



GreenDiLT Toolkit



GreenDiLT Toolkit

Universities are undergoing a **rapid digital transformation** in teaching and learning. While digital technologies offer significant opportunities, their **environmental impacts** are often:

- Poorly measured, making it difficult to assess their true sustainability performance.
- Misunderstood, with common assumptions such as “online equals green” overlooking the environmental burdens associated with digital infrastructures and devices.
- Rarely integrated into educational design or institutional policies, limiting the ability of universities to make informed and sustainable decisions.

As a result, education stakeholders often lack **shared, credible, and practical tools** to understand, assess, and reduce the environmental impacts of digitally-enhanced education.

The **GreenDiLT toolkit** includes:

1. **Resources** about digital sustainability
2. **Tools** developed by the GreenDiLT project
3. **Training material** developed by the GreenDiLT project

01

Resources to enhance the
environmental sustainability of
digital teaching and learning
practices



University networks addressing digital sustainability

Target: Faculty, Support Staff

- **EAUC – Alliance for Sustainability Leadership in Education**
Focus: Operational sustainability including digital/ICT, procurement, data and climate
 <https://www.eauc.org.uk/>
- **AASHE – Association for the Advancement of Sustainability in Higher Education**
Focus: Metrics and reporting (including IT/digital aspects in STARS)
 <https://www.aashe.org/>
- **COPERNICUS Alliance – European Network on Higher Education for Sustainable Development**
Focus: Transformative learning, curricula, including digital-enabled sustainability topics
 <https://www.copernicus-alliance.org/>
- **ISCN – International Sustainable Campus Network**
Focus: Strategic digital infrastructure, campus systems integration
 <https://international-sustainable-campus-network.org/>



University networks addressing digital sustainability

Target: Faculty, Support Staff

- **RUS – Rete delle Università per lo Sviluppo Sostenibile** (Italian Network)
Focus: National sustainability coordination (including digitalization themes)
 <https://reterus.it/>
- **SDSN – Sustainable Development Solutions Network**
Focus: SDG-aligned frameworks and guidance (digital sustainability included within SDG context)
 <https://www.unsdsn.org/>
- **IAU – International Association of Universities (with HESD working group)**
Focus: Global higher education engagement on sustainability and digital transformation trends
 <https://www.iau-aiu.net/>



Standards and tools

UNI/PdR 147:2025

Target: Faculty, Support staff

What it covers

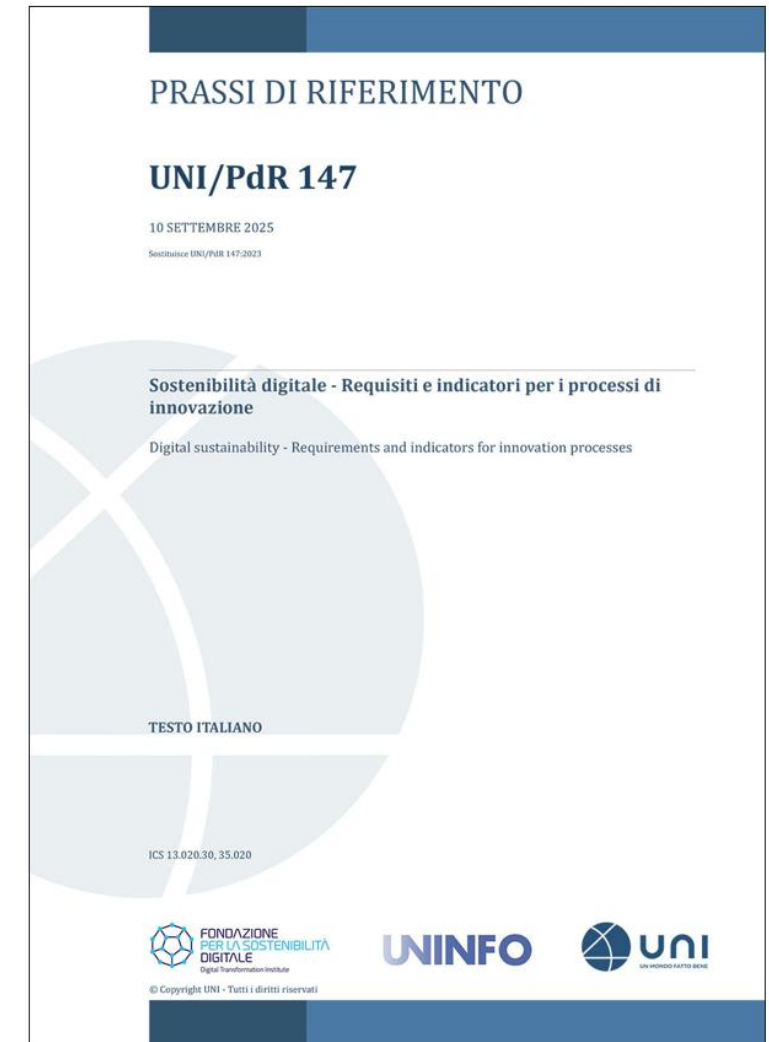
Digital sustainability - Requirements and indicators for innovation processes

Why it matters for digital education

UNI/PdR 147:2025 defines requirements and indicators (KPIs) to measure digital sustainability in innovation projects, aligning them with the objectives of the 2030 Agenda

Updated to improve usability and consistency, the practice (50 KPIs) covers the entire technological life cycle, integrating ESG criteria, environmental impact assessments and CSRD regulations.

 <https://store.uni.com/uni-pdr-147-2025>



Standards and tools

ITU-T L.1410 – Environmental Impact of ICT Goods, Networks and Services

Target: Faculty, Support Staff

What it covers

Life Cycle Assessment-based assessment of ICT products and services

Why it matters for digital education

Directly applicable to:

- online learning platforms
- video conferencing
- cloud services
- networks and data transmission

 <https://www.itu.int/rec/T-REC-L.1410>

ITU-T L.1410 (11/2024)

عربي | 中文 | English | Español | Français | Русский

Methodology for environmental life cycle assessments of information and communication technology goods, networks and services

Recommendation ITU-T L.1410 deals with environmental life cycle assessments (LCAs) of information and communication technology (ICT) goods, networks and services. It is organized in two parts:

•Part I: ICT life cycle assessment: framework and guidance.

•Part II: Comparative analysis between ICT and reference product system (baseline scenario); framework and guidance.

Part I deals with the life cycle assessment (LCA) methodology applied to ICT goods, networks and services. Part II deals with comparative analysis based on LCA results of an ICT goods, networks and services product system and a reference



Standards and tools

GHG Protocol – ICT Sector Guidance

Target: Faculty, Support Staff

What it covers

How to account for greenhouse gas emissions from ICT services

Why it matters

Used for cloud services, platforms, networks, etc.

It helps universities classify digital emissions under Scope 2 and Scope 3

 <https://ghgprotocol.org/sites/default/files/2023-03/GHGP-ICTSG%20-%20ALL%20Chapters.pdf>



Software and calculators

EUSTEPs Footprint calculator

Target: Faculty, Support Staff, Students

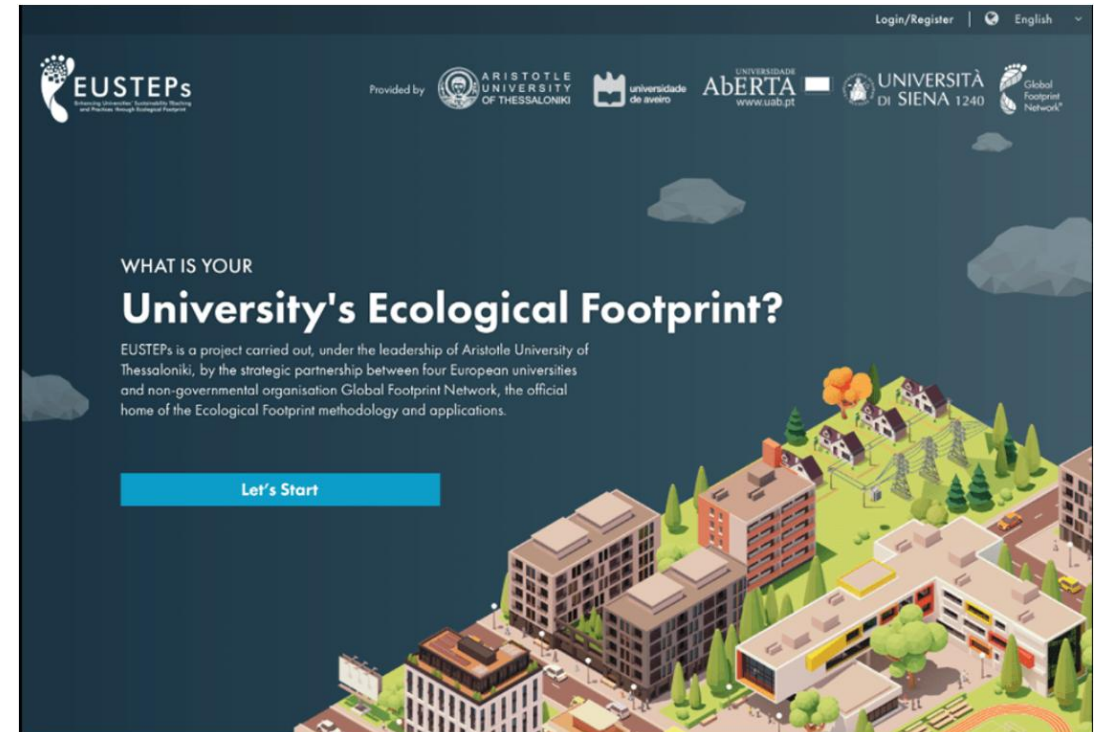
What it covers

The open-access, online University Footprint Calculator allows calculating the Ecological Footprint of universities based on their consumption of natural resources and ecosystem services, and identifying interventions area for reducing their environmental impact.

Why it matters

Equip EU university students and the wider academic community to actively participate in the societal effort towards sustainability.

 <https://eusteps.footprintcalculator.org/home>



Software and calculators

Green Software Foundation – Software Carbon Intensity

Target: Faculty, Students

What it covers

Standardized way to measure carbon intensity of software applications

Why it matters

Applies to:

- LMS platform
- Learning apps
- AI-based educational tools

Increasingly influential, even if not yet ISO

<https://cloud.google.com/resources/software-guide?hl=it>

<https://sci.greensoftware.foundation/>

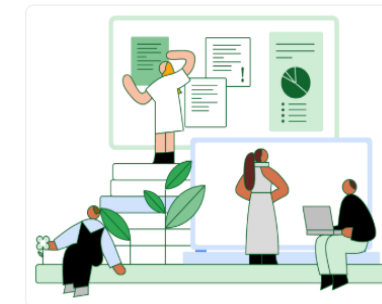


SCI Specification

Software Carbon Intensity (SCI) Specification

It's time for your software to Go Green

Discover how to make your software development eco-friendly and sustainable with our Go Green Software guide.



Let Green Software leaders be your guides



GreenDiLT



Co-funded by
the European Union

Software and calculators

compar:AI – The chatbot arena

Target: Faculty, Support staff, Students

What it covers

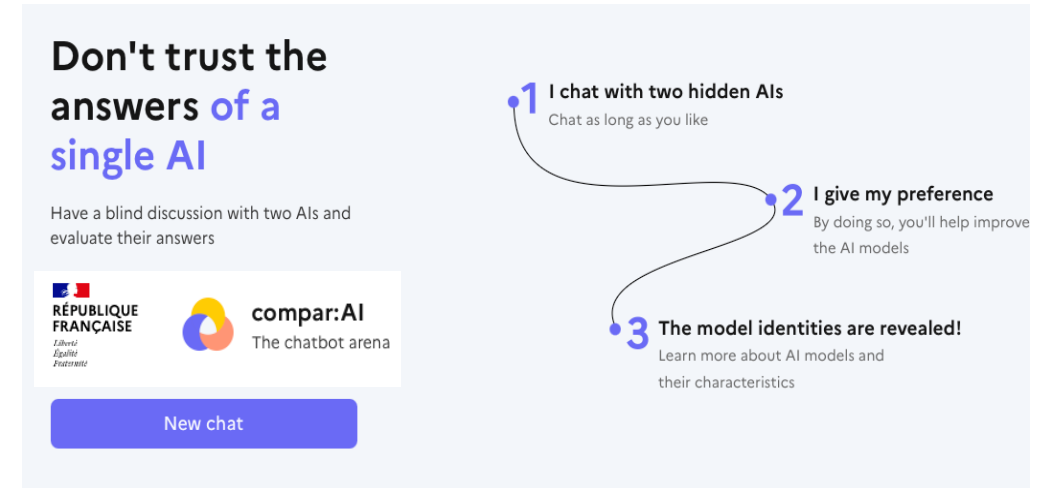
Free tool helping raise awareness among citizens about generative AI and its challenges.

Why it matters

- Compare the responses of different AI models
- Test the latest AI in the ecosystem in one place
- Measure the environmental footprint of question asked to AI

The tool is also useful to AI experts, developers and for educational purposes.

 <https://comparia.beta.gouv.fr/>



Software and calculators

Green Algorithms calculator

Target: Faculty, Students

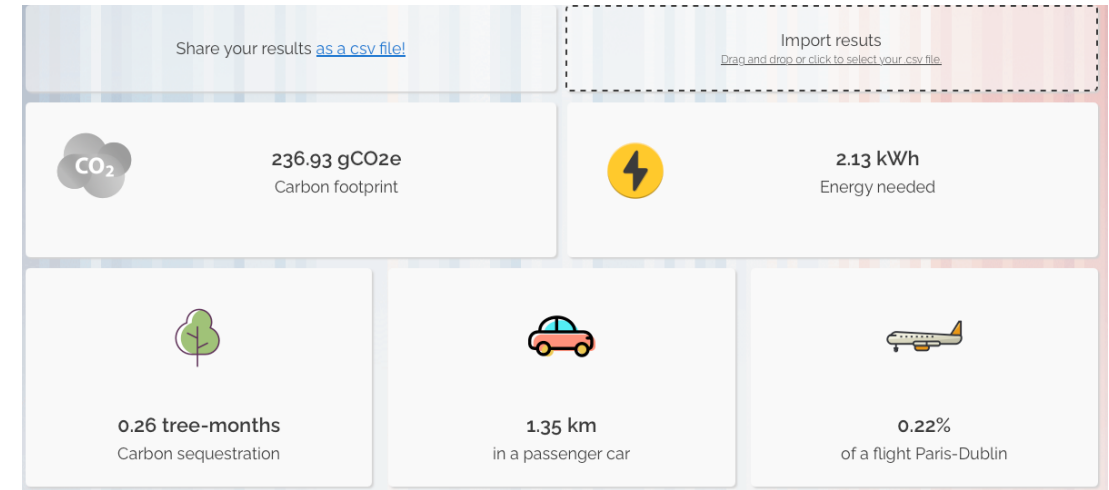
What it covers

Free and easy tool for calculating the carbon footprints of computations.

Why it matters

It aims at promoting more environmentally sustainable computational science. It regroups calculators that researchers can use to estimate the carbon footprint of their projects, tips on how to be more environmentally friendly, training material, past talks etc..

