040 report card with a carbon footprint function.
Ecological scenarios			
Definition	Goal	Procedure	Example of application in GreenEDU
It involves creating future scenarios focused on the relationships between humans and ecosystems.	• Understanding the long-term consequences of environmental actions. • Developing regenerative thinking. • Supporting environmental education.	1. Choosing an ecological system. 2. Identifying drivers of change. 3. Construction of scenarios. 4. Analysis of consequences.	Local ecosystem future scenarios are used in classes as a starting point for educational activities.
Expert method			
Definition	Goal	Procedure	Example of application in GreenEDU

It involves using the knowledge and perspectives of experts from various fields to explore possible futures, identify key challenges, and reveal dominant assumptions about the development of social, environmental, and educational systems.	• Gaining in-depth perspectives on future changes. • Confronting different ways of thinking about the future. • Identifying risks, opportunities, and areas of uncertainty. • Supporting the envisioning and decision-making process.	1. Selection of experts representing various areas (e.g., education, environment, technology). 2. Formulating future-oriented questions (e.g., "what competencies will be key in 2040?"). 3. Gathering opinions (interviews, panels). 4. Synthesizing conclusions and identifying key assumptions. 5. Reflecting on the implications for strategy and actions.	Experts in the field of sustainable development, education and the labor market analyze the future competence needs of students, supporting the design of curricula compliant with GreenComp.
Educational prototypes			
Definition	Goal	Procedure	Example of application in GreenEDU
It involves designing and testing prototype forms of education—such as courses, activities, teaching tools, or learning experiences—that address the needs of various possible futures.	• Combining envisioning the future with educational practice. • Testing innovative forms of learning under conditions of uncertainty. • Developing adaptability and educational creativity. • Fostering competencies in the area of Envisioning Sustainable Futures.	1. Selecting a future scenario (e.g., education in a climate crisis). 2. Identifying educational challenges and learner needs. 3. Designing a prototype (course, module, method, tool). 4. Rapid testing and gathering feedback. 5. Reflecting on and iterating the prototype.	A prototype project for a Futures Literacy and GreenComp-based activity, such as a module using campus future scenarios, which is then tested and modified based on participant feedback.
Future narratives			
Definition	Goal	Procedure	Example of application in GreenEDU

Creating stories, scenarios, and plots from the lives of people in the future to better understand everyday life in various potential worlds.	• Enables "stepping into the future". • Supports systems thinking and empathy.	1. Selecting a protagonist (future persona). 2. Describe their day/life in the future (taking into account trends). 3. Analyze challenges and needs.	Narrative: "A typical day for a student at a climate school in 2050."
Future stress testing			
Definition	Goal	Procedure	Example of application in GreenEDU
It involves creating extreme, hypothetical future scenarios to test the resilience of systems, processes, or institutions to crises and unforeseen events.	• Assessing the resilience and flexibility of systems in the face of uncertainty. • Identifying weaknesses and areas requiring strengthening. • Supporting strategic and proactive planning. • Developing adaptive and scenario-based competencies.	1. Selecting a system or institution for testing (e.g., a campus). 2. Developing extreme scenarios (e.g., a prolonged drought, a power outage, an epidemic). 3. Simulating the system's impact and analyzing the response. 4. Identifying risk areas and developing strategies to strengthen resilience. 5. Reflecting on conclusions and possible preventive actions.	Students create a scenario: "Campus in 2040 during an energy crisis" and analyzing how the operation of laboratories, educational systems, and infrastructure will change. The results allow us to design educational and operational strategies that minimize risks and strengthen institutional resilience.
Future wheel			
Definition	Goal	Procedure	Example of application in GreenEDU
An exploratory tool that maps the first-, second-, and third-order consequences of a given event or trend.	• Identifying long-term effects. • Better understanding systemic complexity.	1. In the center, we write down the trend (e.g., "autonomous city buses"). 2. We create radii with the first effects.	Circle of the future for: Mandatory climate education in schools.

		3. We develop further consequences. 4. We analyze the relationships between effects.	
Futures literacy labs			
Definition	Goal	Procedure	Example of application in GreenEDU
Futures Literacy Labs are participatory learning spaces where students experiment with different ways of using the future for reflection and action.	• Developing futures literacy competencies. • Questioning assumptions about the future. • Learning through experience.	1. Choosing a futures challenge. 2. Working with different Futures Literacy methods. 3. Experimentation and reflection. 4. Transferring lessons to practice.	Places on campuses where students and staff explore the future of sustainable development education together.
Leverage analysis			
Definition	Goal	Procedure	Example of application in GreenEDU
It involves identifying key points in a complex system where small, well-designed interventions can produce disproportionately large and lasting changes in its future functioning.	• Identifying places in the system where small interventions can lead to significant change. • Developing strategic and systemic thinking about the future. • Supporting the design of effective actions for sustainable development. • Strengthening Envisioning Sustainable Futures and Acting for Sustainability competencies.	1. Defining the system – e.g., the higher education system or a university campus. 2. Mapping elements and relationships – utilizing the results of a systems analysis. 3. Identifying potential leverage points – places where changing policies, information flows, goals, or narratives could impact the entire system. 4. Assessing impact and feasibility – comparing possible interventions. 5. Selecting and testing interventions – designing actions	Students analyze the campus as a socio-educational system and identify leverage points, such as assessment methods, narratives surrounding sustainability, and knowledge flow between departments. Thanks to this, they design educational activities that have a real impact on the development of green competences and the transformation of institutions.

		with the greatest potential for change. 6. Reflecting on consequences – short- and long-term effects of decisions.	
Monitoring early warning signals			
Definition	Goal	Procedure	Example of application in GreenEDU
A method that systematically tracks warning signals of crises or breakthroughs.	• Early detection of threats. • Increasing system resilience. • Supporting adaptive management.	1. Defining monitoring areas. 2. Selection of indicators and signals. 3. Regular analysis of changes. 4. Response and strategy updates.	Staff monitors signals related to climate, education, and technology to update curricula and competency development strategies.
Resilience scenarios			
Definition	Goal	Procedure	Example of application in GreenEDU
A method for creating and analyzing future scenarios that focus on the capacity of systems, institutions, or communities to absorb shocks, adapt to change, and transform in the face of long-term crises.	• Developing resilience and adaptive thinking. • Identifying system vulnerabilities and resources. • Designing strategies to strengthen long-term resilience. • Fostering Adaptability and Envisioning Sustainable Futures competencies.	1. Selecting a system or site – e.g., a campus, educational program, academic community. 2. Identifying stressors and disruptions – climatic, social, technological. 3. Building crisis and post-crisis scenarios – how the system responds and how it changes. 4. Analyzing adaptive capacity – resources, flexibility, learning mechanisms. 5. Conclusions and actions – what	Students create scenarios for campus resilience in the face of long-term climate and energy crises. They analyze which elements of education, infrastructure, and student competences allow universities not only to survive but also to develop in conditions of uncertainty.

		strengthens resilience today.	
Risk analyses			
Definition	Goal	Procedure	Example of application in GreenEDU
It involves systematically identifying, assessing, and prioritizing risks that could impact the future of systems, places, or activities, in both social, technological, and environmental contexts.	• Increasing awareness of potential threats. • Supporting decision-making under uncertainty. • Identifying priorities for adaptation actions. • Strengthening *Futures Literacy* and *Adaptability* competencies.	1. Defining the area or system of analysis (e.g., university campus). 2. Identifying potential risks (climate, social, technological). 3. Assessing the likelihood and impact of risks. 4. Prioritizing risks by severity. 5. Discussing risk mitigation strategies and contingency plans.	Students analyze risks for the campus in 2040: e.g., water shortages, renewable energy system failures, and decreased student attendance. On this basis, they design actions to minimize risk and support green competences.
Roadmapping			
Definition	Goal	Procedure	Example of application in GreenEDU
Planning the development of a technology, organization, or institution over a multi-year period.	• Creating a development map. • Identifying key milestones and interdependencies.	1. Defining the goal (e.g., climate neutrality). 2. Dividing it into stages (short, medium, long term). 3. Adding technologies, resources, and partners. 4. Developing an implementation map.	Sustainable University 2025–2035–2050.
Scenario analysis (scenario planning)			
Definition	Goal	Procedure	Example of application in GreenEDU
A method for creating multiple alternative futures (possible, probable, desirable) to better understand	• Identify key factors of influence and uncertainty.	1. Collect trends and data. 2. Identify the two main uncertainties	"Green Future Campus 2040" scenarios: • autonomous campus,

uncertainty and prepare for various development paths	• Prepare the organization/university for changing future conditions. • Support strategic decisions.	that form the "scenario axis." 3. Develop 3–4 coherent visions of the future. 4. Analyze opportunities and threats in each scenario. 5. Develop a strategy resilient to diverse futures.	• zero-emission campus, • campus based on local energy, • hybrid campus.
Short / medium / long-term scenarios			
Definition	Goal	Procedure	Example of application in GreenEDU
It involves constructing a set of future scenarios in different time horizons, which allows for the analysis of both the immediate effects of decisions and their long-term consequences under conditions of uncertainty.	• Developing the ability to think across time horizons. • Recognizing that short-term decisions have long-term consequences. • Supporting strategic planning in conditions of uncertainty. • Strengthening Envisioning Sustainable Futures competencies.	1. Selecting a topic or challenge – e.g., transforming education towards sustainable development. 2. Defining time horizons – short (1–3 years), medium (5–10 years), long (20+ years). 3. Building scenarios for each horizon – key changes, actors, risks, and opportunities. 4. Comparing scenarios – identifying continuity, turning points, and uncertainties. 5. Reflection and conclusions – what actions are needed today.	Students create scenarios for the development of students' green competencies: short-term (curriculum changes), medium-term (new models of interdisciplinary education), and long-term (universities as centers for socio-environmental regeneration).
Strategic foresight			
Definition	Goal	Procedure	Example of application in GreenEDU
It involves systematically using knowledge about	• Supporting long-term planning.	1. Analysis of trends and uncertainties.	Used to design long-term programs for developing green

possible futures to make strategic decisions in the present.	• Increasing institutional resilience. • Integrating future thinking with action.	2. Development of future scenarios. 3. Assessment of strategic options. 4. Choosing courses of action.	competencies in higher education.
Systems analysis			
Definition	Goal	Procedure	Example of application in GreenEDU
It involves the study of complex systems by identifying their elements, relationships, feedback loops, and the dynamics of change in order to better understand how decisions made today influence possible futures of the system.	• Developing systems and anticipatory thinking. • Understanding the complex interdependencies between system components. • Identifying leverage points for sustainable development. • Supporting the design of resilient educational and environmental strategies.	1. Defining the system boundaries – e.g., a university campus as a socio-environmental system. 2. Identifying system components – actors, resources, processes, infrastructure. 3. Mapping relationships and feedback loops – cause-and-effect relationships, reinforcing and stabilizing loops. 4. Analyzing the dynamics of change – how the system responds to stimuli and decisions. 5. Conclusions and reflection – where interventions leading to desired futures are possible.	Students analyze the campus's operating system, considering education, energy, mobility, and user behavior. Systemic analysis allows for the identification of key intervention points that support the development of green competencies and a reduction in the environmental footprint.
System mapping			
Definition	Goal	Procedure	Example of application in GreenEDU
Graphical mapping of system elements and the relationships between them.	• Identifying dependencies. • Understanding where interventions will have the greatest impact.	1. Identifying key system elements. 2. Connecting them into a network. 3. Analyzing critical nodes.	A system map of the circular economy at a university.

