eGreen

HOW TO REDUCE THE ENVIRONMENTAL IMPACT OF DIGITAL TECHNOLOGY ?

Pedagogical Handbook

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TECHNICAL SPECIFICATIONS

PEDAGOGICAL OBJECTIVES OF THE TRAINING

- Understand the issues surrounding the digital sector and its impact on the environment;
- Question the learner's relationship with digital technology and its place in our daily life;
- Identify the players, practices and initiatives that help to reduce the environmental impact of digital technology;
- Create your own action plan to reduce your digital carbon footprint.

PEDAGOGICAL PROCESS

- Pedagogical handbook is meant to provide the necessary information and knowledge to the trainers to enable the preparation of the training;
- Training outline provides the trainers with a detailed step-by-step plan to enable the implementation of the training ;
- Learners have to use the Participants Notebook throughout the training session.

KEY MESSAGES FOR THE TRAINING

- Engage learners in to the Green Digital Transition;
- Explain crucial notions: Global warming, digital carbon footprint, lifecycle approach, psychological obsolescence;
- Develop an extensive overview of the environmental impact of the digital sector;
- Promote digital moderation;
- Highlight on-going initiatives and actions that individuals can adopt.

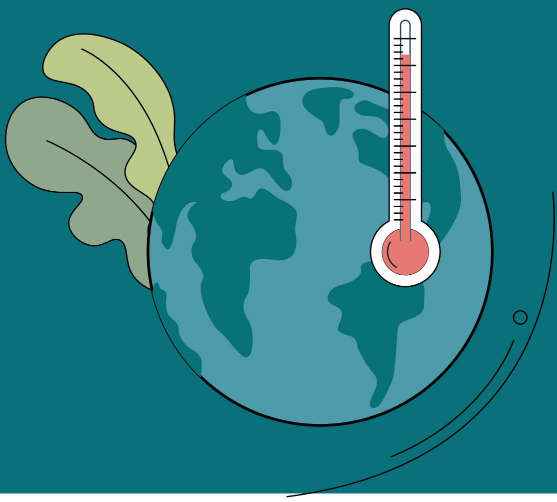
INTRODUCTION

OBJECTIVES OF THE TRAINING

- Introducing learners to important notions: climate change, carbon footprints and lifecycle analysis;
- Explain how the production of digital devices impacts the environment;
- Provide key understandings on the usage of digital devices and how it impacts the environment;
- Highlight the challenges behind the disposal of digital devices;
- Raise awareness on the impact and consequences of the digital sector on the environment;
- Highlight existing initiatives at the international, EU and individual level;
- Explain digital sobriety;
- Provide solutions and a set of recommended actions for each phase of the lifecycle of a digital device.

SLIDE 2 **Training outline**

INTRODUCTION	Important notions
MODULE 1	Production of digital devices
MODULE 2	Impact of daily usage
MODULE 3	End-of-life of digital devices
MODULE 4	The future of digital technology - Initiatives and actions



INTRODUCTION TO KEY CONCEPTS

Section 0.1
Climate change & carbon footprints

OBJECTIVE

- Explain the causes and effects of climate change;
- Illustrate the concept of carbon footprint and a digital carbon footprint.

SLIDE 4

Climate change

Climate change refers to long-term variations in temperature and weather patterns. Global warming refers to such variations with an overall tendency of temperatures to rise. Even though climate change is a natural process, since the 1800s, human activities have been the main driver and accelerator of this effect.

Global warming is mainly caused by greenhouse gases emissions which are generated by multiple factors. When released, gas emissions act like a blanket enveloping the Earth, therefore forbidding UV rays to be reflected.

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Sources of greenhouse gas emissions are numerous, and are mostly attributable to burning fossil fuels like coal, oil and gas used for human activities (United Nations).

Such fuels are used for several purposes:

- Generating power
- Deforestation
- Production of food
- Consumption
- Manufacturing goods
- Transportation
- Powering buildings
- Creation of waste

On the PowerPoint, smartphone pictograms show which sources are affected by digital technology.