 <https://calculator.green-algorithms.org>



02

Tools developed during
the GreenDiLT project



Life cycle assessment model for digitally-enhanced education scenarios

Target: Faculty, Support staff

Suggested uses:

- **Teaching case study** to exemplify the application of Life Cycle Assessment to estimate climate change impact of digital technologies in education.
- **Guideline and example** to develop a life cycle assessment model to evaluate the impact of digitally-enhanced education scenarios in other universities and education settings.



Comparative Life Cycle Assessment of educational scenarios

Objectives:

1. Development of a **replicable reference model based on Life Cycle Assessment (LCA)**, designed for educational institutions, to **quantitatively assess and compare GHG emissions** across various educational scenarios.
2. **Application of the model** to the Politecnico di Milano management engineering department and evaluation of the findings, to **ensure the model's relevance** and **applicability** to real-world educational settings.
3. **Formulation of recommendations** that can provide actionable guidelines for reducing environmental impacts in education.

Goal and scope definition

Decision support?		Kind of process-changes in background system / other systems	
		None or small-scale	Large-scale
		Situation A "Micro-level decision support"	Situation B "Meso/macro-level decision support"
	No	Situation C "Accounting" (with C1: including interactions with other systems, C2: excluding interactions with other systems)	

Goal and scope definition

The boundary system was defined using a **cradle-to-gate** approach, covering stages from production to resource use during lessons and study.

The **functional unit** represents the quantified performance of a product or service and serves as the basis for comparing different scenarios on an equivalent basis. In this study the functional unit (F.U.) is equal to **25 hours of education per student**, including staff and faculty's activities for delivering the education.

Functional unit	Characterization
25 hours for 1 student	corrisponding to 1 ECTS for 1 student
Composed by:	
10 hours	Number of contact hours between the professor and the student. They can be delivered onsite, online etc.
30 hours	Average number of hours spent by a professor to prepare the learning material
10 hours	Average number of hours spent by a professor to prepare and review the exam
15 hours	Number of hours spent by a student for independent study
6 hours	Average number of hours spent by support staff for backoffice work

Systems analyzed: Education scenarios

Face-to-face: This system represents traditional face-to-face teaching; individual study also takes place at the university. Preparation activities by staff and lecturers is divided between home and university.

Hybrid (in-person with streaming and recording): It combines traditional face-to-face teaching with digital components such as streaming and recording of lectures. Part of the students (75%) attend in person, while the rest attend remotely via streaming (12.5%) or recording (12.5%).

Fully online: All lectures are delivered via live streaming.

Hybrid Scenario: On site + Live streaming + Recordings

This is the «standard» scenario for most of the «traditional» courses nowadays. The face-to-face lecture is delivered at Polimi's facilities. The professor and most of the students go to the university to attend the lecture on site. WEBEX is used to stream and record the lecture. If some students want to attend the lesson via live stream they can do it by connecting to the WEBEX room of the professor. At the end of the lecture the recording is stored in the RecManager and then shared with students through the WeBeep platform.

At Polimi each classroom is equipped with:

- Seats with electric socket
- Video projector
- Radio microphone
- Dimmable
- Wired desk
- Wi-Fi network

Polimi professors use WEBEX and the video projector to share the content (slides, videos, etc) with students onsite and students at home.

Slides and other documents are provided before the lecture. They are uploaded to the WeBeep platform, Polimi's learning management system based on Moodle. Usually, WeBeep is also used to communicate with the students.

Students can download the slides and print them to take notes. Otherwise, they use a laptop or a tablet (sometimes both) to take notes and/or solve some exercises using excel or similar software etc.

After the class, the professor publish the recording so that students can use it as learning material. Usually, students cannot download the recording but they to watch it online.

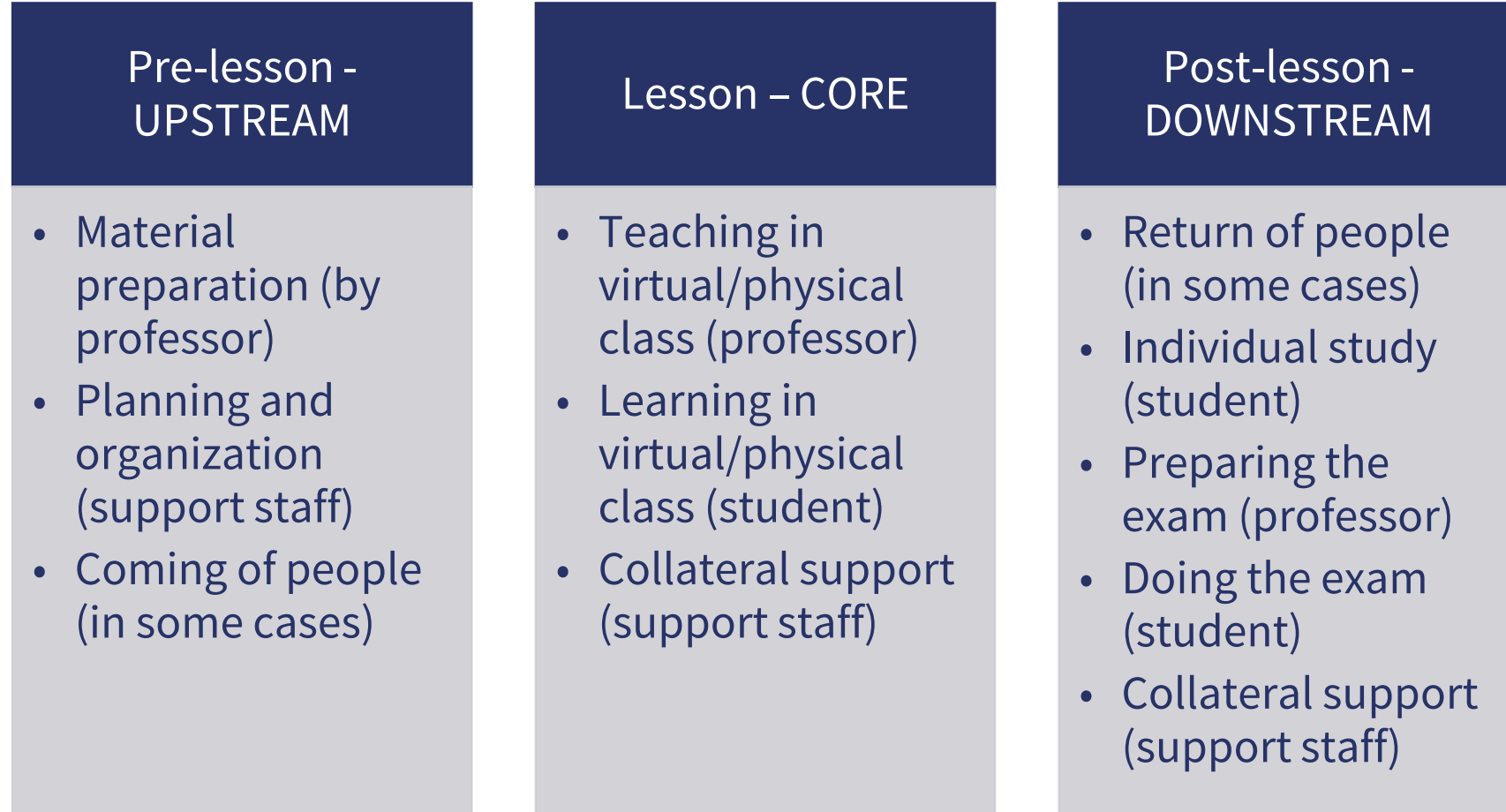
The final evaluation is usually done onsite. It can be:

- Oral examination (+ presentation and discussion of a project work)
- Written test: paper-based / paper + laptop (most used) / only laptop. Usually, students are asked to record their screen and send the recording to the professor after the exam.



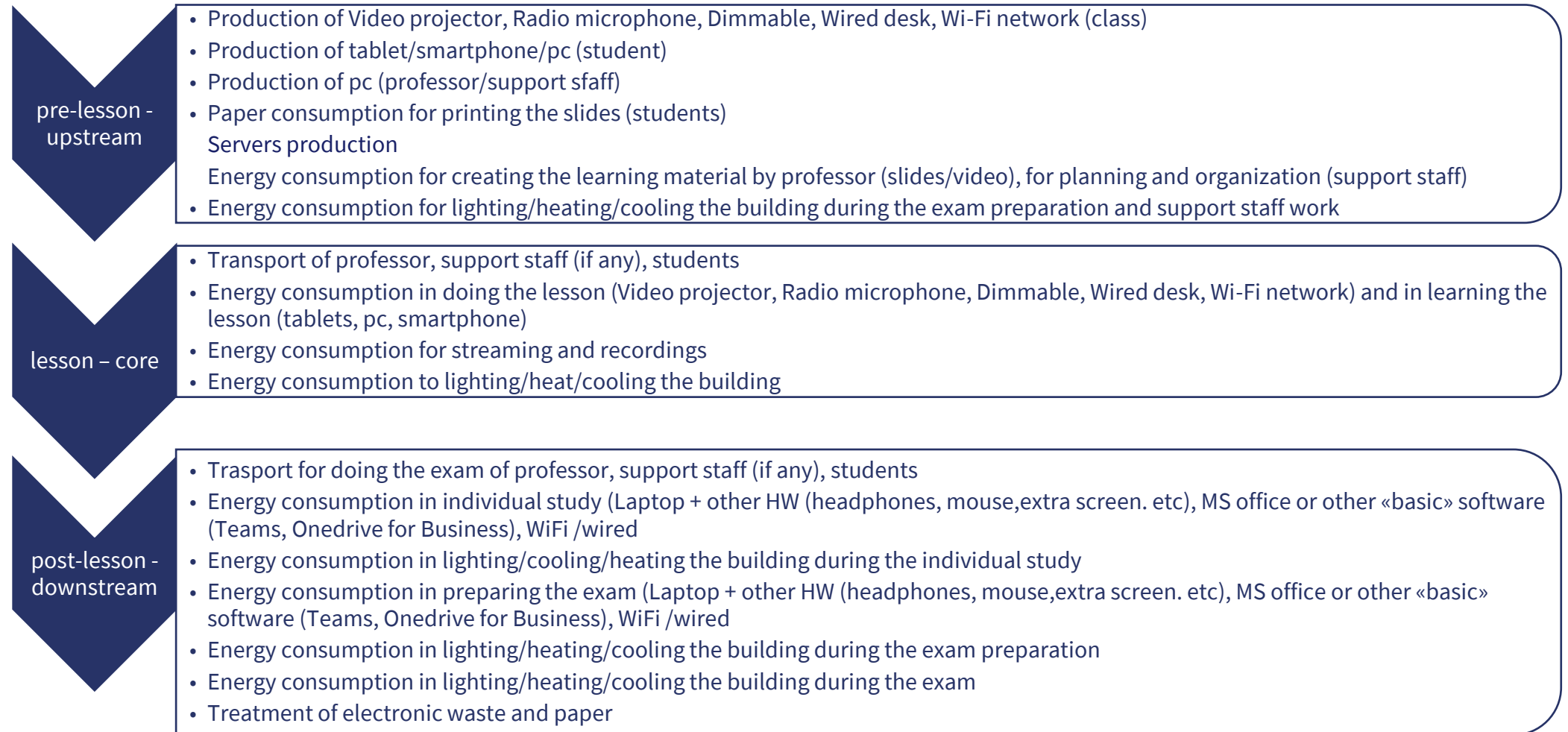
Registrazioni da meeting							
Cerca							
Riproduci	Data Registrazione	Corso	Forma didattica	Argomento	Osipi	Durata	Dimensione
▶	29/05/2024 09:45	059189 - DESIGN AND MANAGEMENT OF PRODUCTION SYSTEMS (PINZONE MARTA)	Lezione	20240529_M3_L3.7_Industrial sustainability and LCA+presentation the industrial logistics course		181 min	211 MB
▶	22/05/2024 09:28	059189 - DESIGN AND MANAGEMENT OF PRODUCTION SYSTEMS (PINZONE MARTA)	Esercitazione	20240522_1040_M3_T4_PR_Tutorial on Scheduling exercises		82 min	95 MB
▶	17/05/2024 09:37	059189 - DESIGN AND MANAGEMENT OF PRODUCTION SYSTEMS (PINZONE MARTA)	Lezione	20240517_M3_L3.5_MP_scheduling		153 min	129 MB

Life Cycle Inventory (LCI) - Diagram



		1) PHYSICAL: On site With basic ICT (laptop, projector)	2) HYBRID : On site + live streaming + Recordings	3) FULLY ONLINE: Synchronous Virtual class
10 contact hours between the professor and the student	HW - STUDENT	Laptop, tablet	Laptop, tablet	Laptop, tablet
	HW – PROF	Laptop, tablet	Laptop, tablet	Laptop, tablet
	HW - ROOM	Seats with electric socket, video projector, radio microphone, dimmable, wired desk	Seats with electric socket, video projector, radio microphone, dimmable, wired desk	-
	SW	MS office + other «basic» SW, e.G. Matlab Webeep (learning management system – LMS based on moodle)	MS office + other «basic» SW, e.G., Matlab Webex, webeep (LMS)	MS office + other «basic» SW, e.G., Matlab Webex, webeep (LMS)
	EDUCATIONAL MATERIAL	- Mostly slides, pdf, etc. Books are usually suggested but less used.	Recordings Videos/moocs Mostly slides, pdf, etc. Books are usually suggested but less used.	Recordings Videos/moocs Mostly slides, pdf, etc. Books are usually suggested but less used.
	INTERNET	Wifi	Wifi	Wifi
	TRANSPORT	Student, professor, staff	Student, professor, staff	-
15 hours of independent study	HW - STUDENT	Laptop + other HW (headphones, mouse,extra screen. Etc)	Laptop + other HW (headphones, mouse, extra screen. Etc)	Laptop + other HW (headphones, mouse,extra screen. Etc)
	SW - STUDENT	- MS office or other «basic» software Teams, onedrive for business	Recordings MS office or other «basic» software Teams, onedrive for business	Recordings MS office or other «basic» software Teams, onedrive for business
	INTERNET	Wifi /wired	Wifi /wired	Wifi /wired
	TRASPORT	Student	Student	-
30 hours for course and exam preparation by the professor	HW - PROF	Laptop + other HW (headphones, mouse, etc)	Laptop + other HW (headphones, mouse,etc)	Laptop + other HW (headphones, mouse, etc)
	SW - PROF	MS office or other «basic» software Teams, onedrive for business / dropbox	MS office or other «basic» software Teams, onedrive for business / dropbox	MS office or other «basic» software Teams, onedrive for business / dropbox
	INTERNET	Wifi /wired	Wifi /wired	Wifi /wired
	TRASPORT	Professor	Professor	
6 hours of support staff	HW - STAFF	Laptop + other HW (headphones, mouse,extra screen. Etc)	Laptop + other HW (headphones, mouse,extra screen. Etc)	Laptop + other HW (headphones, mouse,extra screen. Etc)
	SW - STAFF	MS office or other «basic» software	MS office or other «basic» software	MS office or other «basic» software
	INTERNET	Wifi	Wifi	Wifi
	TRASPORT	Suppor staff	Support staff	-

Life Cycle Inventory (LCI) - Diagram



Foreground data

Lighting – at home
Heating/Cooling – at home
Lighting – university
Heating/Cooling – university
ICT Devices
WiFi Network
Books, Handouts
LMS – Webeep
Student Commutes
Teacher and staff Commutes
Recordings
Streaming
Generative AI

The foreground data, i.e. data relating to the process under consideration, were collected from **primary sources** (i.e. collected directly for the specific purpose of the study from resources provided by Politecnico di Milano), and the most recent available data was consistently utilized.