		4. Designing interventions.	
Technology foresight			
Definition	Goal	Procedure	Example of application in GreenEDU
Assessment of future technologies and their potential role, risks, and development paths.	• Defining R&D directions. • Preparing for technological change.	1. Analysis of technological trends. 2. Expert interviews. 3. Assessment of the technology's impact. 4. Creating strategic recommendations.	Assessing the future of environmental sensors on campuses.
Urban simulations			
Definition	Goal	Procedure	Example of application in GreenEDU
It involves simulating the functioning of a city or its part in various future scenarios, taking into account environmental, social, technological and economic factors.	• Developing systems and spatial thinking. • Understanding complex urban interdependencies. • Testing the effects of decisions and policies under conditions of uncertainty. • Supporting the envisioning of diverse futures.	1. Selecting an urban or campus area. 2. Identifying variables (e.g., mobility, energy, climate, resident behavior). 3. Building future scenarios. 4. Conducting simulations and observing the effects. 5. Analyzing the results and reflecting on them.	Simulate the operation of a campus as a “mini city” in climate neutrality, energy crisis and environmental regeneration scenarios, analyzing the impact of decisions on quality of life, emissions and education.
Weak signal map			
Definition	Goal	Procedure	Example of application in GreenEDU
It involves identifying and visualizing early, ambiguous signals of change that may herald significant transformations in the future.	• Developing sensitivity to early signs of change. • Breaking through dominant narratives about the future. • Fostering exploratory and anticipatory thinking.	1. Collecting weak signals (behaviors, initiatives, innovations). 2. Grouping signals thematically. 3. Discussing their potential significance.	Students identify weak signals in education (e.g., grassroots student initiatives) that may herald a shift in the university's role in the sustainable development system.

		4. Mapping possible implications for the future.	
Wild cards			
Definition	Goal	Procedure	Example of application in GreenEDU
Low-probability but high-consequence events (e.g., water crises, technological blockages).	• Preparing for sudden changes. • Developing organizational resilience and flexibility.	1. Select 10–15 wild cards. 2. Analyze their effects. 3. Develop contingency and adaptation plans.	Weak Signal: "Increasing adoption of microgrids on campuses".

Futures literacy map for GreenEDU

The map is based on the premise that Futures Literacy is a cyclical learning process, not a sequence of linear steps. Students can enter the process at any point, but full competence is developed by progressing through all areas. The map's focal point is Envisioning Sustainable Futures (Fig. 1).

I. Sensing futures

Sensing Futures incorporates Futures Literacy methods focused on early recognition of change, uncertainty, and signals of impending transformation. This group develops the ability to spot trends, weak signals, and potential breakthroughs before they become widely apparent.

These methods help participants understand that the future "begins" in the present, and that careful observation of the environment is crucial for responsible planning and decision-making. At GreenEDU, Sensing Futures strengthens critical thinking, foresight, and systemic awareness.

Methods in the Sensing Futures group:

- Analysis of Trends and Weak Signals
- Assessment of Breakthrough Technologies
- Expert Method
- Monitoring Early Warning Signals
- Technology Foresight
- Trend Map
- Weak Signal Map
- Wild Cards

Role in GreenEDU

Students learn to identify early signals of change in education, the environment, and technology, allowing educational institutions to respond proactively rather than reactively.



Figure 23 Futures Literacy Map for GreenEDU. Generated by AI.

II. Understanding futures

Understanding Futures focuses on analyzing complex systems and mechanisms that shape possible futures. This group's methods help understand the relationships, feedback loops, risks, and leverage points that influence long-term change.

The goal is to develop systems thinking and the ability to interpret the consequences of decisions made under conditions of uncertainty. At GreenEDU, this group fosters a deep understanding of the dynamics of socio-environmental systems.

Understanding Futures group methods:

- Anticipatory Systems / Anticipatory Thinking
- Behavior Models for Future Generations
- Competence Projection
- Leverage Analysis
- Risk Analyses
- Systems Analysis
- System Mapping

Role at GreenEDU

These methods are used to analyze campuses, curricula, and management systems as a whole, enabling the identification of strategic intervention points.

III. Imagining futures

Imagining Futures encompasses Futures Literacy methods that develop the ability to imagine multiple alternative futures and analyze their consequences in conditions of complexity and uncertainty. This group focuses on challenging linear thinking and dominant narratives about the future through scenario creation, simulation, and exploration of long-term trajectories of change.

Methods from this group help participants recognize that the future is not a single predictable path, but a set of possible variants shaped by decisions, values, technologies, and social processes. In the context of GreenEDU, Imagining Futures supports the Envisioning Sustainable Futures competency, enabling reflection on the long-term impacts of educational, environmental, and institutional actions.

Methods in the Imagining Futures group:

- Adaptation Scenarios
- Backcasting
- Future Wheel
- Future Stress Testing
- Ecological Scenarios
- Resilience Scenarios
- Scenario Analysis / Scenario Planning
- Short / Medium / Long-term Scenarios
- Urban Simulations

Role in GreenEDU

In GreenEDU programs, Imagining Futures methods are used to work on the future of campuses, cities, educational systems, and local communities. They enable students and faculty to explore alternative development models, assess the consequences of decisions, and design visions of sustainable futures based on responsibility, resilience, and long-term thinking.

IV. Shaping futures

Shaping Futures encompasses Futures Literacy methods focused on actively shaping the future through design, experimentation, and learning by doing. The future is treated as a testing ground for new ideas, practices, and solutions.

This group integrates reflection on the future with educational and strategic practice, enabling participants to translate their vision into concrete action. At GreenEDU, Shaping Futures fosters competences of agency, innovation, and responsibility.

Methods in the Shaping Futures group:

- Anticipatory Games
- Design Futures / Speculative Design
- Educational Prototypes
- Future Narratives
- Futures Literacy Labs
- Roadmapping

Role at GreenEDU

These methods allow students and staff to create and test future models of education, technology, and management, developing competencies essential for institutional transformation.

V. Resilience and adaptation

Resilience and Adaptation encompasses Futures Literacy approaches focused on the capacity of systems, institutions, and communities to cope with uncertainty, shocks, and long-term environmental, social, and technological changes. This group emphasizes preparing for futures that cannot be fully predicted or controlled.

This group helps participants shift from reactive to adaptive thinking, developing the ability to design flexible strategies, strengthen resilience, and learn from crises. In the context of GreenEDU, Resilience and Adaptation directly supports the competencies of Adaptability, Envisioning Sustainable Futures, and Acting for Sustainability.

Resilience and Adaptation Methods:

- Adaptation Scenarios
- Ecological Scenarios
- Future Stress Testing
- Monitoring Early Warning Signals

- Resilience Scenarios
- Risk Analyses

Role in GreenEDU

GreenEDU programs utilize Resilience and Adaptation methods to prepare universities, academic communities, and students for the impacts of climate change, energy crises, and social disruptions. They enable the design of strategies that not only minimize risks but also strengthen the long-term capacity for transformation toward sustainable development.

Cases as a starting point

Suggested **case study** topics where futures literacy methods can be applied—in education, business, the public sector, and the environmental sector.

Topic 7 – Futures literacy

For topic 7 we will work with the method **Three futures of place.** This method focuses on a specific location (campus, town, building, ecosystem) and three perspectives: the expected future, the changed future, the "unthinkable" future. Below a number of possible cases are outlined for topic 7.

1. **Title:** Green Campuses 2040 – How are universities adapting to climate change?
   Short description: A study in which students predict how university campuses will change (energy, transport, waste management, educational spaces).
   Futures literacy methods: scenarios, backcasting, anticipatory systems.
2. **Title:** Urban transport 2050 – what sustainable mobility model will dominate?
   Short description: An analysis of various possible futures of transport: autonomous vehicles, shared transport, micromobility, zero-emission cities.
   Futures literacy methods: trend map + scenarios + urban simulations.
3. **Title:** The future of work in the green economy
   Short description: How will professions and skills related to sustainable development and low-emission technologies change?
   Futures literacy methods: future wheels, expert method, competence projection.
4. **Title:** Sustainable Agriculture 2040 – Food Transformation Scenarios.
   Short description: Developing a future for regenerative agriculture, hydroponics, vertical farms, and smart food systems.
   Futures literacy methods: scenarios, wild cards (e.g., climate fluctuations, water crises).
5. **Title:** School of the Future – How Will Environmental Education Change by 2050?
   Short description: Exploring alternative education models for a sustainable society.
   Futures literacy methods: design futures, educational prototypes, futuristic narratives
6. **Title:** Circular Economy in the City of the Future.
   Short description: How Will Cities Transition from a Linear Model (Production–Consumption–Waste) to a Circular One?
   Futures literacy methods: systems analysis + short/medium/long-term scenarios.
7. **Title:** The Future of Energy – Local Energy Microgrids 2035.
   Short description: Forecasting how the development of renewable energy sources, battery storage, and microgrids will change the functioning of local communities.

Futures literacy methods: technology foresight, leverage analysis.