It is estimated that by 2100 the temperature should rise from 1.3 up to 5.3°C across the globe *(Alestra et al., 2020).*

This increase will be more prevalent in large cities and during summer. There is an overall consensus in the scientific community that global warming causes irreversible damage to the environment and is mostly caused by human actions.

Examples of devastating effects of global warming include loss of biodiversity, increase of natural disasters, increased mortality rates and spread of diseases and difficulty to access water. Therefore, measuring our impact on the environment is an essential step to tackle the issue of global warming. This knowledge encourages to put in place practices to reduce and limit further environmental damage

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Activity 1
How to measure climate change?

Group work - 3 minutes

Tools: Participants use their notebook for this activity.

STEP 1 Ask the questions to the participants

What is the most widely used measure for assessing climate change ?
What formula is used to obtain this measure ?

PROPOSED ANSWERS

The main instrument at our disposal to measure our environmental impact is the carbon footprint. The **carbon footprint** is the total quantity of greenhouse gases emitted (usually measured in tons of carbon dioxide equivalent, CO2e). To obtain a carbon footprint, the quantity consumed of goods or services is multiplied by the factor of our CO2 emissions. Every category of daily life can be measured using this formula: food, transport, housing (electricity, water, gas, insurance…), consumption of goods, public services. Public services include health, education, justice, security and infrastructures *(ARCEP 2020).*

CO2 EMISSIONS = QUANTITY CONSUMED x EMISSION FACTOR

SLIDE
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Taking the example of transport, the environmental impact of an individual travelling from Paris (France) to Rome (Italy) can be calculated

On an plane

- Quantity consumed: Taking a flight for a distance of approximately 1100 km;
- Factor of CO2 emissions: Approximately 0.2 kg of CO2 per kilometre;
- Contribution to the carbon footprint: 1100km x 0.22 kg/km = 220 kg of CO2e.

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On a train

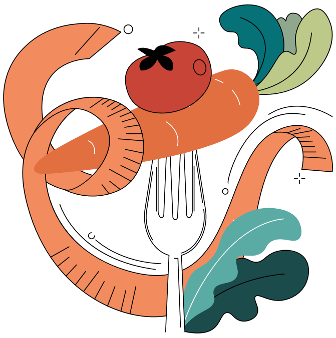
- Quantity consumed: Taking a train for a distance of approximately 1400 km of railway;
- Factor of CO2 emissions: Approximately 0.05 kg of CO2 per kilometre;
- Contribution to the carbon footprint: 1400km x 0.05 kg/km = 70 kg of CO2e.

On a bus

- Quantity consumed:Ttaking a bus for a distance of approximately 1500 km;
- Factor of CO2 emissions: : Approximately 0.06 kg of CO2 per kilometre;
- Contribution to the carbon footprint: 1500 km x 0.06 kg/km = 90 kg of CO2e.

In a car

- Quantity consumed : taking a bus for a distance of approximately 1400 km of road;
- Factor of CO2 emissions: approximately 0.12 kg of CO2 per kilometre;
- Contribution to the carbon footprint: 1400 km x 0.12 kg/km = 168 kg of CO2e.



SLIDE 9

Taking the example of food, we can look at the various carbon footprint of an individual eating 100 grams of something for a year

Daily consumption of 100 gr of beef
- Daily carbon footprint contribution: approximately 1.33 kg of CO2e;
- Yearly carbon footprint contribution: approximately 1.33 kg CO2e x 365 **= 485.45 kg of CO2e.**

Daily consumption of 100 gr of carrots
- Daily carbon footprint contribution: approximately 0.014 kg of CO2e;
- Yearly carbon footprint contribution: approximately 0.014 kg CO2e x 365 **= 5.11 kg of CO2e.**

Daily consumption of 100 gr of rice
- Daily carbon footprint contribution: approximately 0. 27 kg of CO2e;
- Yearly carbon footprint contribution: approximately 0.27 kg CO2e x 365 **= 98.55 kg of CO2e.**

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Like the carbon footprint, the digital carbon footprint is a significant tool to measure the environmental impact of the digital sector.

Digital carbon footprint enables to assess the environmental impact associated with internet use and online activities, based on the same calculation system.