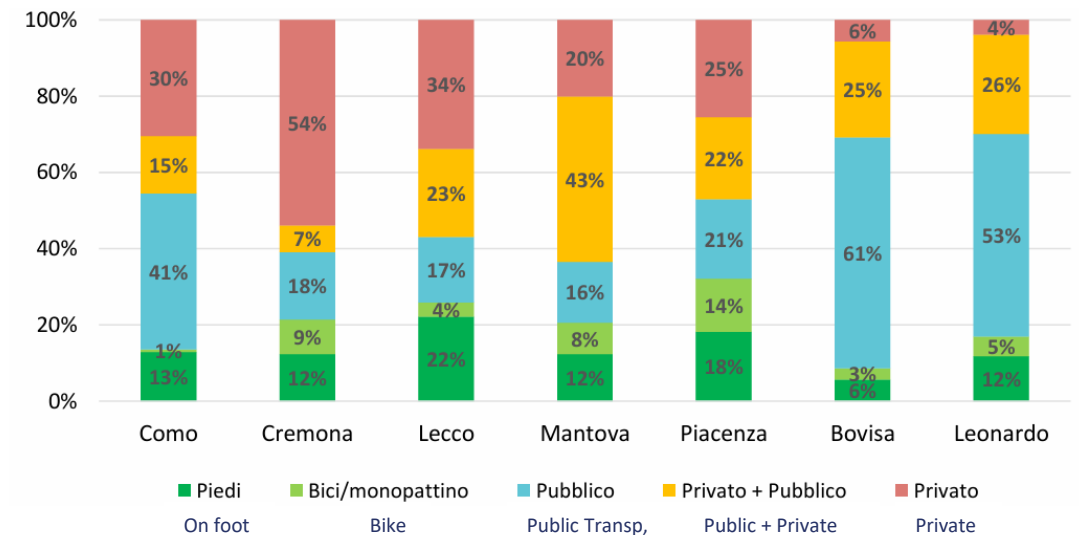
Example of documents:

- POLIMI Energy Report
- POLIMI Sustainability Report
- POLIMI Home-work / university commuting plan 2021

Example of foregrounding data:

Student mobility data at Politecnico di Milano

Mode of Transport	Winter	Summer
Public transport	53.8%	52.1%
Active mobility	29.4%	30.6%
Private motorized	14.6%	14.7%
Shared mobility	1.6%	1.9%
Other	0.6%	0.7%



On average, a student spends **52 minutes** traveling to the university, covering approximately **32 km** for the one-way journey between home and campus.

Example of foreground data: Energy used in the University buildings

Building BL27 is part of an energy system that serves several buildings within the Bovisa campus. The **electricity supply** is provided through a single Point of Delivery (POD) shared by buildings B25, B25A, B26, B27, and CT4.

The **heating demand** is met by a centralized heating plant located in the basement of Building BL27. The plant consists of **two heat generators** and is supplied through a dedicated Point of Redelivery (PDR).

The **cooling demand** is satisfied by a refrigeration plant equipped with **two RC GROUP chillers**, also located in the basement of the building. In addition, **CLIMAVENETA heat pump units** are installed in the attic level and contribute to the building's climate control system.

Total kWh			Demand of electricity	Demand of thermal energy	Demand of cooling energy
Electricity	962106	%	78%	0%	22%
		Eff. Conv.	98%	336%	235%
		Quantity	731838,89	-	506028,80
Natural Gas		%	0%	0%	0%
		Eff. Conv.	0%	85%	70%
		Quantity	-	-	-
Thermal energy	444195	%	0%	100%	0%
		Eff. Conv.	0%	96%	0%
		Quantity	-	426427,68	-
Cooling energy		%	0%	0%	0%
		Eff. Conv.	0%	0%	96%
		Quantity	-	-	-
Total demand			731839	426428	506029
Floor Area			10873	9621	-
Total demand per m2 per year			67,31	44,32	-

Background data

Educational Materials production
Projector production
Devices production
Servers production (recordings, streaming)
Energy Production
Fuel Production Network
Component Production
Servers production (Webeep)
Generative AI servers production and training

The **background systems**, which include supporting processes such as **raw material production, energy generation, and equipment manufacturing**, were modeled using **secondary data**, namely existing data collected from external sources and made available through specialized databases. In this study, these processes were modeled using data from the **Ecoinvent 3.10 database**, one of the most widely used and comprehensive databases specifically developed for Life Cycle Assessment studies.

Allocation on the functional unit

Allocation based on the functional unit is the process of distributing the environmental impacts of a system among the products or services it provides, according to a common reference measure known as the **functional unit**.

In this study, the functional unit is defined as **25 hours of education for one student**, comprising both lecture attendance and individual study activities.

All environmental impacts are therefore allocated and expressed with reference to this unit, ensuring a consistent comparison across the different educational scenarios analyzed.

Example: Allocation on the functional unit

ICT PROFESSORS

To be divided by the number of students per professor.

LESSON PREPARATION (10H)									
lesson preparation - PRESENCE	number of devices	% device	allocation based on Useful life	allocation to functional unit	lesson preparation - AT HOME	number of devices	% device	allocation based on Useful life	allocation to functional unit (for production)
LAPTOP	1,21	0,78	0,00135	0,0013	LAPTOP	1	0,89	0,00135	0,0012
TABLET	1,21	0,17	0,00116	0,0002	TABLET	1	0,11	0,00116	0,0001
SMARTPHONE	1,21	0,044	0,00135	0,0001	SMARTPHONE	1	0	0,00135	0,0000
ROUTER	1	1	0,0002	0,0002	ROUTER	1	1	0,0002	0,0002

LESSON (10H)									
lesson - PRESENCE	number of devices	% for device	allocation based on Useful life	allocation to functional unit	lesson - ONLINE	number of devices	% device	allocation based on Useful life	allocation to functional unit (for production)
LAPTOP	1,21	0,78	0,00135	0,0013	LAPTOP	1	0,89	0,00135	0,0012
TABLET	1,21	0,17	0,00116	0,0002	TABLET	1	0,11	0,00116	0,0001
SMARTPHONE	1,21	0,044	0,00135	0,0001	SMARTPHONE	1	0	0,00135	0,0000
ROUTER	1	1	0,0002	0,0002	ROUTER	1	1	0,0002	0,0002
PROJECTOR	x	0,9	0,0017	0,0015					
MICROPHONE	x	0,58	0,0007	0,0004					

Average
consumption
on per hour

0,045 kwh Malmudin et al
0,015 kwh media di mercato per ultimi 5 anni
0,006 kwh Tabata et al
0,0012 kwh Malmudin et al

0,045 kwh Malmudin et al
0,015 kwh media di mercato per ultimi 5 anni - niente in letteratura
0,006 kwh Tabata et al
0,0012 kwh Malmudin et al
0,244 kwh specifiche di produzione - documento: specifiche dotazioni aule
0,00185 kwh specifiche di produzione - documento: specifiche dotazioni aule

Life Cycle Impact Assessment (LCIA)

Method: ReCiPe 2016 Mipoint (H) V1.07 / World (2010) H

Impact category: Global Warming Potential

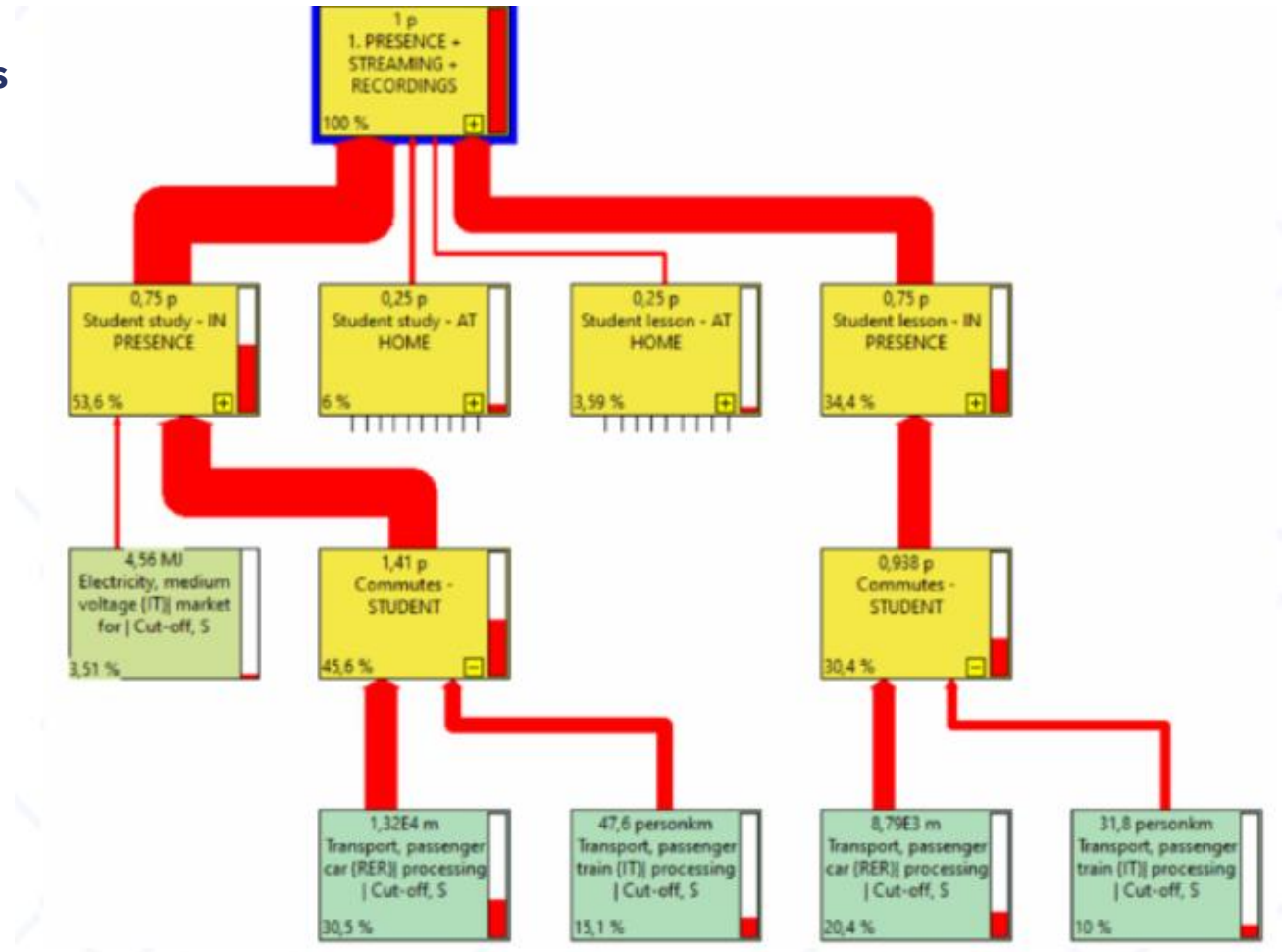
Education Scenario	Total emissions (kgCO ₂ eq)
Face-to-face	17.2
Hybrid (in-person with streaming and recording)	14.3
Hybrid (in-person with streaming and recording), including generative AI*	14.7
Fully online synchronous (live streaming)	5.87
Fully online synchronous (live streaming), including generative AI*	6.27

**The Generative AI impact nearly doubles the emissions of 10 hours of live streaming, suggesting that unoptimized AI use could significantly increase the environmental impact of educational systems.*

Results – Hybrid scenario

The **Hybrid scenario**, in which **75% of lectures are attended in person** and the remaining **25% are attended remotely through live streaming or recorded sessions**, generates **14.3 kg CO₂-eq** per functional unit.

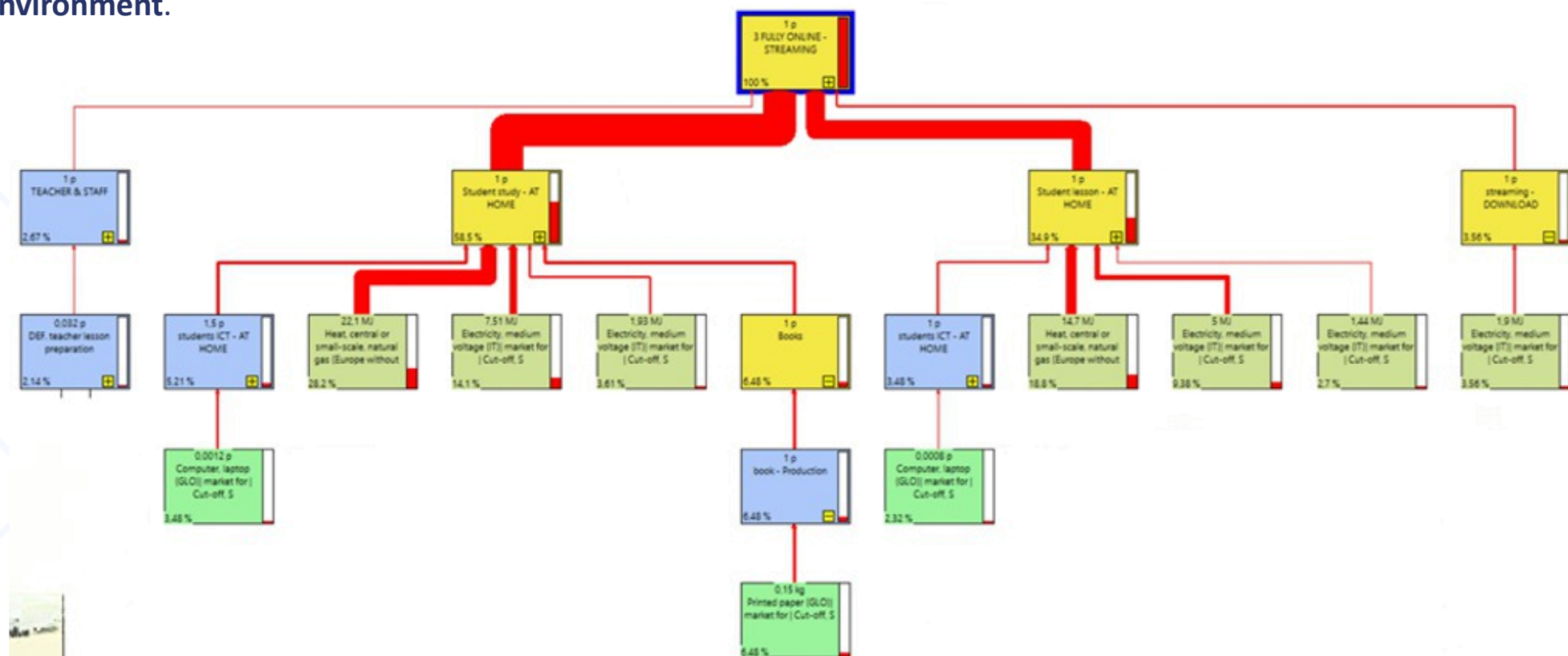
The **largest contribution to the overall environmental impact comes from transportation**, which accounts for approximately **76% of total greenhouse gas emissions**. This highlights that, despite the partial adoption of digital learning modalities, student commuting remains the dominant source of emissions in the hybrid educational model.