8. **Title:** Green Cities and Climate Resilience 2045.
   Short description: Analysis of how communities adapt to extreme weather events and water constraints.
   Futures literacy methods: risk analyses + adaptation scenarios + future stress testing
9. **Title:** Transforming the Apparel Industry – Carbon-Free Fashion 2050
   Short description: Assessment of potential trajectories of change in textile production (biological materials, recycling, digitalization).
   Futures literacy methods: future narratives + weak signal map.
10. **Title:** The Future of Public Health in the Context of Climate Change.
    Short description: How can health systems leverage futures literacy to better respond to climate-related threats and epidemics?
    Futures literacy methods: system mapping, resilience scenarios, roadmapping.
11. **Title:** The Green Consumer 2050 – How Are Attitudes and Motivations Changing?
    Short description: A case study on the evolution of purchasing behavior and ecological responsibility.
    Futures literacy methods: trend analysis + behavior models for future generations.
12. **Title:** Transforming Technology Companies to Zero-Emissions Model
    Short description: Analysis of how companies like Dell, Cisco, and HP can change their production and logistics models.
    Futures literacy methods: strategic foresight, assessment of breakthrough technologies.
13. **Title:** Education for the Future in Primary Schools
    Short description: Designing programs that develop future-thinking and climate responsibility in children.
    Futures literacy methods: futures literacy labs, future narratives, anticipatory games
14. **Title:** Biodiversity Protection – How Can Local Communities Anticipate Change?
    Short description: Case study on parks, forests, and ecosystems.
    Futures literacy methods: ecological scenarios, monitoring early warning signals.

Topic 8 - Adaptability

For topic 8 we will work with the method **What if…?** that stimulates cause and effect thinking, analyzing the consequences of a single event or change. Below a number of starting questions are outlined for topic 8.

1. **Title:** What if the campus had to operate without electricity for six months?
   Short description: Analysis of how education, infrastructure and competences function in conditions of long-term energy shortages.
   Futures literacy methods: risk analyses, resilience scenarios, future stress testing, systems analysis.
2. **Title:** What if on-campus learning became a temporary and scarce resource?
   Short description: Exploring future models of hybrid education in conditions of limited availability of physical spaces.
   Futures literacy methods: scenario planning, short/medium/long-term scenarios, futures literacy labs.

3. **Title:** What if access to clean water became intermittent?
   Short description: Analysis of campus adaptation and user behavior to intermittent water resources.
   Futures literacy methods: adaptation scenarios, ecological scenarios, future wheel.
4. **Title:** What if cities had to function under permanent heatwaves?
   Short description: Analysis of the future of urban living, working and learning systems under conditions of chronic climate stress.
   Futures literacy methods: urban simulations, adaptation scenarios, future stress testing.
5. **Title:** What if AI became the primary educator for basic competencies?
   Short description: A reflection on the teacher's role, ethics and relationships in AI-dominated education.
   Futures literacy methods: assessment of breakthrough technologies, design futures, futures literacy labs.
6. **Title:** What if AR became the default educational interface?
   Short description: Exploring the consequences of learning embedded in augmented reality.
   Futures literacy methods: technology foresight, educational prototypes, anticipatory games.
7. **Title:** What if lack of digital access became a new form of exclusion?
   Short description: Analysis of educational inequalities resulting from technological limitations.
   Futures literacy methods: behavior models for future generations, scenario planning, futures wheel.
8. **Title:** What if academic knowledge was updated like software?
   Short description: Exploring future models of knowledge production, validation and distribution.
   Futures literacy methods: strategic foresight, trend map, design futures
9. **Title:** What if full-time employment ceased to be the dominant model?
   Short description: An examination of how education prepares for unstable and project-based forms of work.
   Futures literacy methods: short/medium/long-term scenarios, competence projection, scenario planning.
10. **Title:** What if climate migration became a constant feature of university cities?
    Short description: Analysis of the inclusiveness and adaptability of academic institutions.
    Futures literacy methods: adaptation scenarios, behavior models for future generations, resilience scenarios
11. **Title:** What if future generations had a formal voice in today's decisions?
    Short description: Analysis of management models that take into account the interests of future generations.
    Futures literacy methods: anticipatory systems, future narratives, strategic foresight.
12. **Title:** What if regulation always lagged behind technological change?
    Short description: Analysis of management models that take into account the interests of future generations.
    Futures literacy methods: wild cards, adaptation scenarios, strategic foresight.
13. **Title:** What if carbon neutrality proved unattainable under current models?

Short description: Reframe the Sustainable Development Goals in the Face of Structural Constraints.
Futures literacy methods: scenario planning, leverage analysis, strategic foresight.

14. **Title:** What if students co-created curricula in real time?
    Short description: Exploring how dynamic co-creation of programs impacts the quality and accountability of education.
    Futures literacy methods: anticipatory games, educational prototypes, strategic foresight.

Topic 9 – Exploratory thinking

For topic 9 we will work with the method **Design Fiction.** Design fiction materializes potential futures in the form of artifacts, making them more tangible and discussable. Below a number of possible cases are outlined for topic 9.

1. **Title:** The Carbon Budget Student ID.
   Short description: A design for a fictional student ID that tracks and reduces individual carbon footprints on the campus of the future.
   Futures literacy methods: design futures, scenario analysis, risk analysis, futures literacy labs.
2. **Title:** Degree Certificate with an Ecological Footprint.
   Short description: A diploma of graduation containing information on the environmental impact of the educational process.
   Futures literacy methods: backcasting, leverage analysis.
3. **Title:** The Classroom Without a Teacher.
   Short description: A fictional scenario and prototype of an educational space run by AI and adaptive systems.
   Futures literacy methods: speculative prototyping, assessment of breakthrough technologies, design futures.
4. **Title:** The Zero-Waste Graduation Ceremony
   Short description: Designing a graduation ritual for a world with zero tolerance for waste.
   Futures literacy methods: design futures, ecological scenarios
5. **Title:** AR Sustainability Overlay for the Campus
   Short description: Augmented reality concept showing hidden flows of energy, water and emissions on campus.
   Futures literacy methods: educational prototypes, technology foresight.
6. **Title:** The Future Student Code of Ethics 2035
   Short description: A fictional document regulating students' responsibility towards the environment and future generations.
   Futures literacy methods: future narratives, strategic foresight
7. **Title:** Time-Delayed Feedback System.
   Short description: An educational system that shows students the consequences of their decisions after 10–20 years.
   Futures literacy methods: design futures, futures wheel.
8. **Title:** Campus Marketplace for Shared Resources
   Short description: A fictional platform for the exchange of resources and competences within the academic community.

Futures literacy methods: educational prototypes, system mapping, design futures

9. **Title:** The Autonomous Green Campus Council
   Short description: The concept of an autonomous decision-making system managing the sustainable development of the university.
   Futures literacy methods: speculative prototyping, systems analysis, strategic foresight

DOMAIN 7: FUTURES LITERACY

General information

TOPIC	Scenarios for 2050: Imagining sustainable communities
GREENCOMP AREA	AREA 3: Envisioning Sustainable Futures
GREENCOMP SKILL	Futures literacy
LINK TO OTHER GREENCOMP SKILLS	Adaptability (Area 3, Skill 8) – dealing with uncertainty and change in long-term sustainability transitions. Exploratory thinking (Area 3, Skill 9) – experimenting with alternative sustainable innovations and futures.
OTHER FRAMEWORKS	SDG 17 EC4T Imagining alternative green futures GT Exploration of the future and transitioning strategies
LEARNING GOALS	by the end of the module, students are able to: • Explain futures literacy in the context of GreenComp Area 3 and distinguish it from prediction-oriented approaches to the future. • Use at least one futures method (e.g. Three Futures of Place, Futures Wheel) to generate multiple possible futures for a sustainable community or campus in 2050. • Identify and question their own assumptions about sustainable futures (environmental, social, technological) and how these shape current decisions. • Collaboratively develop and present a simple 2050 scenario for a sustainable community, including key drivers, possible pathways and implications for different stakeholders. • Use a basic AR workflow to superimpose at least one future scenario element onto a current campus or community space (image or location) to make futures more tangible and discussable.
SOURCES	• Transforming the future: anticipation in the 21st century https://unesdoc.unesco.org/ark:/48223/pf0000264644 • https://arxiv.org/abs/2410.00274 • What is Futures Wheel?
DURATION	Number of hours needed to complete this module: 6 classroom hours + 1 hour homework

About domain 7: futures literacy

Futures literacy is the capacity to imagine, analyze and discuss different possible futures, including expected, alternative and preferred sustainable futures. Learners explore how current trends might unfold, how shocks or innovations could change trajectories, and how today's decisions open or close future options. This competence encourages the cocreation of desirable visions that are compatible with planetary boundaries and sustainability values, and the identification of pathways and milestones towards those visions.

Detailed lesson plan - domain 7

Lesson 1 (2 hours) – introduction & expected future

Main focus: Introduction to futures literacy and Three Futures of Place; mapping the expected future of a chosen place (campus / neighborhood / city district) towards 2050.

Goals:

- Students can explain futures literacy and the Three Futures of Place method and distinguish it from prediction.
- Students can describe the current state of a specific place and formulate an "expected future" for 2050 if no major changes are made.
- Students can identify initial assumptions and drivers (environmental, social, technological, economic) that shape their expected future.

Time / Goals	Content / Element(s)	Teaching method	Point(s) of attention / AR application
0:00–0:30 Activation of prior knowledge Empathize - Explain futures literacy vs. prediction. - Describe current state of chosen place.	- GreenComp Area 3 intro. - Futures literacy basics (possible/probable/desirable). - Place selection (e.g. campus square).	- Individual prompt: "Sustainability experience of this place?" - Plenary sharing (photos/notes).	- Anchor in real emotions/experiences. - Avoid jumping to solutions. - Students take photo of current place.
0:30–1:00 Demonstration Define–Ideate - Understand Three Futures of Place method. - Identify key drivers/assumptions.	- Three Futures explained: expected/changed/unthinkable. - Example map (other location). - Current system elements (stakeholders/infra).	- Teacher demo with visual example. - Group brainstorm: baseline description.	- Explicitly list assumptions. - Include social/educational dims. - Basic AR overlay prep: current photo loaded.

1:00–2:00 Application Prototype - Formulate "expected 2050" if no changes. - Map key features/assumptions.	- Expected future trends (business-as-usual). - Drivers: env/social/tech/econ.	- Small groups create paper/whiteboard map. - 3–5 explicit assumptions per group.	- Stay with "likely if nothing changes". - Multi-dimensional (not just tech). - AR sketch: Add expected markers (e.g. more cars, heat effects) to photo. Quick group share.