Activity 2
What is the carbon footprint of the digital sector?

Group work - 3 minutes
Tools: Participants use their notebook for this activity.

STEP 1 Ask the multiple-choice questions to the participants.

What is the percentage of the digital carbon footprint in global CO2 emissions?

A. 0.05%-0.1% B. 0.5%-1% C. 1%-2% D. 2-3%%

When comparing the CO2 emissions from digital activities and aviation on a global level, which statement best describes their relative contributions?

A. 
B. 
C. 

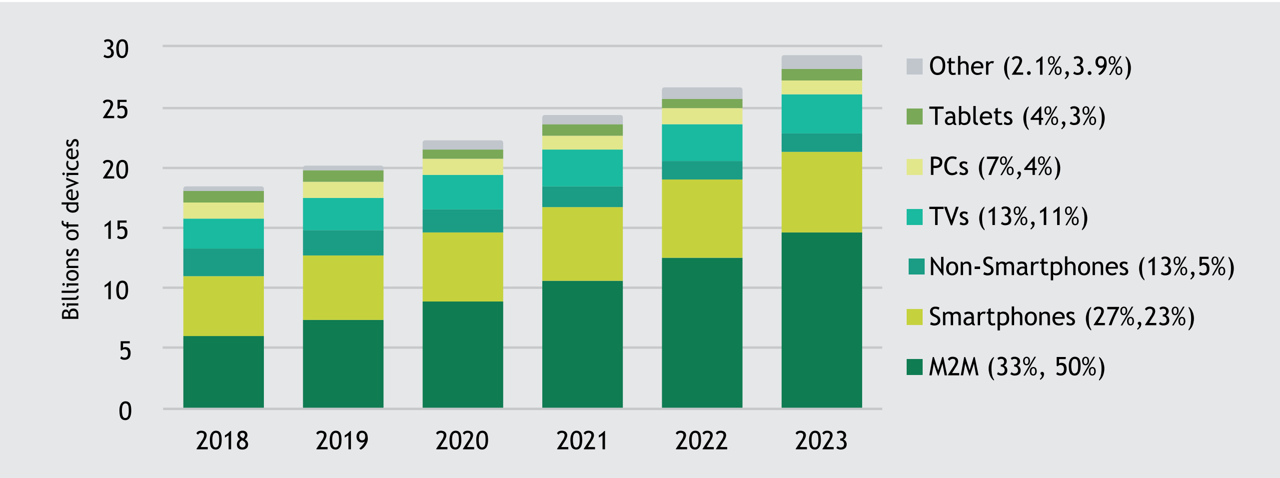
PROPOSED ANSWERS

In this training we will focus on the carbon footprint of digital devices. The environmental impact of digital devices can be expressed as a digital carbon footprint.
In 2020, the digital sector was responsible for around 1.5 billion metric tons of CO2 equivalent emissions, approximately **2 to 3%** of the global CO2 emissions *(Freitag et al., 2021, The Shift Project, 2019)*, which is the **equivalent of the entire aviation industry** *(Ericsson, 2020).*

SLIDE 11

Digital devices are electronic tools that use digital technology to perform a specific function.

In 2023, the most used digital devices by individuals were smartphones, tvs and computers for individuals *(Ninassi, INRIA, 2021)*. However, over half of used digital devices are M2M (Machine to Machine) which enable networked devices to exchange information and perform actions without the manual assistance of humans *(Cisco, 2023)*. M2M are direct connections between machines to transmit data, for example automatic saves between a computer or a server without the intervention of a person, GPS systems in cars, automatic distributors, tracking systems in shipping and manufacturing sectors, or medical applications making patient records and health status more readily available.