Method: ReCiPe 2016 Mipoint (H) V1.07 / World (2010) H

Results – Online scenario

The **fully online (live-streaming) scenario** reduces total greenhouse gas emissions to **5.87 kg CO₂-eq**, primarily due to the elimination of transportation-related impacts. However, this scenario results in a **less efficient use of energy at the household level**, with energy consumption during online learning estimated to be **77% higher than that of a classroom environment**.



Method: ReCiPe 2016 Mipoint (H) V1.07 / World (2010) H

Some recommendations

To reduce transportation-related impacts, universities should consider maintaining **hybrid or online learning options** for students who live far from campus or attend classes on days with limited teaching activities. At the same time, any such measures should carefully account for their potential effects on learning outcomes, student engagement, and social interaction. In addition, institutions can encourage more sustainable mobility by offering incentives for the use of **public transportation, cycling, and other low-impact transport modes**.

Since online learning shifts part of the energy demand to the household level, it is advisable to promote the use of **energy-efficient devices** and provide students and staff with guidance on **responsible energy consumption practices**, such as optimizing device settings and reducing unnecessary energy use.

Furthermore, universities should encourage the **maintenance, repair, and reuse of electronic devices** to extend their lifespan and reduce the environmental impacts associated with manufacturing new equipment. Sustainable end-of-life management practices, including **device collection and recycling programs**, can further contribute to lowering the overall environmental footprint of digital education.



Digital Carbon Footprint Calculator

Target: Faculty, Support staff, Students

Suggested uses:

- **Teaching activities**, to illustrate concepts related to digital sustainability, carbon footprints, and environmental impact assessment in an interactive and practical way.
- **Outreach activities**, to engage the wider community, raise awareness about the environmental consequences of digital technologies, and encourage the adoption of more sustainable behaviors.

Context: Why This Matters?



Climate change is one of the most urgent global challenges

- **Greenhouse gas** emissions caused by human activities are the main driver of **global warming**.
- The **digital sector**, though often overlooked, already accounts for around **2–4% of global GHG** emissions and is expected to keep rising.
- **Measuring** these environmental impacts is essential to **raise awareness and to take action** to mitigate the problem.

What is a Carbon Footprint Calculator?

A **Carbon Footprint Calculator** is a tool designed to **estimate the greenhouse gas emissions** generated by **human activities**. It translates **everyday actions** – such as energy use, transportation, consumption, or digital practices – into **CO₂ equivalents**, making invisible impacts measurable.

It serves two main purposes



Quantification

providing an estimate of emissions based on user data.



Awareness

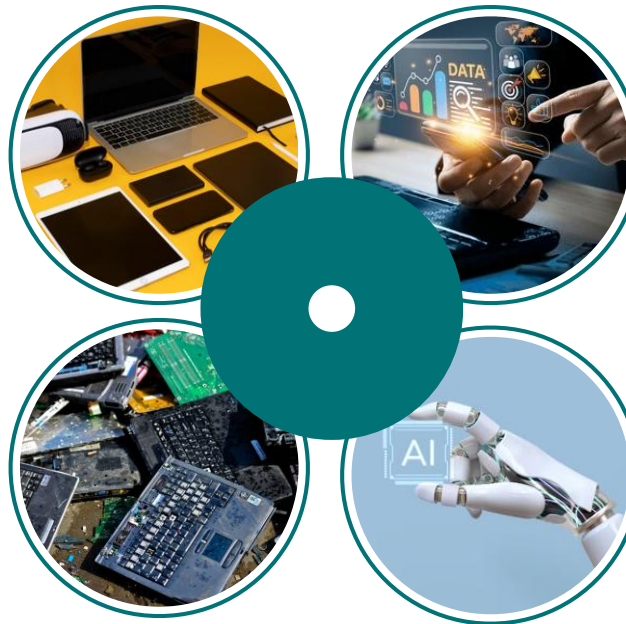
helping individuals understand their footprint and fostering more sustainable practices.

Digital Carbon Footprint Calculator

The Digital Carbon Footprint Calculator is structured into four main dimensions.

Devices – includes production and transport phase. It also considers lifespan, purchase condition (new or used) and ownership (shared or personal)

E-Waste – evaluates different end-of-life scenarios, distinguishing between disposal, recycling, reuse, and storage at home.



Digital Activities – measures the impact of online practices such as email, videoconferencing, streaming, cloud storage, and the use of learning platforms.

Artificial Intelligence – includes emissions from the inference phase of AI-based tools, which are increasingly relevant in academic and research contexts.

Digital Carbon Footprint Calculator

The Digital Carbon Footprint Calculator is **adapted to different user profiles** to provide a more **personalized** experience (student, faculty, support staff)

Core formula:

$$CO_2e = EF \cdot Q \cdot F_{\text{scaling}}$$

- **Emission Factor (EF)** → coefficient for the amount of GHG per unit of activity.
- **Activity Quantity (Q)** → user-provided level of use.
- **Scaling Factor (F_s)** → converts all data to an annual basis.

Example: CO₂e E-mails = (Average number of e-mails per day) × (EF per 1 email) × (Working days per year).

Emission factors are from authoritative sources such as *Ecoinvent v3.11*, *Base Carbone® v23.7 (ADEME)* and peer-reviewed academic literature.

Digital Carbon Footprint Calculator

Results provided to users:

- The **annual carbon footprint**, compared with the average of the same category.
- **Tangible equivalences**. (e.g. your carbon footprint is equal to producing X burgers).
- **Personalized tips** and **good practices** tailored to the user's digital profile.

USER, before you discover your full Digital Carbon Footprint, take a guess!

Based on the area where you think you have the biggest impact, which digital archetype matches you best?

Lord of the Latest Gadgets



Devices

Choose

Prompt Pirate, Ruler of the Queries



Artificial Intelligence

Choose

Guardian of the Eternal E-Waste Pile



E-Waste

Choose

Master of Endless Streams



Digital Activities

Choose

Digital Carbon Footprint Calculator

<https://digitalcarbonfootprintcalculator.azurewebsites.net/>



03

Learning material
developed during the
GreenDiLT project



GreenDilt Academy: the educational board game

Target: Faculty, Support staff, Students

The board game can be effectively integrated into a variety of educational and organizational contexts, including:

- **Institutional events**, to raise awareness of the environmental impacts of digital education among a broad audience.
- **Internal workshops**, to foster discussion, collaboration, and the development of sustainable practices within organizations.
- **Class sessions**, as an engaging learning tool to introduce students to sustainability concepts and encourage active participation.



Context: Why This Matters?

A survey conducted among GreenDiLT stakeholders identified four key learning needs:

- **Understanding digital environmental impacts** — impacts are often invisible and poorly understood
- **Learning how environmental impacts are measured** — through methods such as Life Cycle Assessment
- **Identifying effective eco-actions** — ranked by their actual environmental impact
- **Building institutional strategies** — to develop effective policies for reducing digital environmental footprint at scale



GreenDilt Academy: the educational board game

General purpose: The board game provides education stakeholders with an immersive and interactive learning experience focused on the environmental impacts of digital education.



A collaborative game: players vs the game

Accumulate more sustainability points than problem points by making informed decisions and implementing effective actions to reduce the environmental impacts of digital education.

A game focused on eco-actions

- Each action card provides an eco-action, examples and an indication of its effectiveness
- Each game phase offers individual and collective actions
- Action cards are used during both the game phase and the debriefing

Your team has just joined the GreenDiLT Academy, whose mission is to provide solutions to the environmental impacts associated with the growing use of digital technology in your institution.

To fulfil this mission, you will need to work together to address the challenges specific to your organisation and make digital practices more sustainable in the years to come.

Are you ready to transform your organisation into a leader in responsible digital technology? 🌱 💻

Your objective:

By the end of the game, you must have more 'Sustainability' points than 'Impact' points.

Equipment (for each team):

- 1 game board
- 2 tokens: one green (Sustainability) 🌱 and one orange (Impact) 🚨
- 50 'Resource' tokens ⚙️
- 5 types of cards:



'Problem' cards



'Group action' cards



'Individual action' cards



'Quiz' cards



'Event' cards

Number of players:

The game is ideally designed for 4 to 6 players.

If there are only 3 players, the team receives 2 'Resource' tokens ⚙️ at the start of each turn.

With 2 players, the team receives 4 'Resource' tokens ⚙️ at the start of each turn.

How the game works

A. Each team:

- draws a 'Problem' card and moves its orange token on the board by the number of spaces corresponding to the 'Impact' points 🚨 shown on the card.
- draws 5 'Collective Action' cards and places them next to its board.

B. In each team, each player must choose to draw one of the following two cards:

- 'Individual Action' card: the player moves the green token on the board forward by the number of spaces corresponding to the 'Sustainability' points 🌱 shown on the card.
- 'Quiz' card: the player answers a question to win 'Resource' tokens ⚙️, which are essential for carrying out the actions on the 'Group Action' cards.

C. Once all players have completed their individual phase, they use the 'Resource' tokens ⚙️ they have collected to activate the 'Group Action' cards, which are used to resolve the problem. For each 'Group Action' card used, the team moves the green token on the board forward by the number of spaces equal to the 'Sustainability' points 🌱 shown on the card.

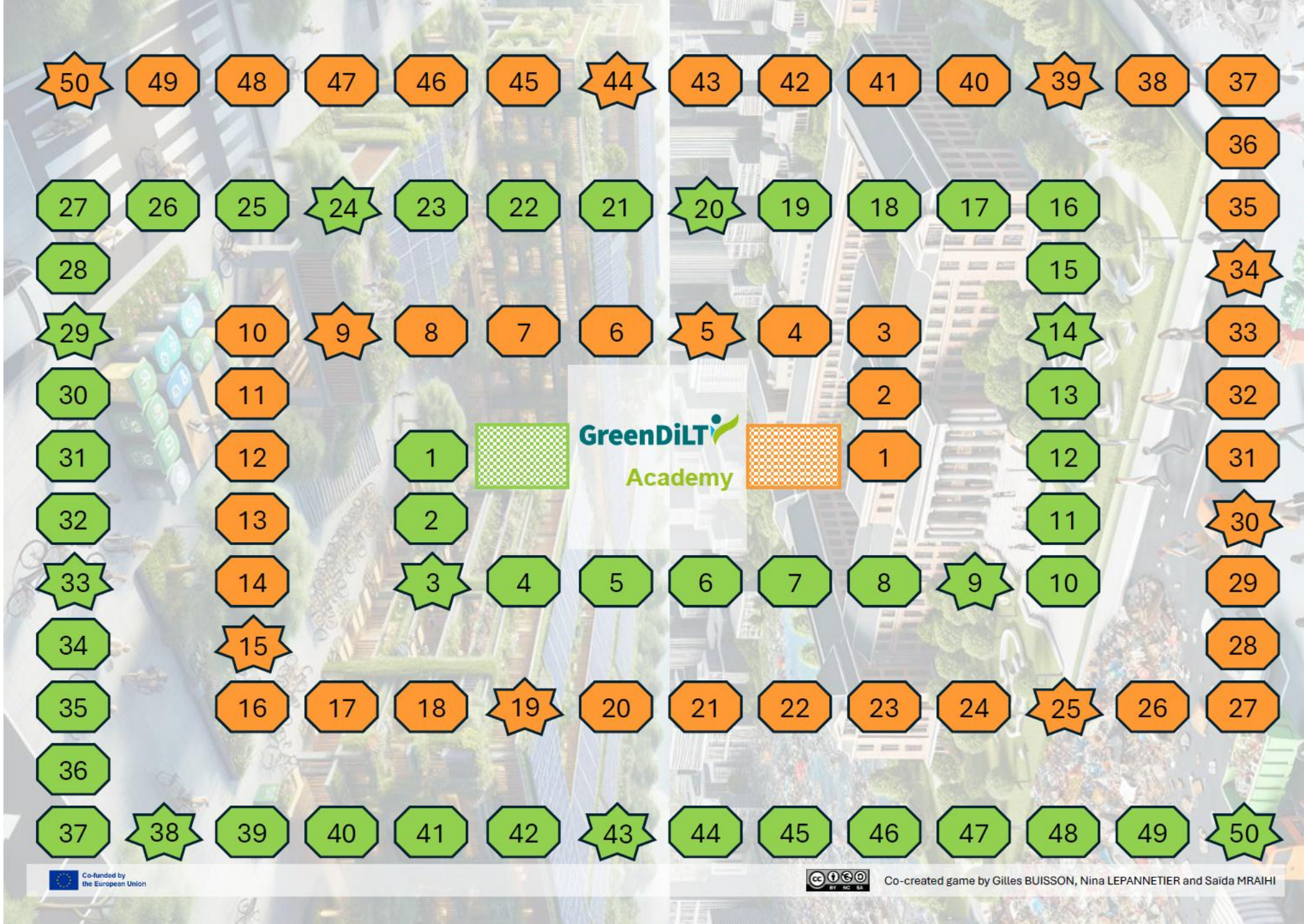
At the start of each new turn, the team draws a new 'Problem' card. The team must always have 5 'Group Action' cards. If they have fewer than that, they draw the missing cards.

D. Please note: If your pieces land on a star-marked square, your team will have to face an event: a challenge, a bonus or a penalty.

E. At the end of the game, players must have solved all the problems drawn during the game. For each problem correctly solved, the team earns 1 additional 'Sustainability' point 🌱 and moves its green token forward one space. The correspondences between the 'Problem' cards and the 'Action' cards are shown in the table provided at the end of the game.

End of the game :

At the end of the rounds, both teams compare the position of their tokens on the board. The team whose green token is furthest forward wins the game.





Extending the lifespan of equipment policy



At an institutional level, extending the lifespan of provide the best way to reduce the environmental footprint associated with the manufacturing of new devices and the impacts linked to their end-of-life.

Examples :

- Set up a plan to buy upgradable equipment as much as is reasonably possible.
- Engage companies or internal personnel to repair equipment.

3



3



Equipment donation and pooling policy



Donating or lending equipment to people in need or those unable to acquire it not only extends the lifespan of existing equipment but also provides significant social benefits.

Examples :

- Set up a lending system towards students.
- Donate equipment to non-profit organisations or schools.

3



3



Recycling policy



An efficient way to deal with the end-life of equipment is to establish a system for collecting and recycling electronic equipment.

Examples :

- Implement a plan for recycling IT equipment at the institutional level.
- Set a plan Communicate about the waste recycling policy (what? when? where?)
- Ensure transparency of the chain of custody for equipment with the refurbishers.

2



2



Barter and second-hand equipment policy



Over the full lifecycle of IT equipment, manufacturing accounts for the majority of environmental impacts. Purchasing refurbished equipment instead of new hardware is an especially effective way to reduce environmental impacts.