Lesson 2 (2 hours) – changed future (interventions & scenarios)

Main focus: Designing a changed future for the same place by 2050, based on deliberate sustainability interventions.

Goals:

- Students can propose and justify sustainability interventions for the chosen place (policies, infrastructures, behaviors).
- Students can develop a changed 2050 future scenario that contrasts with their expected future and is grounded in explicit interventions.
- Students can use AR to visualize key elements of the changed future scenario in situ.

Time Goals	Content Elements	Teaching method	Points of attention AR application
0:00–0:20 **Activation of prior knowledge** **Empathize** **- Reflect on expected future problems.** **- Identify leverage points.**	- Recap expected futures. - Problematic aspects.	- Gallery walk of Lesson 1 maps. - Pair discussion: "Most unacceptable elements?"	- Focus on place-specific issues. - Diverse group perspectives. - View Lesson 1 AR sketches in pairs.
0:20–1:00 **Demonstration** **Define–Ideate** **- Propose sustainability interventions.** **- Link to frameworks.**	- SDGs/circular/nature-based solutions. - Leverage points (mobility/energy/space).	- Teacher input: 2–3 real cases (photos). - Plenary: intervention brainstorm.	- Consider feasibility/system effects. - Who benefits/loses? - Demo AR intervention examples (e.g. solar roofs).
1:00–2:00 **Application Prototype** **- Design changed 2050 scenario.** **- Specify interventions/narrative.**	- 3–5 interventions. - Everyday life changes post-intervention.	- Groups: storyboard/map (now → intervention → changed). - Peer feedback round.	- Place-based, not abstract. - Balance ambition/realism. - AR intervention overlay: Add elements (bike streets, green roofs,

			gardens) to same photo. Group "tour".

Homework part 1 – between lesson 2 and 3 (±30 min)

Individual micro-assignment: Students write a short reflection (max. ½ page) on a question such as: “Which element of the changed future for our place seems most important to realize, and why?”

From your group's "changed 2050 future" (Lesson 2), select ONE element that seems most important to realize for your campus/community place. Answer in max 200 words:

1. What is the element? (e.g. "Pedestrianized campus square with urban food forest")
2. Why is this most important? (link to sustainability benefits + who benefits)
3. What assumption from the "expected future" does this challenge?
4. First concrete step to make it happen now. (e.g. petition, prototype, stakeholder meeting)

Attach 1–2 AR screenshots showing:

- EXPECTED 2050: business-as-usual view of this spot

- CHANGED 2050: your priority element overlaid

Lesson 3 (2 hours) – unthinkable future & reflection

Main focus: Creating an unthinkable future for the place (breaking assumptions), comparing all three futures and reflecting on learning and implications.

Goals:

- Students can design an “unthinkable” 2050 future that deliberately challenges dominant assumptions about the place.
- Students can compare expected, changed and unthinkable futures and discuss implications for present-day decisions.
- Students can reflect on how they use the future in the present and what futures literacy adds to their field.

Time Goals	Content Elements	Teaching method	Points of attention AR application
0:00–0:20 **Activation of prior knowledge** **Empathize** **- Recap all futures so far.** **- Collect core assumptions.**	- Expected + changed summaries. - Shared assumptions list.	- Group keyword recap (2–3 per future). - Board: visible assumptions.	- Emotional check-in (excitement/anxiety). - Quick AR toggle: expected vs. changed.
0:20–0:50 **Demonstration** **Ideate** **- Define "unthinkable" future.** **- Break key assumptions.**	- Unthinkable as exploratory tool. - Examples: post-car, rewilded campus.	- Stimulus: 1–2 radical vignettes. - Flip 2–3 assumptions.	- Plausible but boundary-pushing. - Sustainability link maintained. - Show extreme AR example (rewilded space).
0:50–1:40 **Application** **Prototype** **- Co-create unthinkable 2050.** **- Juxtapose three futures.**	- Narrative for unthinkable. - Comparison: implications/stakeholders.	- Groups: unthinkable design + 3-futures presentation prep.	- Treat as tool, not prediction. - Anchor in same place. - AR three-scenes: expected/changed/unthinkable for one viewpoint. Screenshot clips.
1:40–2:00 **Integration** **Test** **- Compare futures/discuss now.** **- Reflect on futures literacy.**	- Robust elements across futures. - Present-day implications.	- Group presentations + peer Q&A. - Plenary: "How does this change current decisions?"	- Feedback: visibility/blind spots. - Connect to students' fields. - Live AR demos during presentations.

Homework part 2 – after lesson 3 (±30 min)

Individual futures-literacy reflection: Prompt: “How has working with Three Futures of Place changed the way you think about your campus / community and your role in shaping its future?”

Reflect on working with Three Futures of Place (max 250 words). Answer:

1. How has mapping expected → changed → unthinkable futures changed how you see your campus/community place? Give 1 specific example of a "blind spot" you discovered.
2. Name ONE present-day decision about this place that you would reconsider after this module (e.g. "new building permit", "parking expansion", "green space reduction"). Why? Which future informs this reconsideration?

Optional: Include 1 AR screenshot toggling between 2 futures (e.g. expected vs. unthinkable) that illustrates your insight.

DOMAIN 8: ADAPTABILITY

General information

TOPIC	Adaptability - Living with Uncertainty and Disruption	
GREENCOMP AREA	Envisioning Sustainable Futures	
GREENCOMP SKILL	Adaptability	
LINK TO OTHER GREENCOMP SKILLS	• Futures Literacy (anticipating and preparing for change) • Critical Thinking (evaluating adaptive strategies) • Systems Thinking (understanding feedback and resilience) • Collective Action (coordinating adaptive responses)	
OTHER FRAMEWORKS	SDG	Focus on resilience (SDG 13 - Climate Action, SDG 11 - Sustainable Cities)
	EC4T	Building adaptive capacity for sustainability transitions
	GT	Adaptive business models and supply chain resilience
LEARNING GOALS	By the end of this module, learners will be able to: • **Recognize** sources of uncertainty and disruption in sustainability systems • **Evaluate** adaptive capacity of organizations and communities • **Develop** adaptation scenarios for different contexts • **Design** adaptive strategies for enhanced resilience • **Implement** flexible solutions that can respond to changing conditions • **Reflect** on personal and organizational adaptability	
SOURCES	• Adaptation Scenarios methodology • Resilience and Adaptation literature • Behavioral Models for Future Generations • Anticipatory Systems/Anticipatory Thinking • Backcasting approaches	
DURATION	Number of hours needed to complete this module: 7 hours	

About domain 8: adaptability

Adaptability is about coping constructively with change, uncertainty and complexity in sustainability contexts. Learners learn to adjust their plans and behavior when conditions shift, new information emerges or trade-offs become visible, while still keeping sustainability goals in view. The competence includes managing emotions and risks, learning from setbacks, and staying engaged and resilient during transitions at personal, organizational and societal level.

Detailed lesson plan - domain 8

Lesson 1 (2 hours) – introduction & first-order effects

Main focus: Introduction to adaptability and What If…? method; mapping immediate (first-order) consequences of the heatwave trigger on campus systems.

Goals:

- Students can explain adaptability and distinguish it from resilience in GreenComp Area 3.
- Students can identify first-order effects of the "permanent heatwaves" trigger on campus (infrastructure, people, operations).
- Students can map basic system components affected by climate uncertainty.

Time Goals	Content Elements	Teaching method	Points of attention AR application
0:00–0:30 Activation / Empathize - Explain adaptability vs resilience. - Map campus heat vulnerabilities.	- GreenComp Area 3 intro. - "Permanent heatwaves" case (35–40°C).	- Personal heat stories. - Campus vulnerability brainstorm.	- Normalize eco-anxiety. - Stay campus-specific. - Photo key campus spots (AR baseline).
0:30–1:00 Demonstration / Define - Understand What If…? method. - Identify first-order effects.	- Causal chains: 1st/2nd/3rd-order. - Campus systems (buildings /outdoor/energy).	- Teacher models simple chain. - Group: immediate impacts listing.	- Physical effects first. - Load photos into AR tool.
1:00–2:00 Application / Prototype - Map first-order consequences. - Visualize immediate risks.	- Health/energy/outdoor usability impacts.	- Groups create causal maps. - 5–7 first-order effects each.	- Concrete, observable effects. - AR risk markers (red overlays: heat zones, AC strain). Group share.

Lesson 2 (2 hours) – second/third-order effects & leverage points

Main focus: Cascading effects (2nd/3rd-order) and identifying adaptation leverage points.

Goals:

- Students can trace second- and third-order consequences through causal chains.
- Students can identify leverage points for interventions in the heatwave scenario.
- Students can propose initial adaptive strategies linked to SDG 13 frameworks.

Time Goals	Content Elements	Teaching method	Points of attention AR application
0:00–0:20 Activation / Empathize - Review first-order maps. - Spot patterns across groups.	- Lesson 1 recap. - Common vulnerabilities.	- Gallery walk + patterns discussion.	- Build on peer work. - View AR risk markers together.
0:20–1:00 Demonstration / Define–Ideate - Trace 2nd/3rd-order chains. - Identify leverage points.	- Resilience theory (Gunderson). - 2nd-order examples (energy crisis → cancellations).	- Teacher: real adaptations (shading/water). - Plenary leverage brainstorm.	- Push "and then what?". - Trade-offs discussion. - Demo layered AR cascades.
1:00–2:00 Application / Prototype - Complete causal chains. - Propose leverage interventions.	- 3rd-order systemic effects. - 3–5 leverage points + ideas.	- Groups extend maps + mark leverage. - Quick peer feedback.	- Systemic, not siloed. - AR cascade view: 1st/2nd/3rd markers (red → yellow leverage).

Homework part 1 (post-lesson 2, 30 min)

Individual adaptation pitch – "One leverage point intervention for our campus heatwave scenario + who needs to act?" + AR screenshot.

Select ONE leverage point from your group's causal map (Lesson 2) that could break or redirect the heatwave cascade. Answer these questions in max 200 words:

1. What is the intervention? (e.g. "Green roofs + rainwater harvesting on main lecture halls")
2. Who needs to act? (specific actors: facilities dept, student council, city council, etc.)
3. Why this leverage point? (link to 2nd/3rd-order effects it prevents)
4. First step to make it real? (concrete next action)

Attach 1–2 AR screenshots showing:

- BEFORE: heatwave risk markers on this spot
- AFTER: your intervention overlaid

Lesson 3 (2 hours) – adaptation design & reflection

Main focus: Prototyping adaptation packages + testing against cascading effects + futures literacy reflection.