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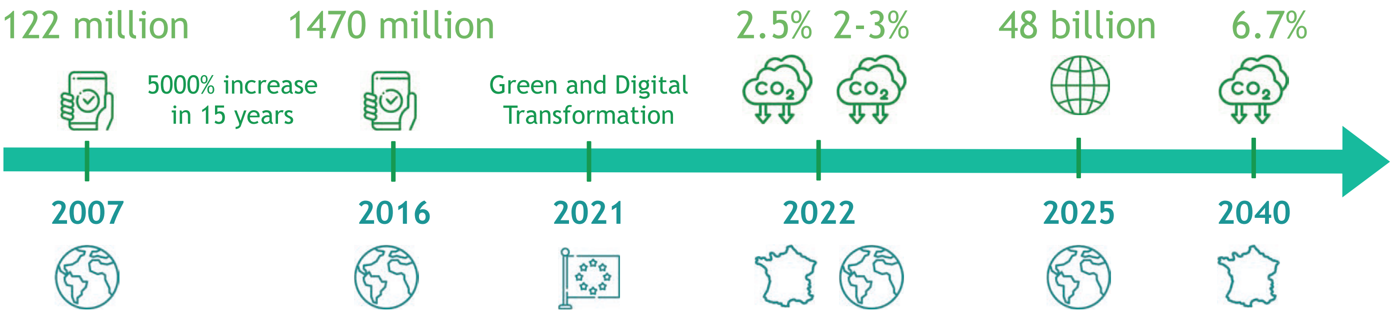
Digital devices are predominantly used in the ICT sector.

According to the OECD, the ICT (information and communications technology) or digital sector refers to a combination of manufacturing and services industries that capture, transmit and display data and information electronically. Here are a few statistics to raise awareness on the importance of the digital sector: the number of digital devices increased by **5000%** over the past 15 years *(ADEME, 2019)*.



To take the example of smartphones, its number increased from 122 million in 2007 to 1470 million in 2016 *(ADEME, 2017)*. The frenetic growth of smartphones is the fastest and largest but not an isolated phenomenon in the digital sector.
At this rate, it is expected that there will be over 48 billion digital devices by 2025 worldwide *(ADEME, 2019)*.
The use of digital devices represents 2.5% of the carbon footprint of France and is estimated to represent 6.7% of the french carbon footprint in 2040 (*ADEME and ARCEP, 2022)*.

The long-term consequences on the environment are still difficult to measure, especially with the growing integration of digital devices in our lives. To produce digital devices, 62.5 million tons of resources are extracted each year. Furthermore, digital devices represent 20 million tonnes of non-recyclable waste per year *(ADEME, 2022)*. The environmental impact of digital devices will be expanded further on in the training.

LEARNING OUTCOMES

- Learners understand the notions of climate change, carbon footprint and digital carbon footprint;
- Learners comprehend the environmental impact of the digital sector.

Section 0.2
Lifecycle of digital devices

OBJECTIVE

- Explain the lifecycle approach to digital devices.

Activity 3
The lifecycle of digital devices

Group work - 5 minutes

Tools: Participants use their notebook for this activity.

STEP 1 **Ask the questions to the participants.**

SLIDE **13** *In your opinion, what are the 5 stages in the life cycle of a digital device?*