Examples :

- Set up a Barter and second-hand equipment policy at an institutional level.
- Set up a second-hand market where teacher, student and staff could exchange or acquire refurbished devices.

3



3



Environmental clauses policy



The systematic inclusion of environmental requirements in tenders is a straightforward and highly effective measure to encourage manufacturers to offer eco-designed equipment and properly manage their end-of-life.

Examples :

- Require in tenders that the service provider or equipment holds recognized eco-labels or standards.

3



3



Implement and optimize the sorting of consumables



The objective of this best practice is to minimize the impact of the company's waste (paper, toner, batteries, etc.) by promoting recycling and the reuse of the raw materials they contain.

Examples :

- Place appropriate waste receptacles in strategic locations.
- Ensure regular collection by a suitable organization.

2



2



Network infrastructure location



The physical location of infrastructure (servers, networks) is particularly important to ensure efficient energy consumption, extend equipment lifespan, and enhance the resilience of the IT system at the institutional level.

Example :

- Arrange network infrastructure in a suitable location (secure, refrigerated, ventilated, etc.).

2



2



Smart power supply policy



There are increasingly more smart devices that can significantly and almost automatically reduce energy consumption at the institutional level.

Example :

- Implement intelligent equipment at the institution (smart plugs, presence sensors, smart thermostats, etc.).

2



2





Collective action



Collective action



Collective action



Collective action



Collective action



Collective action



Collective action



Collective action





Energy-efficient equipment policy



There are increasingly more efficient devices that can significantly and almost automatically reduce energy consumption at the institutional level.

Example :

- *Install energy-efficient devices in the institution (low-power screens, LED bulbs, ARM computers, etc.).*

2



2



Enable eco mode on equipment and infrastructure



Most equipment can be configured to enter sleep mode automatically or remotely, which can result in energy savings both for end users and for the infrastructure itself.

Example :

- *Enable by default the energy-saving features of modern processors and network equipment (switch,...).*

2



2



Renewable energy



Power the institution's equipment with renewable energy instead of fossil energy reduce significantly the carbon footprint.

Examples :

- *Investments in internal infrastructure.*
- *Purchases from green energy suppliers).*

2



2



Social clauses policy



The choice to use digital services goes beyond their mere functionality and may involve legal, economic, or even philosophical considerations.

Examples :

- *Use services that are respectful and transparent regarding data use.*
- *Use open-source software.*

3



3



Social and mental impacts of digital tools



Digital sobriety is one of the most effective ways to reduce the environmental impact of digital technology while also mitigating the psychological and mental strain that can disrupt learning.

Example :

- *Organize a training session on the social and psychological effects of digital tools.*

3



3



Training on the impact of digital tools on teaching and learning



Many beliefs associate digital technology with academic performance. However, digital tools only have indirect effects on learning, which can be either positive or negative depending on the specific context

Example :

- *Organize a training session on the real contributions of digital tools to teaching and learning.*

2



2



Collective moments for digital disconnection



It is challenging to overcome digital addictions on an individual level. Enforcing collective breaks helps create distance and introduces new habits.

Example :

- *Organize events focused on disconnection (email-free days, digital detox week, etc.).*

3



3



Responsible digital charter



Most academic uses of digital technology are implicit for students. With increasingly intelligent digital tools (AI), it is essential to make expectations clear by explicitly communicating the institution's stance on digital usage and academic integrity, thereby fostering a sense of responsibility.

Example :

- *Communicate and display the school's ambitions regarding "Responsible Digital" practices.*

3



3





Collective action



Collective action



Collective action



Collective action



Collective action



Collective action



Collective action



Collective action





Life cycle analysis



Life cycle analysis is the most common and effective method for gaining detailed insight into the environmental impacts associated with an institution and regulate the uses of digital.

Example :

- Conduct a life cycle analysis at an institutional level or in an academic project.

3



3



Protect your equipment



Mobile equipment is constantly transported and handled, increasing the risk of premature damage. One simple way to maintain your devices is to put measures in place to protect them in their daily use.

Example :

- Buy protective cases to safeguard your devices (laptops, tablets, and smartphones).

1



Clean your equipment



Maintain your equipment by regularly cleaning it can extend its lifespan.

Example :

- Use appropriate products to clean the keyboard, screen, and fan of your laptop.

1



Eco-friendly printing



Adopting eco-friendly printing practices can reduce the number of consumables (paper, toner) and the energy consumption.

Examples :

- To use scrap paper for drafting/rough work.
- Print on both side of the paper.
- Use the print preview.
- Print in black and white rather than in colours.

2



Maintain the hardware



Maintaining the hardware of your devices help to extend the lifespan of equipment and to reduce the environmental footprint associated with the manufacturing of new devices and the impacts linked to their end-of-life.

Examples :

- Add or replace component if needed (RAM, HDD,...).
- Purchase extended warranties.
- Extend the accounting depreciation period (beyond 5 years).

2



Limit the number of screen



Compared to all other IT equipment, screens have the highest impact in terms of manufacturing and energy consumption.

Examples :

- Buy a screen with eco-label or an efficient energy consumption.
- Buy a larger screen if needed rather than two screens.

2



Maintain the software



A computer with poorly maintained software can require up to 25% more power and reduce its lifespan.

Examples :

- Avoid systematically upgrading to new software versions.
- Reboot the machines.
- Clear temporary files (browser, system, etc.).
- Clean the registry.
- Defragment the hard drive and the registry.

1



Turn off or set your device to sleep mode



Over a 24-hour day, a workstation is typically used for no more than 8 hours. In sleep mode or turn off, you can save nearly two-thirds of the electricity consumption during working days compared to a workstation left on 24/7.

Example :

- Configure devices to enter sleep mode when you are away from the office.

2





Individual action



Individual action



Individual action



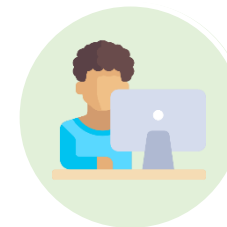
Collective action



Individual action



Individual action



Individual action



Individual action





Disable unused features



Some features of your devices are permanently activated by default, causing unnecessary energy consumption and premature battery wear over time.

Example :

- *Disable wifi, bluetooth, etc when non needed.*

1



Clean up personal digital spaces



Although data storage is not the primary environmental impact of digital technology, the accumulation of unnecessary data requires an increasing number of hard drives, especially since data is often duplicated multiple times for backup purposes.

Example :

- *Regularly delete unnecessary data from the cloud, emails, etc.*

1



Manage battery cycles



The battery of a device is a component that directly affects both the device's lifespan and its power consumption. Proper maintenance practices help optimize both aspects.

Example :

- *Preserve the battery by keeping the charge level between 80% and 20%, this can extend your device.*

1



Limit use of email



Contrary to popular belief, it is not the storage but rather the writing, reading, and transmission of emails that contribute the most to increasing the environmental footprint of the information system.

Examples :

- *Limit the number of emails sent each day*
- *Reduce the number of recipients.*
- *Avoid using emails as a substitute for phone or in-person communication.*
- *If needed, prefer instant messaging systems for quick and casual exchanges.*

2



Centralize data sharing



An effective way to avoid the proliferation of unnecessary data is to centralize it in spaces accessible to those who need it.

Example :

- *Favor common and centralized digital spaces (LMS, collaborative applications, etc.) over individual emails.*

2



Use reduced versions of applications



Although it is difficult to forgo digital services, there are often less energy-intensive alternatives that can be identified and adapted to one's needs.

Examples :

- *Limit data flow by adjusting streaming rates.*
- *Use smaller AI models.*
- *Use instant messaging instead of mail.*

2



Anticipate the use of training materials



Design materials while anticipating student usage so that you can reduce the environment footprint of your course material.

Examples :

- *Limit the printing of training material.*
- *Share your training material on the LMS rather by mail.*

2



Prescribe technology usage in courses



Students usually bring their digital devices to class by default. One effective way to avoid distractions and help students stay focused during class is to set specific times when they are allowed to use their digital devices.

Examples :

- *Explain to students at which times they are allowed to use their laptops, tablets, or phones.*
- *Indicate the purpose of each designated period, such as note-taking, research, or interactive activities.*

2





Individual action

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Academy



Individual action

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Individual action

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Individual action

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Favor low-tech teaching activities



Using digital learning applications doesn't automatically translate to learning benefits. Prefer non-digital alternatives when the digital dimension does not add value.

Example :

- Using an online polling app when you have a large number of students allows everyone to participate, which is less necessary with a smaller class size.

2



Open access resources



Make resources openly accessible by applying a Creative Commons license.

Example :

- Display the legal notice for your resources.

2



Learn and work in airplane mode



Allow time for offline work using physical materials instead of digital ones.

Example :

- Avoid going online if the task does not require online resources, in order to prevent distractions.

2



Question digital benefits in learning and teaching



Using digital learning applications doesn't automatically translate to learning benefits. Use digital tools or resources only when their pedagogical value can be clearly explained.

Example :

- For example, video allows students to quickly grasp key concepts or complex dynamic phenomena (such as mechanical processes or 3D representations).

2



Use existing resources



Prefer non-digital alternatives when the digital dimension does not add value.

Example :

- Using an online polling app when you have a large number of students allows everyone to participate, which is less necessary with a smaller class size.

1



Use open-source software



When you need to use professional software, authoring tools are often expensive, but there are sometimes free, open-source alternatives.

Example :

- Moodle, Gimp, Audacity, Shotcut,...

1





Individual action



Individual action



Individual action



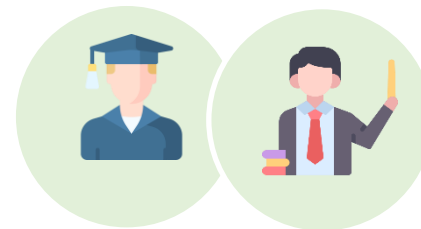
Individual action

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Individual action



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Unethical digital practices

Why bother about data privacy? As long as it saves us money and gets the job done, that's all that matters.

Selection criteria for digital tools shouldn't depend solely on practicality or cost-effectiveness. It's also important to base these choices on ethical criteria—for example, by recognizing knowledge as a common good.

4



Non-sustainable course design

I photocopied 400 copies of my 500-page handout, and to make sure everyone has it, I emailed it to everyone.

Teachers can reduce the environmental footprint of their courses right from the design phase by using existing resources, considering how their materials will be used, and taking into account the resources required for educational activities.

4



Planned obsolescence

Seriously? 20 minutes to boot up those dinosaurs in the computer lab? And they still have floppy drives? Is that for real?

Extending the lifespan of existing equipment through software or hardware maintenance not only avoids the environmental impacts associated with aging infrastructures but also reduces those resulting from overly frequent equipment renewal.

7



Poor management of e-waste

Where should I throw away my old laptop? In the yellow bin or the green bin?

Equipment at the end of their life must be subject to planned actions to help limit the environmental impacts associated with electronic waste. For example, existing waste can be recycled or devices can be given a second life.

6



Overconsumption

The new iPhone is so cool, I have to buy the new one, the new colour is amazing and it even matches my eyes!

Reducing environmental impact at both the institutional and individual levels involves questioning, at the time of purchasing devices, not only the equipment's material characteristics (energy consumption, repairability, manufacturing conditions) but also whether it is truly necessary to acquire them, given the impacts related to manufacturing.

7



Energy-intensive infrastructure

Are you sure that placing the server room in the boiler room to save space is a good idea?

At the institutional level, reducing the energy impact can be achieved by acquiring energy efficient or smart digital equipment or by considering strategically the layout of the infrastructure.

7



Energy consumption: equipment

I leave my computer at the office on 24/7, you never know if I might receive an important message.

At the individual level, reducing the energy impact of equipment can be achieved easily through good consumption habits and appropriate eco-friendly practices.

7



Energy consumption: digital services

To ensure all the students in the class have the latest recorded lecture from the amphitheater, I'll send it to everyone as an email attachment.

Internet usage has tangible consequences on students learning abilities: lack of concentration, reduced attention span, frustration with study situations. A good way to prevent it is to plan individually or collectively disconnection times.

6





Problem



Problem



Problem



Problem

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Problem



Problem



Problem



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Digital misconception

Let's create the school of the future: everyone on e-learning and AI instead of the teachers!

Many people associate digital technology with improved academic performance and innovation. However, its impact can be either beneficial or detrimental depending on the specific course context. Therefore, whether you're an institution or a teacher, it's crucial to question the true value of digital tools and communicate this clearly to students.

6



Digital addiction

My attention span is shot. 15 minutes of a lecture is my limit. TikTok is just as educational these days...

Internet usage has tangible consequences on students learning abilities: lack of concentration, reduced attention span, frustration with study situations. A good way to prevent it is to plan individually or collectively disconnection times.

6



CHALLENGE

How long have you owned your smartphone?

The team with the oldest smartphone wins **2 resources points**.

2





Event



Problem



Problem





How can video conferencing be made more environmentally friendly?

- a) Using lower video resolution
- b) Turning off cameras when not speaking
- c) Recording meetings instead of live streaming
- d) Use an open-source software

Feedback :

These practices can reduce the data transfer and processing power required for video conferencing, lowering its carbon footprint.

2



What is "e-waste"?

- a) Waste from paper production
- b) Waste from plastic packaging
- c) **Waste from discarded electronic devices**
- d) Waste from chemical manufacturing

Feedback :

E-waste includes discarded computers, phones, and other electronics, which often contain hazardous materials that can pollute the environment.

1



What is a "circular economy" in the context of digital technology?

- a) Recycling electronic waste
- b) **Designing devices for durability and repairability**
- c) Refurbishing and reusing old devices
- d) Sell new devices to eco-friendly people

Feedback :

A circular economy aims to keep resources in use for as long as possible, minimizing waste and environmental impact.

2



Which of these environmental impacts of manufacturing digital equipment is the one with the most significant impact ?

- a) Water consumption
- b) **The use of rare earth elements and critical resources**
- c) The production of electronic waste

Feedback :

While water consumption and electronic waste are also important factors, the use of rare earth elements and other critical resources stands out as the most significant impact due to its far-reaching consequences on resource depletion, environmental degradation, and the sustainability of the digital industry as a whole.

2



What is the phenomenon of rapid renewal of digital devices called?

- a) **Planned obsolescence**
- b) Digital life cycle
- c) Technological obsolescence
- d) Digital evolution

Feedback :

Manufacturing digital devices has a multifaceted environmental impact, including high water consumption, the use of scarce resources, and the generation of significant electronic waste.

1



Which of these actions is the most effective in reducing the environmental impact of digital technology?

- a) Turning off your computer at night
- b) Decreasing the brightness of your screen
- c) Using Wi-Fi instead of 4G
- d) **Extending the life of your devices**

Feedback :

Keeping devices for longer significantly reduces the demand for new production, which has the biggest environmental impact.

1



What is "cloud computing"?

- a) **A dematerialized data storage system**
- b) A wireless display technology
- c) Video conferencing software
- d) An online learning method

Feedback :

Cloud computing involves storing and accessing data and programs over the internet instead of on a personal computer or local server.

1



What is the environmental impact of storing data in the cloud?