Goals:

- Students can design and justify adaptation strategies for the full causal chain.
- Students can stress-test adaptations against uncertainty (what if heatwaves worsen?).
- Students can reflect on emotional/practical implications of climate adaptability.

Time Goals	Content Elements	Teaching method	Points of attention AR application
0:00–0:20 Activation / Empathize - Synthesize full causal chains. - Emotional check-in.	- Complete maps review. - Eco-anxiety discussion.	- Peer review rotation. - Quick feelings share.	- Empowerment focus. - AR chain walkthroughs.
0:20–0:50 Demonstration / Ideate - Design adaptation packages. - Stress-test under uncertainty.	- Integrated solutions (roofs / shading / scheduling). - SDG 13 linkages.	- Real campus adaptation examples. - Package design principles.	- Cross-disciplinary. - Show AR "before-after" examples.
0:50–1:40 Application / Prototype - Create full adaptation strategy. - Storyboard causal response.	- Adaptation portfolio per leverage point. - Stress-test variations.	- Groups: design + storyboard. - Internal group testing.	- Feasible + transformative. - Full AR portfolio: risk → intervention → adapted campus.
1:40–2:00 Integration / Test - Present/peer test adaptations. - Reflect on agency.	- Present-day implications. - Uncertainty → action shift.	- 3-min presentations + Q&A. - Closing reflection circle.	- Connect to students' fields. - End positively. - Live AR demos in presentations.

Homework part 2 (post-lesson 3, 30 min):

Reflection – "How does working with What If…? change how you approach climate uncertainty in your field?" + one present-day action recommendation.

Reflect on the full module (max 250 words). Answer:

1. How has working with What If…? causal chains changed how you approach climate uncertainty in your field/program? Give 1 concrete example.
2. Name ONE present-day campus decision you would reconsider after this module (e.g. "new parking expansion", "summer exam scheduling", "catering contracts"). Why?

Optional: Include 1 AR screenshot from your final adaptation portfolio that best shows "before heatwave → after adaptation".

DOMAIN 9: EXPLORATORY THINKING

General information

TOPIC	Exploratory Thinking - Creative Problem-Solving and Innovation for Sustainability
GREENCOMP AREA	Envisioning Sustainable Futures
GREENCOMP SKILL	Exploratory Thinking
LINK TO OTHER GREENCOMP SKILLS	• Futures Literacy (imagining possibilities) • Critical Thinking (evaluating ideas) • Systems Thinking (understanding implications) • Individual Initiative (creating new solutions)
OTHER FRAMEWORKS	SDG Innovation for all SDGs EC4T Creative entrepreneurial thinking for transition GT Sustainable innovation and business model innovation
LEARNING GOALS	By the end of this module, learners will be able to: • **Generate** creative solutions to sustainability challenges • **Evaluate** feasibility and impact of innovative ideas • **Prototype** sustainable innovations using design processes • **Communicate** innovative ideas effectively to diverse audiences • **Reflect** on the role of creativity in sustainability transformation
SOURCES	• Design Thinking and innovation literature • Design Fiction methodologies • Speculative design approaches • Innovation and entrepreneurship frameworks
DURATION	Number of hours needed to complete this module: 7 hours

About domain 9: exploratory thinking

Exploratory thinking invites learners to go beyond conventional solutions and to experiment with new ideas, practices and combinations of knowledge. They connect insights from different disciplines, cultures and types of expertise, and they use creativity to generate innovative options for more sustainable ways of living, producing and organizing. This competence supports an open, inquisitive stance towards sustainability challenges, where questioning, prototyping and learning from experimentation are central.

Detailed lesson plan - domain 9

Lesson 1 (2 hours) – future context & artifact definition

Main focus: Introduction to exploratory thinking and Design Fiction; defining a 2040 campus future context and selecting one artifact to prototype (e.g. "Carbon Budget Student ID").

Goals:

- Students can explain exploratory thinking as experimenting with multiple sustainable futures in GreenComp Area 3.
- Students can identify current campus sustainability gaps and map stakeholders/users for innovation.
- Students can brainstorm and select one Design Fiction artifact grounded in a 2040 campus context.

Time Goals	Content Elements	Teaching method	Points of attention AR application
0:00–0:30 Activation / Empathize - Explain exploratory thinking. - Identify current campus innovation gaps.	- GreenComp Area 3 intro. - Experimental mindset basics.	- "What frustrates you about campus sustainability?" - Stakeholder mapping exercise.	- Connect to real pain points. - Diverse user perspectives. - Photo current campus "problem spots".
0:30–1:00 Demonstration / Define - Understand Design Fiction method. - Define 2040 future context.	- Design Fiction: artifacts from future. - Campus 2040 context (zero-waste, carbon budget).	- Teacher shows examples (fake IDs, apps, diplomas). - Group: define future constraints.	- Tangible, not abstract. - Grounded in campus reality. - Load campus photos into AR tool.
1:00–2:00 Application / Ideate - Brainstorm future artifacts. - Select 1 artifact to prototype.	- Artifact ideas (Carbon ID, Eco-Diploma, AR Overlay). - User needs + constraints.	- Groups generate 5+ ideas. - Vote + select 1 artifact per group.	- Specific users (students, staff, visitors). - Links to SDG 9/12. - AR sketch: rough overlay of 1 artifact idea on photo.

Lesson 2 (2 hours) – artifact prototyping

Main focus: Detailing and prototyping the selected artifact with visual elements, narrative, and circular design principles.

Goals:

- Students can specify artifact functions, interfaces, and rules that make a 2040 future tangible.
- Students can link the artifact to EntreComp4Transition prototyping and SDG 9/12 challenges.
- Students can create a visual prototype and backstory using AR overlays on current campus spaces.

Time Goals	Content Elements	Teaching method	Points of attention AR application
0:00–0:20 Activation / Empathize - Review artifact ideas. - Refine user needs.	- Lesson 1 recap. - Stakeholder feedback simulation.	- Gallery walk of sketches. - "What would users love/hate?"	- Build on peer critique. - View AR sketches together.
0:20–1:00 Demonstration / Prototype - Detail artifact specifications. - Link to circular principles.	- Design Fiction elements (function, interface, rules). - EntreComp4Transition prototyping.	- Teacher: detailed artifact breakdown. - Group specification worksheet.	- Functional + cultural impact. - Circular design principles. - Demo detailed AR artifact example.
1:00–2:00 Application / Prototype - Create detailed artifact prototype. - Develop accompanying narrative.	- Visual prototype (sketch/mockup). - 2040 backstory + usage rules.	- Groups: visual prototype + 1-page narrative. - Peer prototype review.	- Make future feel "real". - Test cultural acceptability. - AR prototype: Full artifact in situ (e.g. Carbon ID interface on phone). Group demos.

Homework part 1 (post-lesson 2, 30 minutes)

Title: Artifact Implementation Pitch

From your group's Design Fiction artifact (Lesson 2), answer in max 200 words:

1. What is your artifact? (name + 1-sentence function)
2. Primary user + their biggest need it addresses?
3. First real-world prototype step? (e.g. "mockup for student council meeting")
4. Which SDG 9/12 challenge does it solve?

Attach 1–2 AR screenshots:

- CURRENT campus spot where artifact "lives"

- 2040 with artifact active

Lesson 3 (2 hours) – stakeholder testing & reflection

Main focus: Role-play testing with stakeholders, iterating based on feedback, and bridging 2040 artifact to present-day implementation paths.

Goals:

- Students can test artifact social feasibility and identify implementation barriers through stakeholder simulation.
- Students can refine the prototype and develop a realistic path from fiction to innovation.
- Students can reflect on how Design Fiction reveals innovation opportunities in their field.

Time Goals	Content Elements	Teaching method	Points of attention AR application
0:00–0:20 Activation / Empathize - Synthesize prototypes. - Prepare stakeholder scenarios.	- Prototype portfolio review. - Stakeholder role-play prep.	- Group portfolio showcase. - Role assignment (student/staff/company).	- Diverse feedback perspectives. - AR portfolio walkthrough.
0:20–0:50 Demonstration / Test - Test artifact social feasibility. - Identify implementation barriers.	- Stakeholder testing protocol. - Green leadership principles.	- Role-play testing scenarios. - Feedback collection template.	- Realistic objections. - Ethical implications. - Live AR testing during role-play.
0:50–1:40 Application / Integration - Refine artifact based on feedback. - Create final presentation.	- Iteration round 2. - Present-day implementation path.	- Groups iterate + prep 3-min pitch. - "How could this exist in 5 years?"	- Bridge 2040 → present. - Concrete next steps. - Final AR scene: artifact + implementation path visualized.
1:40–2:00 Integration / Test - Present to peers/stakeholders. - Reflect on exploratory process.	- Innovation ecosystem connections. - Exploratory thinking meta-skills.	- Final pitches + Q&A. - Closing: "What did prototyping reveal?"	- Connect to students' fields. - Celebrate experimentation. - AR showcase during pitches.

Homework part 2 (post-lesson 3, 30 minutes)

Title: Design Fiction Reflection & Innovation Commitment

Reflect on Design Fiction process (max 250 words):

1. How did creating a "future artifact" change how you approach sustainability innovation? 1 concrete example.
2. Name ONE present-day campus innovation you would prototype differently now (e.g. "waste system", "energy dashboard"). Why?

Optional: Include final AR screenshot showing your artifact "in action".

AREA 4: ACTING FOR SUSTAINABILITY

Area overview

Area 4 focuses on translating knowledge, values, and visions into concrete action for sustainability. This area emphasizes agency, collective action, and the systemic change required to transition to sustainable societies and economies.

Acting for sustainability focuses on turning knowledge, values and visions into concrete individual and collective action that can influence systems and policies. It is concerned with agency: understanding where decisions are made, who is responsible for unsustainable practices, and how people—acting alone or together—can drive change towards more sustainable ways of living and organizing society. This domain recognizes that meaningful action depends both on individuals' willingness and confidence to act and on the availability of enabling conditions and democratic spaces where their actions can have an impact.

Within this area, "political agency" refers to navigating political systems, identifying responsibility and accountability for unsustainable behavior, and demanding effective sustainability policies and structural changes. "Collective action" highlights the importance of collaborating with others, building inclusive coalitions and community driven processes, and co creating solutions at local level that contribute to wider sustainability transitions. "Individual initiative" stresses recognizing one's own potential to contribute to sustainability, developing an internal sense of being able to influence change, and taking concrete steps—such as lifestyle changes, participation in projects or advocacy—to improve prospects for one's community and the planet.