SLIDE **14** *How much of total CO2 is going to production, use and recycling?*

PROPOSED ANSWERS

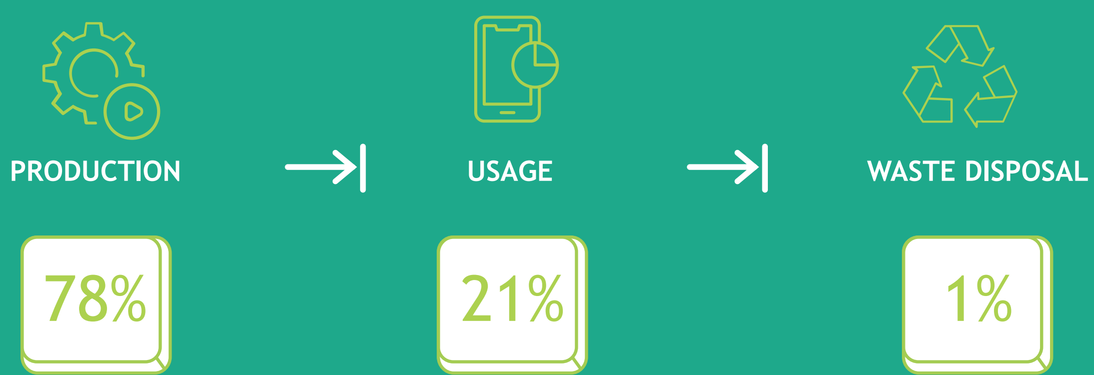
SLIDE **13**

To measure the quantifiable effects of digital products or services on the environment, we can use the life cycle assessment (LCA). This normalised evaluation method provides a framework to measure the environmental impact of any product. It is divided into 5 steps: raw materials extraction, manufacturing and processing, transport, usage and retail, and waste disposal *(ADEME, 2008)*. All these steps are considered when assessing the cumulative digital carbon footprint of individuals. To conduct an LCA, is it important to refer to the environmental management standards of the International Organization for Standardization (ISO 14040 and 14044), set a goal and scope, analyse the inventory through researching data,and analyse the results to identify the impacts. To tackle green digital transformation, it is important to consider the impact throughout the whole lifecycle: before (production), during (use by individuals), and after (e-waste) stages.

SLIDE 14

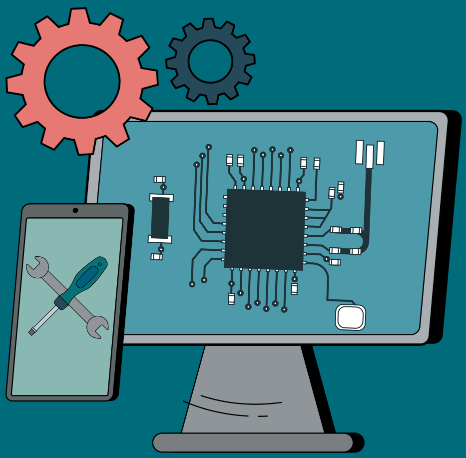
78% of the carbon footprint of the digital sector is being made during the production of digital devices, while usage accounts for **21%** of the digital carbon footprint *(ADEME, 2022)*. The remaining **1%** are mostly from waste disposal.

Disclaimer: Carbon emissions are one aspect of the impact that the digital sector can have on the environment. Throughout this training, digital carbon footprints will be used to demonstrate the impact of the sector on global warming. While it is a convenient measure to assess and illustrate the environmental impact of digital practices, reasoning only in carbon footprint may overshadow other important impacts of digital technology. For example, even though the disposal phase only accounts for 1% of the carbon emissions of the digital sector, unrecycled e-wastes can have a dire impact on biodiversity and health of populations (ADEME, 2019). Therefore, when addressing each phase, bear in mind that carbon emissions are not the only effects to consider and highlight.



LEARNING OUTCOMES

- Learners understand the notion of life cycle analysis;
- Learners understand the challenges of the environmental impact of digital technology.



MODULE 1

SLIDE 15

Production of digital devices

OBJECTIVE

- Explain the necessary steps and procedures to produce a digital device;
- Demonstrate how they affect the environment;
- Provide tips and solutions to prevent such impact.

Section 1.1
The impact of production

SLIDE 16

Stages to produce a digital device

Show the video to the participants:
Impact of the production of digital devices on the environment

To understand the environmental impact of the phase of production, it is important to assess its processes.

There are 5 distinct phases to the production of digital devices:
1. Conception,
2. Extraction and transformation,
3. Manufacture of components,
4. Construction,
5. Distribution.

The first phase - Conception - implies assembling approximately 70 raw materials for the development of a smartphone *(ADEME, 2021)*. Some of them include extremely rare materials such as Gold, silver, or tantalum. The conception of new technologies and devices is unlikely to diminish in the near future as the demand keeps growing. Recent statistics show that the renewal rate of smartphones remains extremely high in Western countries: an average French person changes their smartphone once every 2 or 3 years *(ADEME, 2023).*

The second phase - Extraction and transformation - is one of the most impactful phases of all. On average, it requires the removal of more than 200 kg of materials to extract only a few grams of usable minerals *(ADEME, 2023).* Extracting these materials therefore requires immense amounts of energy. Moreover, the process of mining these elements often involves multiple chemical treatments and purification methods, which often result in land and water degradation.