- a) Negligible
- b) Low
- c) Moderate
- d) **Significant**

Feedback :

Data centers require vast amounts of energy to operate and cool their servers, contributing to greenhouse gas emissions.

1





Quiz



Quiz



Quiz



Quiz



Quiz



Quiz



Quiz



Quiz





What is the main source of energy used to power data centers?

- a) Solar energy
- b) Wind energy
- c) Hydroelectric energy
- d) **Fossil fuels**

Feedback :

While there is a move towards renewable energy, many data centers still rely heavily on fossil fuels, particularly coal and natural gas.

1



Which of these digital devices consumes the most energy?

- a) A smartphone
- b) A tablet
- c) A laptop
- d) **A desktop computer**

Feedback :

Desktop computers generally have more powerful components and larger displays, leading to higher energy consumption compared to other devices.

1



What is a "digital footprint" in terms of the environment?

- a) **The mark left by our online activities on the environment**
- b) The amount of personal data stored on the internet
- c) The number of digital devices we own
- d) The area occupied by data centers in the world

Feedback :

This refers to the environmental impact of our digital actions, including energy use, resource consumption, and waste generation.

1



Classify those actions from the most to the less impactful to reduce the environmental impact of mail.

- a) Deleting unnecessary emails (3)
- b) Limiting the number of attachments (1)
- c) Unsubscribing from unwanted newsletters (2)

Feedback :

1. Limiting the number of attachments can reduce CO2 emissions by up to 92%.
2. Unsubscribing from unwanted newsletters reduces the overall number of emails sent and received.
3. Deleting unnecessary emails helps by freeing up server space and reducing energy consumption for storage.

3



Which of these file formats is the lightest?

- a) .doc
- b) .pdf
- c) **.txt**
- d) .jpeg

Feedback :

Plain text files (.txt) contain only basic text without formatting, making them smaller than richer formats like .doc or .pdf.

1



What is "Moodle"?

- a) A set of rules for good behaviour on the internet
- b) Anti-virus software
- c) Wireless communication technology
- d) **An online learning platform**

Feedback :

Moodle is the leading learning management system used by most of the universities around the world. This is a good example of an open-source software that outdo most of the authoring LMS alternatives.

1



What is the name for waste from electrical and electronic equipment?

- a) Household waste
- b) Industrial waste
- c) Green waste
- d) **WEEE**

Feedback :

WEEE (Waste Electrical and Electronic Equipment) is a category of waste that includes discarded electronic devices.

1



What does the acronym "ADEME" stand for?

- a) Ecological Transition Agency
- b) Association for the Development of Renewable Energies
- c) Agency for the Environment and Energy Management
- d) **Association for the Defense of the Environment and Digital Technology**

Feedback :

ADEME is a French agency that provides expertise and advice on environmental and energy issues.

1





Quiz



Quiz



Quiz



Quiz



Quiz



Quiz



Quiz



Quiz





Which of these metals is used in the manufacture of smartphones ?

- a) Gold
- b) Silver
- c) Cobalt
- d) All of the above

Feedback :
Smartphones contain a variety of metals, including gold, silver, and cobalt, often sourced from conflict zones or environmentally damaging mines.

2



What is the consequence of extracting the raw materials needed to manufacture digital equipment?

- a) Deforestation
- b) Soil pollution
- c) Depletion of natural resources
- d) All of the above

Feedback :
Raw material extraction for electronics has significant environmental consequences, including deforestation, soil pollution, and resource depletion.

2



What is the name for all the actions aimed at reducing the environmental impact of digital technology?

- a) **Digital sobriety**
- b) Digital transition
- c) Digital ecology
- d) Responsible digital technology

Feedback :
Digital sobriety encourages a more mindful and responsible use of digital technology to minimize its environmental footprint.

1



What is the role of higher education institutions in reducing the environmental impact of digital technology?

- a) Raise awareness among students and staff
- b) Implement digital equipment management policies
- c) Promote responsible digital practices
- d) **All of the above**

Feedback :
Higher education institutions have a crucial role in promoting awareness, implementing sustainable practices, and fostering responsible digital citizenship among their communities.

2



List as much actions taken individually to reduce the environmental impact of digital as you can.

1  x answer

5 answers
maximum

?



List as many actions your institution has taken to reduce the environmental impact of digital as you can.

1  x answer

5 answers
maximum

?



List as many actions students in your institution has taken to reduce the environmental impact of digital as you can.

1  x answer

5 answers
maximum

?



List as many actions teachers in your institution has taken to reduce the environmental impact of digital as you can.

1  x answer

5 answers
maximum

?





Quiz



Quiz



Quiz



Quiz



Quiz



Quiz



Quiz



Quiz





BONUS

By turning off unused devices (computers, phones, tablets), you save energy.

Thanks to these hours of downtime avoided, you can move your **Sustainability token** one space forward on the board.



BONUS

You have chosen to change your browser to reduce your environmental footprint. By favouring a more resource-efficient tool, you are promoting more responsible energy consumption.

As a reward for this effort in digital sobriety, you move your **Sustainability token** two spaces forward on the board.



BONUS

By reducing the number of emails with large attachments you send, you can significantly reduce your data consumption.

Every gigabyte saved allows you to move your **Sustainability token** forward three spaces.



BONUS

You have disabled unnecessary notifications on your devices.

This action helps reduce battery and data consumption and earns you **1 resource point**.



BONUS

You adjust the resolution of your streaming videos, (for example from 1080p to 720p).

Each hour of streaming at a lower quality allows you to earn **2 resources points**.



BONUS

By participating in the "Weekend Without Smartphone" challenge, you successfully reduced your online time.

Congratulations on completing the challenge! You earn **3 resources points** as a reward.



BONUS

The points awarded for the next quiz card will be **doubled**, meaning you will receive twice the usual amount of points for completing that specific action.



BONUS

Pick an individual action card.



Event



Event



Event



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BONUS

The other team pick a problem card.



BONUS

Pick a collective action card.



MALUS

Storing data on cloud services requires data centers that consume a lot of energy and resources, thus increasing the digital ecological footprint.

You lose 2 resources points.

-2 



MALUS

The manufacturing of digital equipment requires the extraction of numerous minerals, which can lead to significant environmental and social impacts, particularly in the regions where these resources are mined.

You lose 3 resources points.

-3 



MALUS

Excessive screen time can be detrimental to your health (sleep disorders, anxiety, social isolation).

On the board, move your **Impact token** forward one space.

1 



MALUS

Digital equipment (smartphones, computers, data centres) consumes a lot of energy and generates greenhouse gas emissions.

Because of this, move your **Impact token** forward two spaces on the board.

2 



MALUS

The lack of suitable recycling channels for electronic devices complicates waste management and increases pollution.

Move your **Impact token** three spaces forward on the board.

3 



MALUS

Skip your turn: When a team pick this card, they do not add any tokens to the game board.



Event



Event



Event



Event

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Academy

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Academy

GreenDiLT
Academy



MALUS

Intrusive and targeted advertisements increase data and bandwidth consumption, while detracting from the user experience.

On the board, move your **Sustainability token** back one space.

-1



MALUS

The proliferation of connected devices in homes and offices is leading to an increase in energy and data consumption.

You therefore move your **Sustainability token** back two spaces.

-2



MALUS

Some manufacturers design their devices with a limited lifespan, encouraging consumers to replace them more often and generating more electronic waste.

On the board, move your **Sustainability token** back three spaces.

-3



MALUS

The increase in digital usage can also lead to a rise in cyberattacks and data breaches, creating challenges for the security and protection of personal information.

You lose 1 resource point.

-1



CHALLENGE

Compare the average screen time usage of your smartphone over the past week.

The team with the lowest screen time wins **2 resources points**.

2



CHALLENGE

How often do you charge your smartphones each week?

The team with the lowest number of charges wins **2 resources points**.

2



CHALLENGE

Count the total number of electronic devices owned by each member of your team.

The team with the fewest devices wins **2 resources points**.

2



CHALLENGE

How many hours of videos did you watch online last week?

The team with the fewest hours wins **2 resources points**.