DOMAIN 10: POLITICAL AGENCY

General information

TOPIC	Political Agency - Influencing Policy and Governance for Sustainability
GREENCOMP AREA	Acting for Sustainability
GREENCOMP SKILL	Political Agency
LINK TO OTHER GREENCOMP SKILLS	● Supporting Fairness (ensuring inclusive decision-making) ● Systems Thinking (understanding governance systems) ● Critical Thinking (evaluating policies) ● - Collective Action (mobilizing constituencies)
OTHER FRAMEWORKS	SDG All SDGs, particularly SDG 16 (Peace, Justice, and Strong Institutions) EC4T Mobilizing change at institutional and policy levels GT Influencing corporate governance and business practice
LEARNING GOALS	By the end of this module, learners will be able to: ● **Explain** key policy and governance frameworks shaping sustainability and green transitions ● **Analyze** policy documents and identify gaps, strengths, and opportunities for improvement ● **Engage** in democratic processes through debate, role-play, and advocacy ● **Propose** actionable strategies to influence institutions and advance sustainability goals ● **Reflect** on agency, power, and leadership in societal transitions
SOURCES	● The 25% Revolution concept (https://www.the25percentrevolution.com/en.html) ● EU Green Deal documentation ● European Just Transition Mechanism ● National and local sustainability policies ● Climate governance case studies
DURATION	Number of hours needed to complete this module: 7 hours

About domain 10: political agency

Political agency is the ability to understand how decisions that affect sustainability are made, and to influence those decisions through democratic means. Learners identify actors, institutions and power relations that uphold unsustainable practices, and they explore ways to hold these actors accountable. The competence includes participating in public debate, engaging with policies and decision-making processes, and advocating for regulations and structures that support sustainability transitions.

Detailed lesson plan - domain 10

Block 1: Political Agency and Governance (Activation - Empathize)

Duration: 90 minutes

Core Idea: Students explore how sustainability transitions happen through policy, governance, and institutional action.

Key Elements:

- Understanding political agency and institutional dynamics
- Real-world policy examples from campus/municipality
- Connecting sustainability challenges to policy and institutions

Content Topics:

- **University Policy Examples**:
  - Waste sorting on campus
  - Energy-saving rules (lighting, heating, building access)
  - Travel policies for staff and students (train vs. plane)
- **Municipal Policy Examples**:
  - Bicycle lanes vs. car parking
  - Public transport pricing
  - Restrictions on single-use plastics at events

Key Questions: Who decided this? Was it a technical decision or a political one?

Time / Goals	Content / Element(s)	Teaching Method	AR Application
Activation of Prior Knowledge / Empathize	Topic: Political Agency and Sustainability Governance	Brainstorming, Facilitated Discussion: Prompts students to link sustainability challenges to policy and institutions	AR Application: Governance Visualization
30 min	Real examples from university/municipality	Explore: University Policies (waste, energy, travel); Municipal Decisions (bicycle lanes, transport, plastics)	In AR, teachers can show: Maps of climate vulnerability by region; Emissions by country/sector;

			Before/after policy impact scenarios
		Question: "Who decided this? Was it technical or political?"	
30 min	Governance levels and SDGs	Interactive Lecture & Discussion on local-EU-global governance; Sustainable Development Goals	Use real-life examples students know

Block 2: Governance Levels and Policy Frameworks (Demonstration - Define/Ideate)

Duration: 90 minutes

Core Idea: Understanding sustainability governance across local, national, EU, and global levels.

Key Elements:

- Sustainability and governance levels (local/EU/global)
- The Sustainable Development Goals
- National policies on carbon taxes, renewable energy subsidies, environmental permits
- EU Green Deal and policy-making processes

Content Topics:

- **EU-Level Governance**:
  - EU Green Deal
  - Emission reduction targets
  - Fit for 55 package
  - Just Transition Fund

- **EU Regulations Affecting Daily Life**:
  - Energy efficiency standards for appliances
  - Product repairability rules
  - Emissions standards for cars

Local Application:

- University or municipal sustainability plans
- Climate action plans
- Green transition budgets

Time / Goals	Content / Element(s)	Teaching Method	AR Application
Demonstration /	Topic: EU Green Deal & Policy-Making	**Lecture & Discussion** covering: EU Green Deal; Emission reduction targets; Fit for 55	**AR Application: Policy Visualization**

Define / Ideate		package; Just Transition Fund; EU regulations (appliances, repairability, cars)	
45 min			Highlight decision points, trade-offs, and power relations
	Local/University Climate Plans	**Analyze**: Your own university's sustainability plan: What are good ideas? What can be improved?	

Block 3: Advocacy and Political Participation (Application - Prototype)

Duration: 120 minutes

Core Idea: Students explore how people influence sustainability governance through activism and participation.

Key Elements:

- Social movements and climate activism
- The "25% Revolution" concept
- Case studies of community-led change
- Participatory mechanisms and mechanisms

Content Topics:

- **Student Activism Examples**:
  - Campaigns for sustainable food on campus
  - Pressure for climate-neutral universities
  - Divestment movements
- **Civil Society Examples**:
  - Climate marches
  - NGO advocacy influencing legislation
  - Youth climate movements

Participatory Mechanisms:

- Public consultations
- Citizen assemblies on climate
- Participatory budgets

Global Climate Governance:

- Negotiation of emission targets
- Climate finance debates
- Equity between Global North and South

Time / Goals	Content / Element(s)	Teaching Method	AR Application
Application / Prototype	Topic: Advocacy & Political Participation	**Brainstorming**: "Where do we see advocacy in daily life?"	**AR Application: Solution Mapping**
60 min (combined)	Exploration of: **Student Activism** (campus sustainability campaigns, climate-neutral university pressure); **Civil Society** (climate marches, NGO advocacy); **Participatory Mechanisms** (public consultations, citizen assemblies, participatory budgets)	**Case Studies** of community-led change; Exploration of "25% Revolution" concept (https://www.the25percentrevolution.com/en.html)	Solutions displayed on AR platform
60 min	Global Climate Governance	**World Climate Simulation**: Negotiation of emission targets, climate finance debates, Global North-South equity discussions	**AR Simulation**: Temperature pathways, vulnerability maps, emissions trajectories

Block 4: Policy Development and Reflection (Integration - Test)

Duration: 60 minutes

Core Idea: Students develop actionable policy recommendations and reflect on political agency.

Key Elements:

- Team project: policy recommendation drafts
- Leadership and decision-making power analysis
- Reflection on political agency and change

Content Topics:

- Developing policy advice for institutions, businesses, government
- Advocacy strategies and implementation
- Monitoring and evaluation of policy impact
- Personal reflection on political agency and leadership

Time / Goals	Content / Element(s)	Teaching Method	AR Application
Integration / Test	Topic: Policy Advice Development & Reflection	**Team Project**: Draft policy recommendations for university, business, national government, or EU	**AR Application: Impact Mapping**
30 min			Solutions displayed on AR platform

	Reflection on Political Agency	**Group Reflection:** Who has decision-making power? Who has limited influence? How is leadership exercised?	**AR Map of Change**: Visualize pathways of influence and change
		Individual Reflection: On agency, responsibility, and leadership in sustainability transitions	

Specific futures literacy and AR applications for domain 10

Scenario: three futures of place (green campuses 2040)

Application: "School of the Future in 3 Scenarios"

Features:

- AR shows: green roofs, autonomous classrooms, permaculture gardens, solar panels, smart energy use
- Describes assumptions underlying each scenario
- Students "rebuild the school" using design fiction
- Each group creates their own scenario version

Goal: Make participants aware there is more than one future; understand how policy choices shape it.

DOMAIN 11: COLLECTIVE ACTION

General information

TOPIC	Neighborhood Energy Commons: Co-creating a Local Renewable Energy Hub with the Campus	
GREENCOMP AREA	Acting for sustainability	
GREENCOMP SKILL	Collective action	
LINK TO OTHER GREENCOMP SKILLS	• Systems thinking (Area 2, Skill 4) – understanding interconnections between campus, neighborhood and energy systems. • Problem framing (Area 2, Skill 6) – framing local energy and climate issues from multiple stakeholder perspectives. • Political agency (Area 4, Skill 10) – engaging with governance and policy frameworks that enable or constrain collective initiatives.	
OTHER FRAMEWORKS	SDG	• SDG 7 – Affordable and Clean Energy (local renewable generation and sharing). • SDG 11 – Sustainable Cities and Communities (campus–neighborhood collaboration). • SDG 17 – Partnerships for the Goals (multi-actor collaboration and co-creation).
	EC4T	• Systems innovation for sustainability – experimenting with new socio-technical configurations around energy and community. • Stakeholder engagement and co-creation – involving diverse groups in sustainability initiatives to foster shared ownership. • Mobilizing networks – linking campus, energy coops, municipality and citizen groups for systemic change.
	GT	• Chain thinking from generation to end-user – seeing energy as a value chain involving producers, intermediaries and users. • Business models for community energy and prosumer arrangements (co-ops, shared ownership, service models). • Partnership-based green ventures between HEI, SMEs and local authorities.
LEARNING GOALS	by the end of the module, students are able to: 1. Explain collective action in Area 4 as coordinated multi-stakeholder efforts for sustainability, and distinguish it from individual action and purely institutional initiatives. 2. Map key stakeholders and relationships in a potential neighborhood–campus energy commons, identifying interests, power relations and possible roles for the HEI. 3. Apply basic participatory decision-making and co-creation principles to design a small-scale “Neighborhood Energy Commons” concept (e.g. shared solar scheme, community battery, campus–neighborhood demand-response program).	

	4. Identify barriers and enablers for such collective initiatives (regulation, finance, trust, communication) and propose strategies to address them. 5. Use AR to visualize how a shared energy hub or associated infrastructures (solar arrays, shared spaces, information dashboards) could be embedded in real campus and neighborhood locations to support discussion with stakeholders.
SOURCES	● What is Participatory Decision-Making? – tools4dev (for stakeholder and decision-making processes). ● Stakeholder engagement and co-creation resources referenced in the GreenEDU curriculum (e.g. Stakeholders Ecosystem Map). ● Examples of community energy and energy commons initiatives (to be selected by partners, e.g. European energy coop case studies).
DURATION	Number of hours needed to complete this module: 7 hours

About domain 11: collective action

Collective action focuses on working with others to design and implement sustainability initiatives that no single person could achieve alone. Learners practice collaborating across differences, building trust and shared purpose, and organizing groups or networks that can act at community, institutional or wider levels. This competence values inclusive participation and co-creation, and it recognizes that transformative change often emerges from sustained, coordinated efforts by many people.