The third phase is the manufacture of components. There are more than 180 steps which are necessary to build electronic components *(ADEME, 2023).*

The fourth phase - Construction - implies a wide variety of materials and components. For a single laptop: 40% of its composition is made of plastic, 17% out of regulated components (batteries, incinerated condensers, etc), 15% printed circuit boards, 15% ferrous metals, 11.5 of non-ferrous metals, and 1.5% of other components *(ADEME, 2022).* There is 100 times more gold in a ton of smartphones rather than a ton of gold minerals *(World Economic Forum, 2019).*
The integration of digital devices in daily practice is a global phenomenon and a priority for most countries. Their production phases involve every continent in the world.
While most smartphones are conceptualised in the United States, most of the extraction and transformation of resources occurs in South-Est Asia, Australia, Central Africa and

South America. Once the raw materials are produced, components are manufactured in Asia, the US or Europe, to be assembled back in South-East Asia and then distributed all over the world *(ADEME, 2017)*.

According to the Sustainable Development Scenario (SDS), global demand for minerals could be multiplied by 4 by 2040. Given the exponential growth of production and use of digital devices, the sustainability of the digital sector remains its biggest challenge from a long-term perspective. The whole industry relies on (finite) primary resources that often imply heavy extraction processes *(Shift Project 2019, Kunkel and Matthess 2020)* that have multiple effects on the environment and societies.

SLIDE 17

Geopolitical and social impact

Heavy and internationalised processes of extraction of resources have consequences on multiple levels. In a report published by the International Renewable Energy Agency (2019), the intensive need for ressources extraction has pushed countries to focus even more on acquiring raw materials.
This phenomenon afflicts countries with vast resources like the Democratic Republic of Congo and creates a greater international dependency on China which possesses a considerable amount of resources and effective production chains.
As the global demand for minerals is likely to keep rising, it is likely to create disputes for nine metals: lithium, graphite, cobalt, nickel, manganese, rare earths, molybdenum, copper and aluminium *(Paillard, 2011)*.

Dependency on these resources have been the cause of multiple trade wars between geopolitical powers, and China is a decade ahead of the other leading countries involved *(Kalantzakos, 2019)*.
Extracting raw materials has become such an important target for global powers that Richard Auty, in 1993 used the term "resource curse" to describe countries with high-value natural resources and inadequate socio-economic, environmental and health development indicators. From 1970 to 2008, more than half of the global armed conflicts were related to high-value natural resources.
Three of the most violent wars of the 21st century in Africa were related to extractive industries *(Bartrem et al., 2022)*. Given the expected increased global demand for mineral resources for the making of digital devices, there remains a high risk that conflicts for such resources will amplify.

To focus on a specific example, around 70% of cobalt extraction originates from the Democratic Republic of the Congo. Within this, roughly 15-30% of cobalt production occurs within artisanal and small-scale mining companies, with the remainder sourced from large-scale mining operations *(World Economic Forum, 2020)*.
While the DRC stands as one of Africa's largest, wealthiest, and most strategically located nations, it simultaneously ranks among the least developed countries in Africa, exhibiting notably low scores on the 2019 United Nation Multidimensional poverty index (MPI) *(United Nations Development Programme, 2020)*.
Despite its rich resources and being considered as a very attractive country for foreign investors, the DRC fails to transmit these benefits to the country's population, and seems to be unable to lower its poverty levels.

Generalised poverty poses severe challenges to the working conditions within the population and especially in extraction mines, with workers having to extract cobalt in poor sanitation, security standards, and the widespread occurrence of child labour in the artisanal mining sector *(Beales et al., 2021)*.
While the human costs of resource extraction, like child labour and unsafe working conditions, are undeniable, the environmental impact of the production of digital devices has to be considered.
The very processes that disrupt communities and livelihoods can also severely damage ecosystems and natural resources.
This environmental degradation can have a ripple effect and even further limit the resources available for future generations and potentially threaten the health and well-being of the same communities struggling with the social consequences.