2



Event



Event



Event



Event



Event



Event



Event



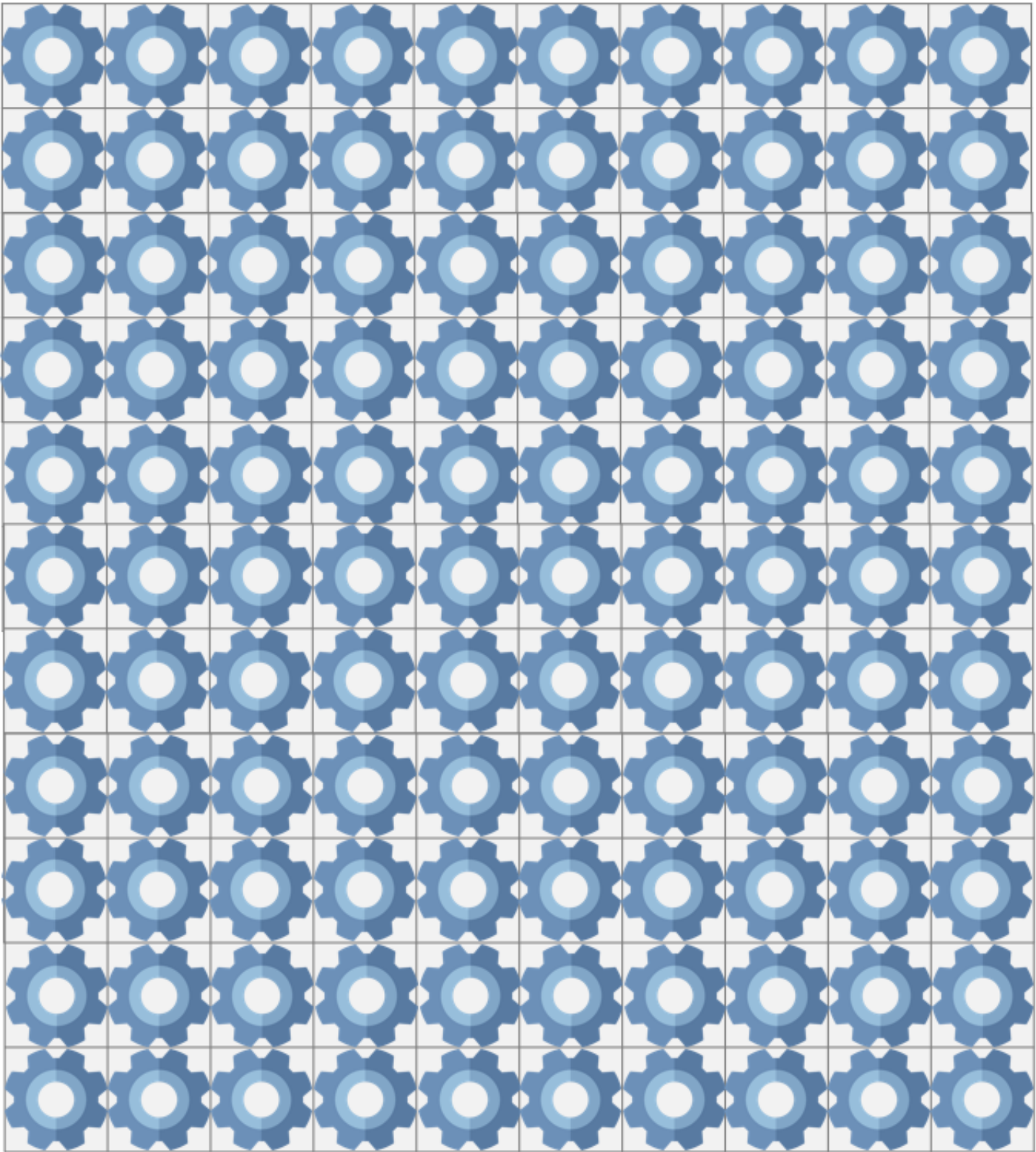
Event

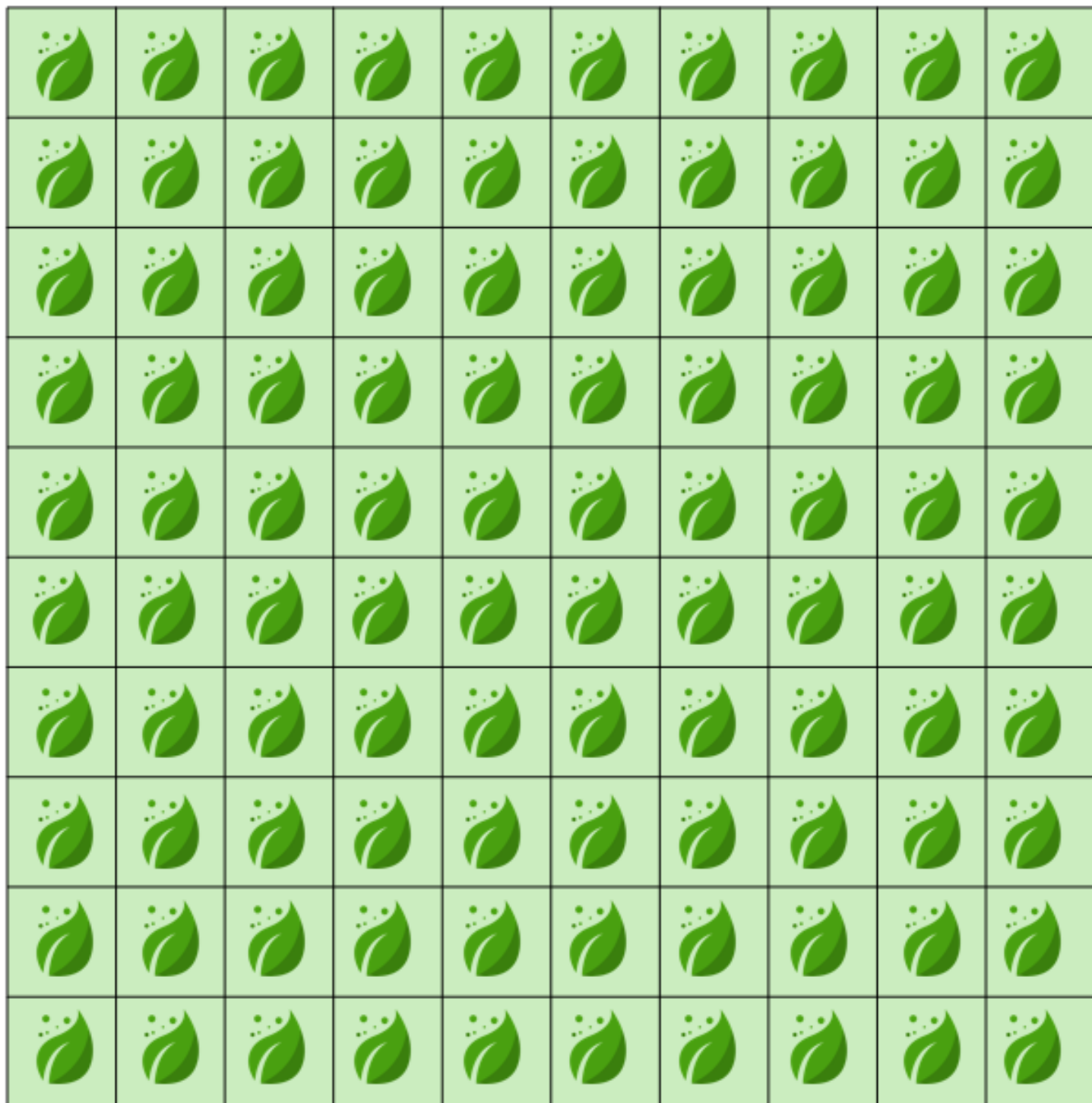


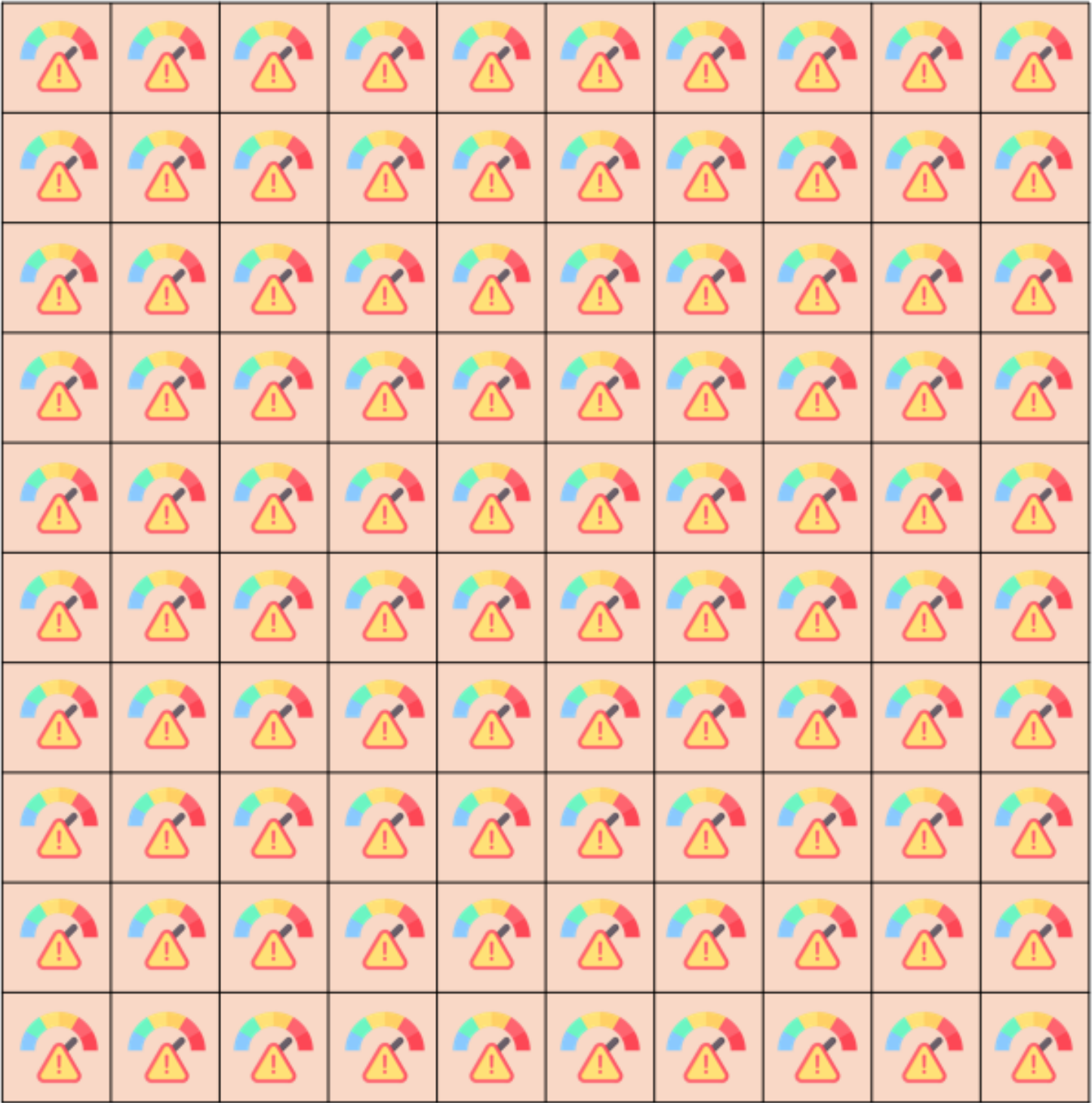
Planned obsolescence	Poor management of e-waste	Overconsumption	Digital misconception	Energy-intensive infrastructure
Collective actions - Extending the lifespan of equipment policy - Barter and second-hand equipment policy - Equipment donation and pooling policy Individual actions - Maintain the hardware - Maintain the software - Clean your equipment - Protect your equipment	Collective actions - Recycling policy - Equipment donation and pooling policy - Barter and second-hand equipment policy - Implement and optimize the sorting of consumables	Collective actions - Environmental clauses policy - Barter and second hand equipment policy - Collective moments for digital disconnection - Equipment donation and pooling policy Individual actions - Limit use of email - Question digital benefits in learning and teaching - Limit the number of screens - Favor low-tech teaching activities - Use existing resources - Eco-friendly printing	Collective actions - Training on the impact of digital tools on teaching and learning - Life cycle analysis - Social and mental impact of digital tools Individual actions - Prescribe technology usage in courses - Favor low-tech teaching activities - question digital benefits in teaching and learning	Collective actions - Renewable energy - Energy-efficient equipment policy - Smart power supply policy - Enable eco-mode on equipment and infrastructure - Network location infrastructure

Energy consumption: equipment	Energy consumption: digital services	Digital addiction	Non-sustainable course design	Unethical digital practices
Collective actions - Enable eco mode on equipment and infrastructure - Energy-efficient equipment policy - Smart power supply policy Individual actions - Manage battery cycles - Turn off or set your device to sleep mode - Disable unused features - Eco friendly printing - Learn and work in airplane mode	Collective actions - Network infrastructure location Individual actions - Clean up personal digital space - Centralize data sharing - Use reduced version of application - Limit use of email	Collective actions - Collective moments for digital disconnection Individual actions - Learn and work in airplane mode - Prescribe technology usage in courses - Use reduced versions of applications - Limit the number of screens	Collective actions - Training on the impact of digital tools on teaching and learning Individual actions - Anticipate the use of training material - Favor low-tech teaching activities - Use existing resources - Prescribe technology usage in courses - Open access resources	Collective actions - Social clauses policy - Responsible digital charter - Environmental clauses policy Individual actions - Open access resources - Use open source software









GreenDiLT Online Course

2.2. The goal and scope of LCA



How to define the scope ?



Allocation procedure

Rules to distribute the environmental impacts of shared resources or activities among multiple outputs or users.



Course preparation = 40 hours

Outputs proportionally allocated :



10kg CO2 eq



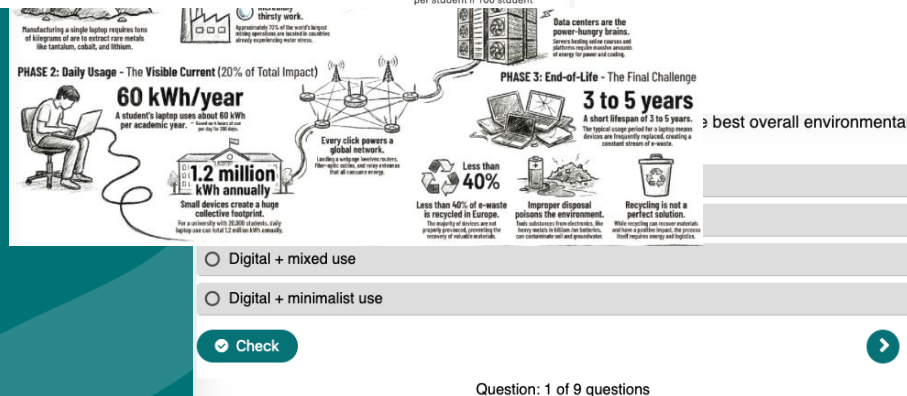
0.1kg CO2 eq

per student if 100 student

mental impact

on:

Transportation adds 1-2% to the impact.
The carbon footprint from shipping packaging is 10% of the total carbon footprint of the product.



Target: Faculty, Support staff, Students

Suggested uses:

- Internal training session
- Online classroom session

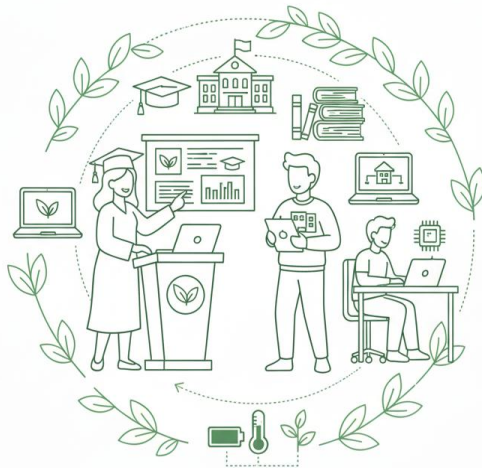
Context: Why This Matters?

A survey conducted among GreenDiLT stakeholders identified four key learning needs:

- **Understanding digital environmental impacts** — impacts are often invisible and poorly understood
- **Learning how environmental impacts are measured** — through methods such as Life Cycle Assessment
- **Identifying effective eco-actions** — ranked by their actual environmental impact
- **Building institutional strategies** — to develop effective policies for reducing digital environmental footprint at scale

GreenDilt online course: what is it ?

General pupose: 3 online modules to provide training stakeholders with a personal analytical framework for assessing the environmental impacts of digital technology



1. Defining the environmental impact of digital education

- Typology of direct (natural resources) and indirect (usage) impacts of digital devices and services
- Orders of magnitude of these impacts



2. Measuring the environmental impact of digital education

- LCA methodology for impact assessment
- Application to the GreenDiLT case study



3. Reducing the environmental impact of digital education

- Classification of eco-actions by effectiveness
- Key actions to implement at the institutional level

GreenDilt online course: what content ?

2.2. The goal and scope of LCA GreenDiLT

How to define the scope ?



Allocation procedure
Rules to distribute the environmental impacts of shared resources or activities among multiple outputs or users.



Course preparation = 40 hours

Outputs proportionally allocated :



10kg CO2 eq



0.1kg CO2 eq per student if 100 student

Educational videos to explain the key concept

1. Based on the paper or pdf case study, which scenario presents the best overall environmental assessment?

- ☐ Centralized printing + full retention
- ☐ Hybrid + optimal use
- ☐ Digital + mixed use
- ☐ Digital + minimalist use

✓ Check



Question: 1 of 9 questions

Quiz to assess the global understanding

Mr. Dupont's Dilemma
Course coordinator • Management Sciences Master's

For the past 10 years, Mr. Dupont has provided printed course materials to his 120 students. Aware of environmental issues and encouraged by his institution, he decides to **digitize his teaching materials**. At first glance, the calculation seems simple: *no more paper = environmental benefit*. But is it really that simple?

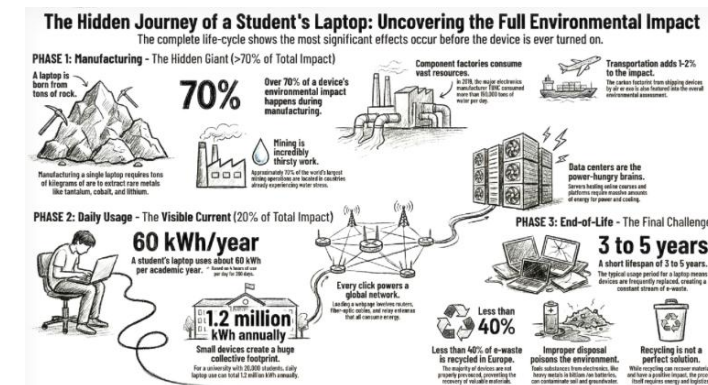
STUDENTS 120	COURSE MATERIAL 150 pages	CURRENT PRACTICE Centralized printing
------------------------	-------------------------------------	---

The Question

Should he completely switch to digital, continue printing, or find a hybrid approach? What will be the real environmental, economic, and pedagogical consequences of each choice?

[Understand the Context →](#)

Interactive case studies to reflect on practical usual topics



Infography to focus on the key value of environmental impact

GreenDilt online course: where to find it?

Institutional learning platforms

Ecole nationale des ponts et chaussées	https://educnet.enpc.fr/course/view.php?id=2304
ENSAM	https://savoir.ensam.eu/moodle/course/view.php?id=13890

Life Cycle Assessment (LCA) Game on Digital Education

Target: Faculty, Support staff, Students

The LCA Game can be effectively integrated into a variety of educational and organizational contexts, including:

- **Institutional events**, to raise awareness of life cycle thinking and the environmental impacts associated with products, services, and activities among a broad audience.
- **Internal workshops**, to encourage discussion, collaboration, and the application of LCA principles in decision-making and sustainability strategies.
- **Class sessions**, as an interactive and engaging learning tool that helps students understand LCA concepts, develop systems-thinking skills, and actively explore sustainability challenges and solutions.



Context: Why This Matters?

A survey conducted among GreenDiLT stakeholders identified four key learning needs:

- **Understanding digital environmental impacts** — impacts are often invisible and poorly understood
- **Learning how environmental impacts are measured** — through methods such as Life Cycle Assessment
- **Identifying effective eco-actions** — ranked by their actual environmental impact
- **Building institutional strategies** — to develop effective policies for reducing digital environmental footprint at scale

Instructions

General purpose: The board game provides education stakeholders with an immersive and interactive learning experience focused on life cycle assessment and the environmental impacts of digital education.

1. Read carefully the case study (15 min)
2. Define the life cycle phases starting from Scenario1 (face-to-face) (15 min)
3. Define the resources consumed in each phase (15 min)
4. Estimate the first impact using coins (10 min)
5. Estimate the second impact using coins (10 min)
6. Estimate the third impact using coins (10 min)
7. Sensitivity analysis: expected changes for the hybrid scenario and fully on line scenario (20 min)
8. Share your solution with other groups (6/7 min per group)
9. Compare the results with the solutions and discuss it (15 min)

Total time: 1 h 30 min / 2 h

Case study - Goal and Scope Definition

This case study examines the Life Cycle Assessment (LCA) of a **student** at Politecnico di Milano, considering the different study modalities that the university has continued to offer beyond the pandemic period.

The analysis compares the **traditional in-person mode**, in which students physically attend classes on campus, with the **hybrid mode**, which combines on-campus attendance, live-streamed lectures, and access to recorded lessons.

By evaluating these alternative learning modalities, the study explores and compares their respective **environmental impacts**, providing insights into potential differences in sustainability performance.

Case study - System Boundaries

The data used in this analysis were obtained from the ERASMUS+ GreenDiLT project and from the Master's thesis by Francesca Sarti, “*Evaluating the Environmental Impact of Digitally-Enhanced Education: A Comparative Life Cycle Assessment of Educational Scenarios in an Italian University*”. The dataset serves as the basis for assessing and comparing the sustainability performance of alternative approaches to higher education.