Detailed lesson plan – domain 11

Lesson 1 (2 hours) – Understanding the system & actors

Main focus

Introduce collective action and the Neighborhood Energy Commons case; map the local energy–community system and key stakeholders (campus, neighborhood, municipality, energy actors).

Goals

- Students can explain collective action in Area 4 and distinguish it from individual action and purely institutional initiatives.
- Students can identify and map key stakeholders and relationships around campus–neighborhood energy (residents, SMEs, city, energy coop, HEI departments).
- Students can describe the current energy and social situation around the campus neighborhood (basic “as is” picture).

Suggested structure

- Activation / Empathize: short input on Area 4 + local energy/climate context; students share how they and their neighbors currently use/experience energy around campus.
- Demonstration / Define: teacher introduces the Neighborhood Energy Commons idea, shows 1–2 examples of community energy projects; co-creates an initial system map on the board.
- Application / Prototype: in groups, students create a stakeholder map + simple system map (flows of energy, money, information, trust) for the campus neighborhood; identify potential “touch points” where campus and community meet (shared roofs, public spaces, mobility hubs).

AR use (Lesson 1)

- Students photograph 2–3 relevant places (campus roofs, parking, bordering streets/neighborhood squares) and create a first AR “as is” view with labels for current uses (parking, offices, housing, shops). This will be the baseline for later energy-commons overlays.

Time / Goals	Content Elements	Teaching method	Points of attention /AR application

0:00–0:30 Activation / Empathize - Explain collective action vs. individual/institutional. - Describe current energy situation around campus.	- Area 4 intro + Neighborhood Energy Commons concept. - Local energy/climate context.	- Short input + students share energy experiences (campus/neighborhood). - Quick plenary mapping.	- Connect to real local context. - Include non-campus actors. - Photos of 2–3 campus–neighborhood spots (roofs, streets).
0:30–1:00 Demonstration / Define - Map stakeholders and system relationships. - Identify campus–neighborhood touchpoints.	- Stakeholder examples (residents, SMEs, city, energy coop). - Energy/money/info/trust flows.	- Teacher: 1–2 community energy examples. - Co-create system map on board.	- Power dynamics and tensions. - Multi-scale (building/street/neighborhood). - AR baseline: label current uses on photos.
1:00–2:00 Application / Prototype - Create stakeholder + system map. - Spot potential collaboration opportunities.	- Stakeholder interests/roles. - Touch points (shared roofs, public spaces).	- Groups: stakeholder map + simple system sketch. - Gallery walk + pattern spotting.	- Realistic stakeholder diversity. - Focus on mutual benefit areas. - AR “as is” views with stakeholder labels.

Lesson 2 (2 hours) – Co-designing the energy commons concept

Main focus

Use participatory decision-making and co-creation principles to design a small-scale Neighborhood Energy Commons concept (e.g. shared solar + community battery + information system).

Goals

- Students can formulate a concrete concept for a local energy commons that includes roles for at least three stakeholder groups (campus, residents, municipality/energy coop).
- Students can apply basic participatory decision-making principles (listening to interests, seeking win-wins, addressing power imbalances) in the design process.
- Students can identify initial barriers/enablers (regulation, finance, trust, technical constraints) for their concept.

Suggested structure

- Activation / Empathize: groups briefly present their stakeholder/system maps from Lesson 1, focusing on tensions and opportunities; class identifies common patterns.

- Demonstration / Define–Ideate: short input on participatory decision-making and co-creation (e.g. tools4dev, stakeholder ecosystem mapping); teacher introduces 2–3 design prompts (e.g. “shared rooftop solar”, “community battery + flexible tariffs”, “energy awareness displays in shared spaces”).
- Application / Prototype: groups choose or combine prompts and develop a **Neighborhood Energy Commons concept sheet**:
    - what is shared (energy, data, spaces)
    - who participates and in which role
    - how decisions are taken
    - expected benefits and risks for each stakeholder.

AR use (Lesson 2)

- Groups overlay key elements of their concept (solar arrays, battery containers, info screens, co-owned spaces) on their baseline photos to create a first visual prototype of the energy commons in situ; short in-class AR “micro-tour” per group.

Time / Goals	Content Elements	Teaching method	Points of attention / AR application
0:00–0:20 Activation / Empathize - Review stakeholder / system maps. - Identify tensions + opportunities.	- Lesson 1 recap. - Common patterns across groups.	- Quick presentations + plenary synthesis.	- Build on peer insights. - AR map walkthroughs.
0:20–1:00 Demonstration / Define–Ideate - Apply participatory decision-making principles. - Formulate energy commons concept.	- Co-creation basics (tools4dev). - Design prompts: shared solar, community battery, info hubs.	- Teacher input + prompt selection. - Group concept brainstorming.	- Win-win framing. - Decision-making process included. - Demo AR energy commons examples.
1:00–2:00 Application / Prototype - Design concrete energy commons proposal. - Specify stakeholder roles + governance.	- Shared elements (energy/data/space). - Roles, benefits, risks per stakeholder.	- Groups: concept sheet + visual sketch. - Peer feedback round.	- Realistic scope (pilot scale). - Governance clarity. - AR prototype: solar/battery/info screens overlaid. Group tours.

Lesson 3 (2 hours) – Testing, barriers & pathways to action

Main focus

Stress-test the concepts through stakeholder role-play; identify barriers/enablers and outline first steps and collective action strategies.

Goals

- Students can test and refine their energy-commons concept by simulating reactions of different stakeholders (students, neighbors, city, energy coop, campus management).
- Students can identify concrete barriers (policy, finance, technical, social) and propose strategies to overcome them.
- Students can outline a realistic first-step collective action plan (who to involve, how to start, which forum to use).

Suggested structure

- Activation / Empathize: groups recap their concept and AR visuals, highlighting expected benefits for each stakeholder.
- Demonstration / Ideate–Test: teacher introduces a simple role-play/testing protocol (rounds of questions from different stakeholder roles – "what do I gain/lose?", "what do I fear?", "what conditions do I need?"); briefly connects to political agency and policy frameworks (link to topic 10).
- Application / Prototype–Integration:
    - In small role-play sessions, students test their concept: some act as proponents, others as specific stakeholders (neighborhood resident, SME owner, city energy officer, facilities manager).
    - After each round, group updates:
        - barriers/enablers list
        - minimal conditions for success
        - a short **collective action roadmap** (first 3–5 steps over the next 1–2 years, including meetings, pilots, and communication).

AR use (Lesson 3)

- Groups refine their AR scenes to reflect negotiated changes (e.g. different locations, added co-benefits such as green roofs, public seating); during final short pitches, they use AR visuals to support stakeholder-focused storytelling ("this is what your street/our roof could look like under the energy commons").

Time Goals	Content Elements	Teaching method	Points of attention AR application

0:00–0:20 Activation Empathize - Recap energy commons concepts. - Anticipate stakeholder reactions.	- Group concept summaries. - Expected benefits per stakeholder.	- 1-min pitches + reaction prediction.	- Diverse stakeholder perspectives. - AR concept walkthroughs.
0:20–0:50 Demonstration Test - Stress-test via role-play. - Identify barriers/enablers.	- Role-play protocol. - Policy/regulatory context (link topic 10).	- Teacher: testing framework. - Role assignment + first round.	- Realistic objections. - Power imbalances. - AR visuals during role-play.
0:50–1:40 Application Integration - Refine concept based on feedback. - Create collective action roadmap.	- Barriers/enablers matrix. - 1–2 year first steps.	- Groups: iterate + roadmap (3–5 steps). - Peer pre-mortem.	- Concrete meetings/pilots. - Realistic timeline. - AR “first pilot” scenes.
1:40–2:00 Integration Test - Pitch final concepts. - Reflect on collective action skills.	- Implementation forums (living lab, city council). - Collective action meta-skills.	- Final pitches + Q&A. - Closing reflection.	- Connect to students' networks. - Celebrate collaboration. - AR pitches with stakeholder views.

Homework (1 hour total)

Homework Part 1 (after Lesson 2, ~30 min)

Title: *Stakeholder Letter or Message*

Students individually pick one stakeholder group relevant to their group concept (e.g. local resident, city energy officer, student union, facilities manager) and write a brief letter/email/message (max. 250 words) from the **perspective of that stakeholder** reacting to the proposed Neighborhood Energy Commons:

- perceived opportunities and worries
- conditions under which they would support the initiative
- one concrete question or demand for the student group.

They attach 1 AR screenshot that best illustrates “their” viewpoint (e.g. the roof they would co-own, the street they live in).

Homework Part 2 (after Lesson 3, ~30 min)

Title: *Collective Action Micro-Roadmap*

Working individually or in pairs, students translate the group roadmap into a **micro-roadmap** for the next 6–12 months (max. 1 page):

- 3 concrete actions (what, who leads, who else is involved)
- where/when these actions could realistically occur in their HEI/community context (e.g. living lab, city consultation, student council).

Optionally they include a final AR screenshot capturing the “first pilot” they’d like to see (e.g. one building or one street segment).

DOMAIN 12: INDIVIDUAL INITIATIVE

General information

TOPIC	My Green Micro-Mandate – Designing and Implementing a Personal Sustainability Initiative in the Campus Ecosystem	
GREENCOMP AREA	Acting for sustainability	
GREENCOMP SKILL	Individual initiative	
LINK TO OTHER GREENCOMP SKILLS	• Valuing sustainability (Area 1, Skill 1) – translating personal values into concrete action. • Critical thinking (Area 2, Skill 5) – analyzing where own behavior and practices can change. • Collective action (Area 4, Skill 11) – positioning one's initiative within broader campus and community efforts.	
OTHER FRAMEWORKS	SDG	• SDG 12 – Responsible Consumption and Production (changes in everyday practices, waste, resources). • SDG 13 – Climate Action (personal contributions to mitigation/adaptation). • SDG 11 – Sustainable Cities and Communities (impact on campus and local environments).
	EC4T	• Spotting opportunities for green changes in one's own context. • Taking the initiative – moving from idea to first action. • Planning and management of small experiments and pilots. • Learning through experience – iterating based on feedback and results.
	GT	• Micro-innovation in daily processes (e.g. lab, office, teaching, mobility). • Behavioral change for sustainability in organizations. • Intrapreneurship – leading small green changes from within existing structures.
LEARNING GOALS	At the end of the module, students are able to: 1. Explain individual initiative in Area 4 as proactive, self-directed action for sustainability within their own sphere of influence. 2. Map their personal roles, networks and constraints in the campus/community ecosystem and identify at least one realistic leverage point for change. 3. Design a small-scale sustainability initiative (aim, target group, steps, timeline, minimal resources) that they can start within one semester. 4. Anticipate likely barriers and enablers for their initiative and propose strategies to address them in a healthy, realistic way. 5. Use AR to visualize how their initiative would change a concrete space or practice in their real context and use this visualization to communicate with peers or stakeholders.	