SLIDE
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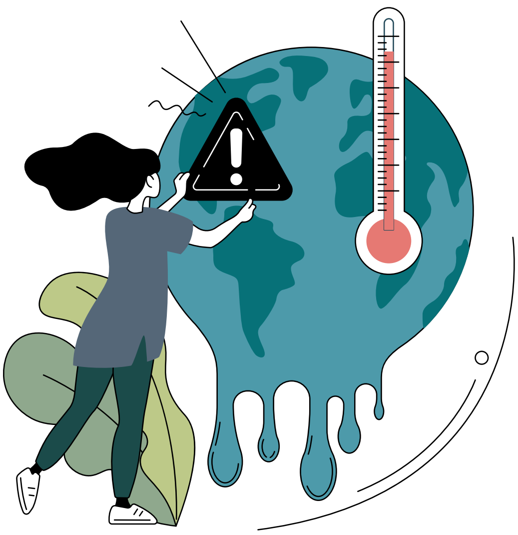
Environmental impact



Producing digital devices also contributes ac tively to biodiversity loss through activities like resource extraction, mining, and data centres construction, which can harm ecosystems and wildlife. It is estimated that over 60% of biodiversity has been lost in the past century and almost 30% of mammals are at risk of extinction today *(WWF, 2018)*.

Manufacturing of electronic devices requires intensive mining that leads to the exhaustion of natural resources through deforestation, soil erosion, water pollution, and the loss of biodiversity. It's estimated that 44% of all operational mines are located in forests *(World Bank, 2019)*, contributing to further environmental degradation.
Additionally, the production and assembly of electronic devices release pollutants into the air and water due to the use of chemicals, solvents, and other hazardous substances. These pollutants can contaminate soil and water sources, leading to health hazards for nearby communities.

Overall, extracting raw materials can cause disruption of ecosystems and loss of biodiversity by land-use, disruption of local water flows, pollution of the aquatic environment, polluting the local population with direct impact on health, drying out of water sources by dewatering mines, mineral pollution of the ecosystem, and mineral and dust pollution of the local population *(Beales et al., 2021)*.
The manufacturing of electronic devices is a water-intensive process. Data centres with several thousand servers can consume between 11 million and 19 million litres of water per day *(Hsu, 2022)*, which can lead to water shortages and pollution. This also affects aquatic life and human health.

The whole production process, by necessitating intensive mining and the transport of products across the world, is also the cause of massive carbon dioxide emissions having a severe impact on global warming. To take the example of the production of a laptop, a study conducted by researchers from Mc Master University in Canada found that manufacturing a typical laptop computer emits approximately 270 kg of $CO2$, which is equivalent to driving a car for about 1,600 km.

SLIDE 19

Activity 4
Carbon footprint of the production of my digital devices

Individual / group work - 15 minutes

Tools: Participants use their notebook for the activity

STEP 1 Brainstorming session

Ask participants: «How many digital devices do you own today?»
Encourage them to write down all the devices they can think of on sticky notes.

STEP 2

Ask participants to come forward one by one and place a sticky note with their name on it under the category corresponding to each device they listed. If the training is held online, add the number of devices owned by the participants in the table (slide 19).
This will create a visual representation of the collective digital device ownership within the group.

STEP 3 Categorise the devices:

SLIDE 20

Provide pre-written categories of devices with their associated carbon footprint for production *(ADEME, 2019)*

Digital device	Carbon footprint of their production	Number of devices	Calculate your footprint
Smartphone	39,07 kg CO2e	1	
Tablet	63,19 kg CO2e		
Laptop	156,24 kg CO2e	1	
Desktop	417 kg CO2e		
Gaming consoles and virtual reality headset	73,75 kg CO2e		
TVs and streaming devices	371,69 kg CO2e		
Wearable and smart home devices (speaker, smartwatch...)	10 kg CO2e	1	
Other (to add)			

STEP 4 Calculate the individual digital carbon footprint

Each participant calculates their individual digital carbon footprint by adding up the carbon footprints of the digital devices they own.

STEP 5

Calculate the collective digital carbon footprint

Calculate the digital carbon footprint of the group. Identify the most carbon heavy device for the group and compare it to individual results.

STEP 6

Discussion and reflection

Once everyone has participated, facilitate a discussion around the following questions:

- What surprised you about the collective number of devices represented here?
- Considering the information, we learned about the environmental impact of production, in your opinion what are some potential consequences of this high level of device ownership?