The data considered in **this study relate exclusively to core educational activities**, excluding food consumption and other ancillary activities occurring outside the academic setting, such as the use of libraries, cafeterias, and other campus services. Consistent with the selected functional unit, the analysis focuses specifically on the environmental impacts associated with different study modalities and the use of technological devices required for learning activities.

Case study - Functional unit

The **functional unit** was defined as **25 hours of education per student**, consisting of **10 hours of lectures** and **15 hours of individual study**. In addition, the functional unit includes the **time devoted by faculty members to preparing teaching materials and examinations**, as well as the **support activities carried out by administrative staff**.

Faculty-related activities were estimated at 40 hours, including 30 hours for lesson preparation and 10 hours for exam preparation and grading. Administrative support activities were estimated at 6 hours. To allocate these impacts to an individual student, both values were divided by the total number of students enrolled in the course. This approach ensures that the environmental impacts associated with teaching and administrative support are proportionally assigned to the functional unit of a single student.

Functional unit	Characterization
10 hours	Number of contact hours (lesson) between professor and students
30 hours	Average number of hours spent by a professor to prepare learning materials
10 hours	Average number of hours spent by a professor to prepare and review the exam
15 hours	Number of hours spent by a student for individual study
6 hours	Average number of hours spent by support staff for back office work

Case study - Scenario 1

Face-to-Face (In-Person)

The first scenario analyzed, **face-to-face learning without streaming or recording**, represents the traditional educational model in which all teaching activities take place on campus and students, faculty members, and administrative staff are physically present at the university.

The main sources of energy consumption in this system are associated with the operation of university facilities, including classroom lighting, heating, ventilation, and air conditioning (HVAC) systems, as well as the use of information and communication technology (ICT) equipment such as projectors and classroom computers. Individual study activities are also assumed to occur on campus, generating additional energy consumption using laptops, lighting, and other electronic devices.

In addition to student-related activities, the system encompasses the contributions of faculty and administrative staff, including lesson preparation, examination-related tasks, and administrative support activities. These processes are included to provide a comprehensive assessment of the environmental impacts associated with the traditional in-person educational model.

For faculty activities:

- **75%** of lesson and exam preparation is assumed to take place at **home**
- **25%** of lesson and exam preparation is carried out at the **university campus**.

For administrative staff support activities, the workload is divided equally:

- **50%** is performed remotely from **home**
- **50%** takes place on **campus**.

Case study - Scenario 2

Hybrid (In-Person with Streaming and Recording)

This model combines traditional **face-to-face** education with digital components, including **live-streamed and recorded lectures**. In addition to the infrastructure required for in-person teaching, the hybrid system relies on supplementary ICT resources, such as streaming equipment, servers, and software platforms used to deliver and record educational content.

The system also includes the creation, storage, management, and distribution of online learning materials. Consequently, environmental impacts are associated with data storage servers, content management systems, streaming platforms, and the transmission of digital content.

Compared with the fully in-person model, student commuting is reduced, depending on the proportion of students participating remotely. Faculty and administrative staff activities are distributed between home and the university according to the same assumptions adopted in the face-to-face scenario, ensuring consistency in the comparison of educational modalities.

For students:

- **75%** attend lectures in person, resulting in lower energy consumption at home during teaching hours
- **12.5%** attend lectures via live streaming
- **12.5%** access recorded sessions

For **faculty** activities:

- **75%** of lesson and exam preparation is assumed to take place at **home**
- **25%** of lesson and exam preparation is carried out at the **university campus**.

For **administrative staff support** activities, the workload is divided equally:

- **50%** is performed remotely from **home**
- **50%** takes place on **campus**.

Both remote participation modes increase household energy consumption due to the use of ICT devices, lighting, internet connectivity, and, where applicable, heating, ventilation, or cooling systems.

Case study - Scenario 3

Fully on line (Streaming and Recording)

This scenario combines the two fully online learning modalities, with **75% of students attending lectures via live streaming (synchronous learning)** and **25% accessing the recorded content of the lectures (asynchronous learning)**. All other characteristics remain consistent with those of the fully online synchronous and asynchronous scenarios.

The system relies entirely on digital infrastructure for the delivery of educational activities. Consequently, it involves the use and management of online educational content through **streaming platforms, content management systems, and servers for storing and distributing recorded lectures**. These components contribute to the environmental impacts associated with data transmission, data storage, and ICT infrastructure operation.

As all teaching and learning activities take place remotely, **student commuting is completely avoided**, eliminating transportation-related impacts. However, energy consumption is transferred to the home environment, where students use personal ICT devices, internet connections, lighting, and, where applicable, heating or cooling systems to participate in lectures and complete individual study activities.

- **75% of students** participate in lectures remotely through live streaming, resulting in increased household energy consumption due to the use of ICT devices, internet connectivity, lighting.
- **25% of students** access lectures through recorded sessions, which similarly increases energy consumption associated with personal devices, internet use, lighting, and home climate control systems.

For **faculty** activities:

- **75%** of lesson and exam preparation is assumed to take place at **home**
- **25%** of lesson and exam preparation is carried out at the **university campus**.

For **administrative staff support** activities, the workload is divided equally:

- **50%** is performed remotely from **home**
- **50%** takes place on **campus**.



What are the environmental impacts of a POLIMI student?

Functional Unit

25 hours of education per student



Climate Change
(in CO2 Emissions)



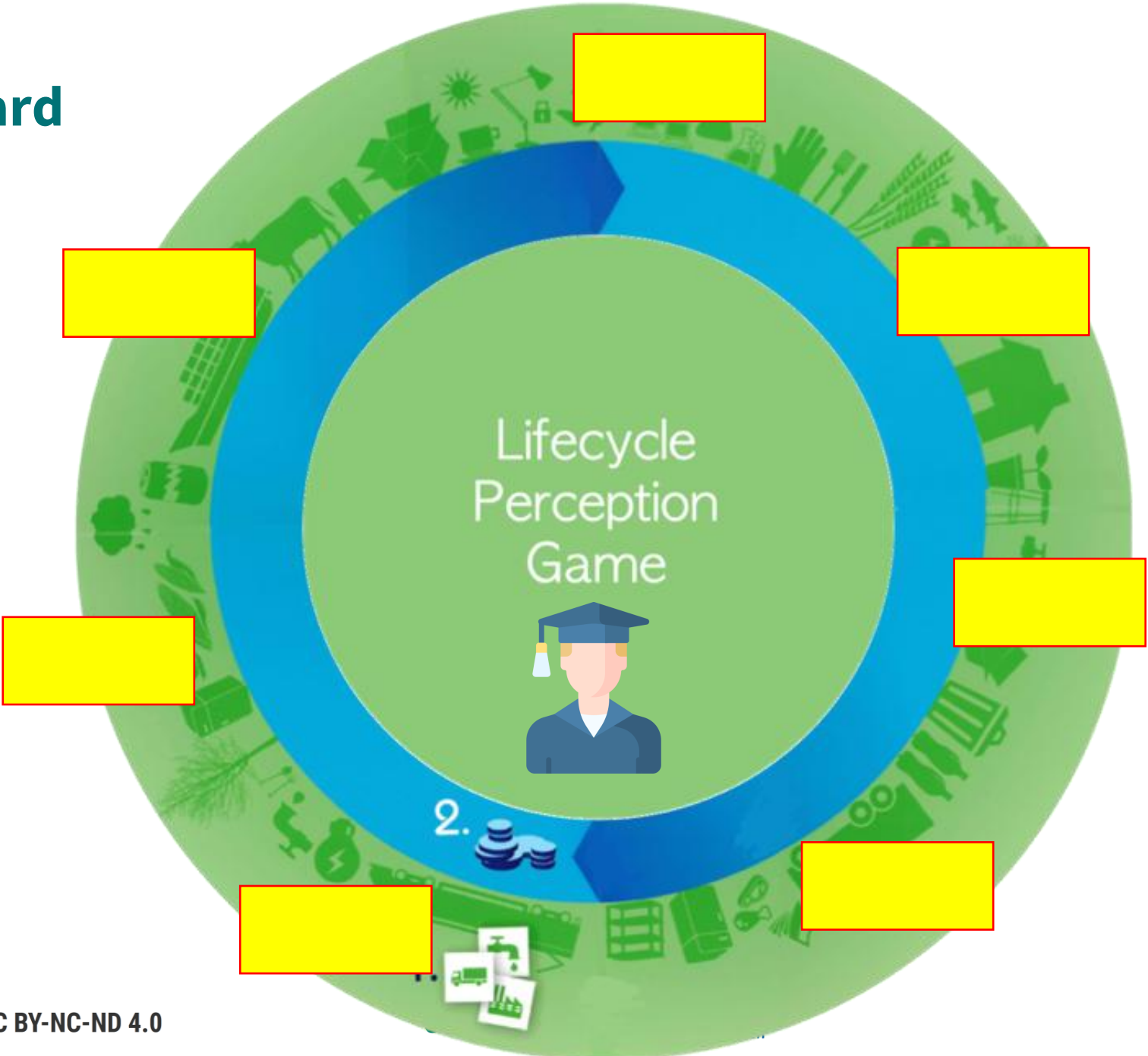
Freshwater
Ecotoxicity



Human Ecotoxicity

NOTE: the environmental impacts have been chosen on the base of the POLIMI LCA study conducted in the framework of the GreeDiLT project

Board



Resources



PAPER PRODUCTION



ELECTRICITY
CONSUMPTION



BOOKS PRODUCTION



ROUTER/INTERNET

DEFORESTATION



TRANSPORT
BY PLANE



TRANSPORT
BY TRUCK



TABLET / SMARTPHONE



TRAIN
TRANSPORT



PAPER PRINTING



CAR
TRANSPORT



COMPUTER, LAPTOP
PRODUCTION

IRRIGATION



NATURAL GAS
CONSUMPTION



SAND EXTRACTION



BUILDING CONSTRUCTION



DATA CENTERS



E-WASTE



FOOD WASTE



ELECTRIC BIKE



UNDERGROUND



RAW MATERIAL
EXTRACTION

Warning

Note: You do not need to use all the cards.
Choose the ones that best fit the activity and the topics you
want to explore.

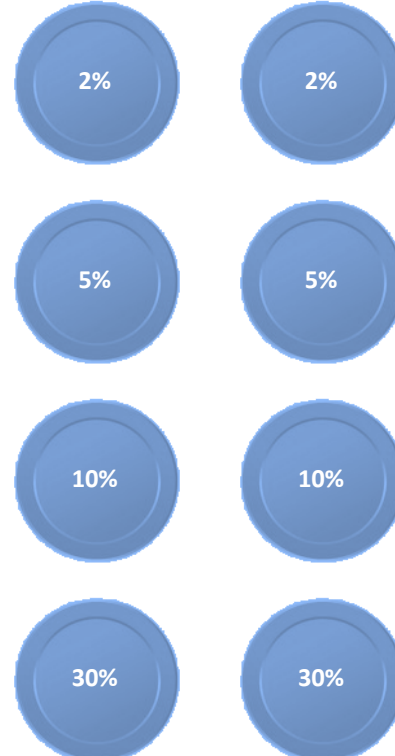
You are free to consider them or not!

Impacts estimation – constrains

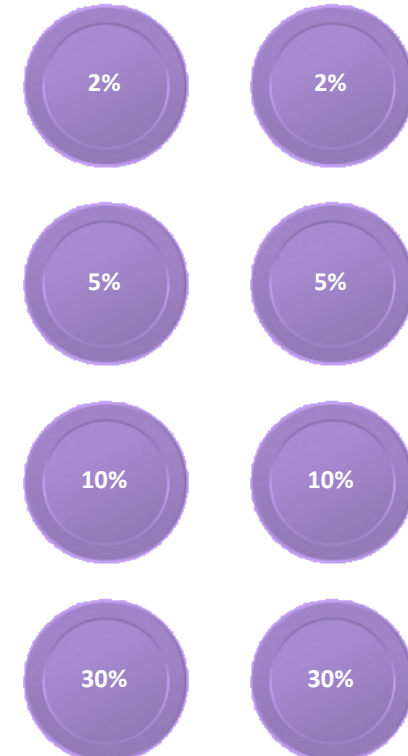
Token Indicator 1
(100%)



Token Indicator 2
(100%)



Token Indicator 3
(100%)



Work discussion

1. Present the results of your group work.
2. Identify any potential data gaps or uncertainties in the Life Cycle Inventory (LCI).
3. What are the main differences among the three scenarios analyzed?
4. Besides climate change, are there other environmental impact categories that should be considered? Why?
5. What are the main limitations of your analysis?
6. Based on the results, what recommendations would you make to reduce the environmental impacts of the product or system under study?

Results – Scenario 1 FACE-TO-FACE



Climate Change
(in CO2 Emissions)

Climate Change	FACE -TO-FACE
Car transport	57%
Train/underground transport	29%
Electricity	7%
Computer, laptop	4%
Printed paper / books	2%
Others	2%
Total	100%



Freshwater Ecotoxicity

Freshwater ecotoxicity	FACE -TO-FACE
Car transport	70%
Computer, laptop	13%
Train/underground transport	9%
Router, internet	3%
Electricity,	2%
Others	2%
Printed paper/books	1%
Total	100%



Human Ecotoxicity

Human carcinogenic ecotoxicity	FACE -TO-FACE
Car transport	67%
Train/underground transport	24%
Computer, laptop	3%
Electricity	2%
Printed paper /books	2%
Others	2%
Total	100%

Results – Scenario 2 HYBRID



Climate Change
(in CO2 Emissions)

Climate Change	HYBRID
Car transport	51%
Train/underground transport	25%
Electricity	10%
Natural gas for heating	6%
Computer, laptop	3%
Printed paper/books	3%
Consumer electronics, mobile device, tablet	1%
Router, internet	0%
Others	1%
Total	100%



Freshwater Ecotoxicity

Freshwater ecotoxicity	HYBRID
Car transport	64%
Computer, laptop	16%
Train/underground transport	8%
Router, internet	4%
Electricity,	3%
Others	1%
Printed paper/books	2%
Consumer electronics, mobile device, tablet	1%
Total	100%



Human Ecotoxicity

Human carcinogenic ecotoxicity	HYBRID
Car transport	63%
Train/underground transport	23%
Electricity	4%
Computer, laptop	3%
Printed paper/books	2%
Natural gas for heating	1%
Consumer electronics, mobile device, tablet	1%
Router, internet	1%
Others	1%
Total	100%

Results – Scenario 3 FULLY ON LINE



Climate Change
(in CO2 Emissions)

Climate Change	FULLY ON LINE
Natural gas for heating	48%
Electricity	36%
Printed paper/books	6%
Computer, laptop	6%
oOthers	4%
Total	100%



Freshwater Ecotoxicity

Freshwater ecotoxicity	FULLY ON LINE
Computer, laptop	52%
Electricity	17%
Router, internet	15%
Natural gas for heating	6%
Printed paper/books	5%
Others	5%
Total	100%



Human Ecotoxicity

Human carcinogenic ecotoxicity	FULLY ON LINE
Electricity	34%
Natural gas for heating	19%
Computer, laptop	22%
Printed paper/books	14%
Router, Internet	4%
Others	7%
Total	100%

THANKS

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GreenDiLT 



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