SOURCES	• GreenEDU curriculum and GreenComp framework (Area 4 – Acting for Sustainability). • EntreComp4Transition resources on initiative-taking and green entrepreneurial competences. • Selected case examples of student-led sustainability initiatives in higher education (e.g. repair cafés, green labs, mobility campaigns).
DURATION	Number of hours needed to complete this module: 7

About domain 12: Individual initiative

Individual initiative is about recognizing one's own capacity and responsibility to contribute to sustainability in concrete ways. Learners develop confidence that their actions matter, identify areas where they can make a difference, and take practical steps—from lifestyle choices to professional projects and civic engagement. The competence involves setting personal sustainability goals, monitoring progress, and inspiring others through example while staying aware of structural constraints and the need for broader systemic change.

Short case idea

Each student identifies a concrete leverage point where they personally have influence (e.g. in a course, lab, student association, dorm, internship company, commuting pattern, digital practices) and designs a small, realistic sustainability initiative they can start within one semester (e.g. lab plastics reduction protocol, repair corner in their department, "green thesis" guidelines, low-carbon commuting challenge).

Detailed lesson plan – domain 12

Lesson 1 (2 hours) – From values to my sphere of influence

Main focus

Help students understand **individual initiative** in Area 4 and locate their personal **sphere of influence** in the campus/HEI ecosystem, then choose one realistic focus area for their initiative.

Goals

- Students can explain individual initiative in GreenComp as taking proactive, self-directed action for sustainability within one's own sphere of influence.
- Students can map their personal roles, networks, and constraints in the campus/community (courses, organizations, workplaces, social circles).
- Students can identify and select one concrete **focus area** (e.g. waste, mobility, food, digital, teaching/learning practice) where they can plausibly start a small initiative.

Lesson storyline

- Activation / Empathize: short reflection on previous areas (values, complexity, futures, collective action); students map "where I am active" (study program, jobs, associations, online communities).
- Demonstration / Define: teacher introduces the idea of a "micro-mandate" and shows 2–3 examples of small student-led green initiatives from other HEIs.
- Application / Prototype: students complete a **personal influence map** (nodes = roles/groups, links = influence strength), then choose and briefly justify one focus area for their initiative.

AR use (Lesson 1)

- Students take photos of “their” spaces (lab, studio, classroom, office, dorm, association room, bike parking, canteen) and tag them in AR as **potential intervention spots**, with simple labels (e.g. “waste hotspot”, “mobility bottleneck”, “unused potential for green space”).

Time / Goals	Content Elements	Teaching method	Points of attention AR application
0:00–0:30 Activation / Empathize - Explain individual initiative in Area 4. - Map personal roles/networks.	- Area 4 recap + micro-mandate concept. - Personal ecosystem (study/job/associations).	- Reflection: "Where am I active?" - Plenary sharing.	- Realistic influence areas. - Avoid overambitious scopes. - Photos of "my" campus spaces.
0:30–1:00 Demonstration / Define - Understand sphere of influence. - Select focus area.	- Micro-mandate examples (repair corner, green lab). - Influence mapping principles.	- Teacher: 2–3 student initiative cases. - Personal influence canvas intro.	- Focus on existing roles. - Small scale realistic. - AR tag potential spots.
1:00–2:00 Application / Prototype - Create personal influence map. - Choose + justify focus area.	- Roles → influence → leverage points. - Waste/mobility/food/digital examples.	- Individual: fill influence map. - Group: select + pitch focus area.	- Concrete, controllable area. - Peer challenge for realism. - AR baseline: label intervention spots.

Lesson 2 (2 hours) – Designing my initiative

Main focus

Use basic design thinking and EntreComp-style entrepreneurial thinking to design a **specific personal initiative**: problem definition, target behavior or change, simple plan, and quick prototype.

Goals

- Students can clearly define a sustainability problem or opportunity in their chosen context, from multiple stakeholder perspectives.
- Students can design a small-scale, feasible initiative with clear aim, target group, simple steps, and minimal resources.
- Students can create a first prototype or representation of their initiative (poster, process sketch, small script, layout change, communication concept) and test it informally with peers.

Lesson storyline

- Activation / Empathize: students briefly present their chosen focus area and AR-tagged spot(s); peers ask clarifying questions.
- Demonstration / Define–Ideate: teacher introduces a minimal canvas (e.g. "Why–Who–What–How–When") plus 1–2 principles from EntreComp4Transition (start small, test fast, learn).
- Application / Prototype: students fill in a **Personal Initiative Canvas**:
    - Why (problem/opportunity)
    - Who (target group + allies)
    - What (concrete action/offer)
    - How (simple steps/resources)
    - When (realistic timeline)

      then build a quick prototype (e.g. draft communication, layout sketch, simple rule change, checklist, mini-campaign concept) and get short peer feedback.

AR use (Lesson 2)

- Students overlay their initiative idea on photos of the real space (e.g. visual AR signage for new waste streams, redesigned layout of bikes, green corner in a corridor, "green thesis" label in a course overview) to check visibility, practicality, and aesthetics.

Time Goals	Content Elements	Teaching method	Points of attention AR application
0:00–0:20 Activation / Empathize - Clarify focus area problem. - Understand target group needs.	- Focus area presentations. - Stakeholder perspectives.	- 1-min pitches + peer questions. - Empathy mapping.	- Multiple viewpoints. - Real user needs. - AR spot walkthroughs.
0:20–1:00 Demonstration / Ideate - Design feasible initiative. - Use EntreComp principles.	- Personal Initiative Canvas (Why / Who / What / How / When). - Start small, test fast.	- Teacher: canvas walkthrough + examples. - Group canvas filling.	- Minimal resources. - Clear measurable aim. - AR prototype examples.
1:00–2:00 Application / Prototype - Build initiative prototype. - Get peer feedback.	- Prototype (poster / sketch / script / layout). - Target behavior change.	- Individual: create prototype. - Peer feedback rotation.	- Communicate clearly. - Test usability. - AR overlay: initiative in real space.

Lesson 3 (2 hours) – From idea to commitment & resilience

Main focus

Prepare for **real implementation**: anticipate barriers, identify supports, and make a concrete commitment and monitoring plan; reflect on the emotional and resilience aspects of leading a small change.

Goals

- Students can identify likely barriers and enablers (time, hierarchy, rules, peer culture, resources) for their initiative.
- Students can formulate a realistic **first-steps plan** (what they will actually do in the next 4–8 weeks, who they will talk to, what they will measure).
- Students can reflect on their motivation, limits, and strategies to stay engaged without burnout or guilt (linking back to eco-anxiety and agency from earlier topics).

Lesson storyline

- Activation / Empathize: students share their current idea and what excites or worries them about implementing it.
- Demonstration / Ideate–Test: teacher introduces a simple "barriers & supports" matrix and 1–2 resilience strategies (e.g. buddying, setting boundaries, celebrating small wins), connecting to eco-anxiety and agency.
- Application / Integration:
    - Students fill a **Micro-Roadmap** (next 4–8 weeks): 3–5 steps with dates, contact persons, minimal indicators (what would count as "started").
    - Short peer "pre-mortem": partners imagine obstacles and help adjust the plan; each student formulates a **commitment statement** (what they are realistically willing to try).

AR use (Lesson 3)

- Students update their AR scenes to show **"Day 1 of implementation"**: for example, the first poster, the reorganized corner, the changed digital workflow; they use this as a visual anchor when presenting their plan and commitment to the group.

Time Goals	Content Elements	Teaching method	Points of attention AR application
0:00–0:20 Activation / Empathize - Share initiative ideas. - Surface excitement/ worries.	- Prototype showcase. - Implementation feelings.	- Quick shares + emotion check.	- Normalize barriers. - Build peer support. - AR prototype demos.

0:20–0:50 Demonstration / Test - Anticipate barriers/supports. - Build resilience strategies.	- Barrier's matrix. - Eco-anxiety → agency (small wins, boundaries).	- Teacher: matrix + resilience tips. - Group barrier brainstorming.	- Realistic obstacles. - Healthy boundaries. - AR "Day 1" visuals.
0:50–1:40 Application / Integration - Create micro-roadmap. - Formulate commitment.	- 4–8-week plan (steps, dates, contacts). - Minimal indicators.	- Individual: fill roadmap. - Peer pre-mortem.	- First step doable. - Measurable progress. - AR "first step" scene.
1:40–2:00 Integration / Test - Share commitments. - Reflect on agency.	- Motivation + staying engaged. - Personal sustainability journey.	- Commitment statements round. - Closing reflection.	- Celebrate small starts. - Peer accountability. - AR commitment anchors.

Homework (total 1 hour)

Homework Part 1 (after Lesson 2, ~30 min)

Title: *Personal Initiative Canvas – Version 1.0*

Students refine their Personal Initiative Canvas at home (max. 1 page) and write a brief description (150–200 words) answering:

1. What exactly will change if your initiative works (describe a scene)?
2. Who needs to say "yes" or cooperate, and how will you approach them first?

They add 1 AR screenshot that best visualizes the **intended change** in their real context (before/after overlay if possible).

Homework Part 2 (after Lesson 3, ~30 min)

Title: *Commitment & Reflection Note*

Within a few days after Lesson 3, students write a short reflection (200–250 words):

1. What is the **first concrete action** you will take in the next two weeks, and on which date?
2. What might make you give up, and what can help you stay engaged in a healthy way (people, routines, boundaries)?

Optionally they add a second AR screenshot once they have taken their first small step (e.g. first conversation, first sign, first rearrangement) or a mock-up of it if timing doesn’t allow.

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