SLIDE
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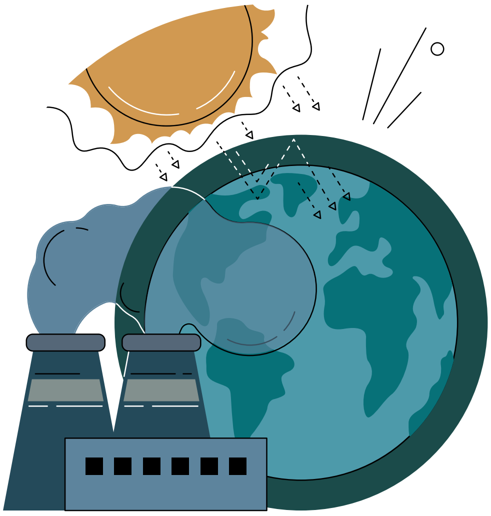
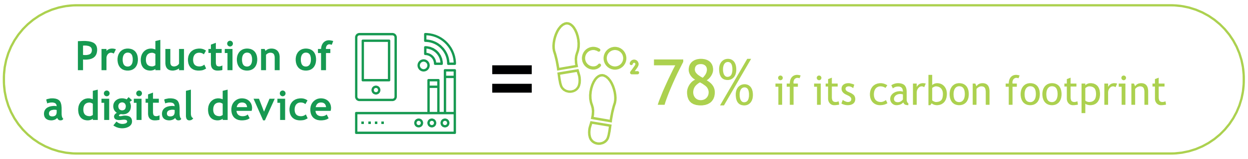
According to The Shift Project (2021), it is expected that greenhouse emissions of the digital sector will rise by 6% every year.



As global demand for digital technology is expected to keep rising in spite of its environmental impact, manufacturing more and more digital devices comes up against the limits of our planet.
It requires the use of non-renewable resources, i.e. resources whose use is increasing faster than the planet's capacity to renew them: oil and metals are non-renewable resources.
For example, smartphones need gold to be produced as it is a material that does not rust and is highly conductible.
This makes smartphones extremely precious devices as gold is the main source of value when they become e-waste. Overall, it is expected that 6% of the gold used globally is used for the digital sector *(Dedryver for France Stratégie, 2020)*.

What is true for smartphones can be applied to the digital industry as a whole. The digital world is not sober: new digital devices do not necessarily replace older objects, while new objects are created in addition to existing objects.
Smartphones do not replace all of our electronic equipment, but they rather come in addition to the connected television, the computer and its screen, the connected watch, and so on.
The miniaturisation of goods is not compensating for the increase in the volume and weight of products.
Demand for metals is exploding, while at the same time concentrations of metals in ores are falling *(french Senate information report, 2016)*.
Depending on the metal, this will inevitably increase the amount of energy and fresh water needed to extract it.

Overall as seen in the introduction, considering all stages of production, this is how the production phase of a digital device represents **78%** of its total carbon footprint.
Solutions exist to reduce the carbon footprint due to the production of digital devices.



SLIDE 22

Suggestions to reduce your impact

- Consider buying a device with a high repairability index (see Module 3);
- Buy second-hand/reconditioned devices instead of brand-new products;
- Taking precautions to maximise the lifespan of a digital device to avoid buying new ones (see Module 3);
- Choose repair over the purchase of a new device: If the device is less than 2 years old, the warranty is still effective. If not, manufacturer's after-sales service can provide repairing services or independent repairers can also be less expensive options. The last option (if the problem is not too serious) is to repair it directly by using online tutorials *(iFixit, SOSav, commentreparer.com)* or remote repair services *(pivr.fr...)*;
- Considering the usefulness of a device and avoid buying it if not necessary.

SLIDE 23

The 5 factors to consider before buying a device!

This method, created by Marie Duboin Lefèvre and Herveline Verdeken, is a quick and easy way to ask myself the right questions before buying *(ADEME, 2023)*:

- **Need -** What need does this purchase meet for me? If it's a need for comfort, change or recognition, buying something is probably not the best way to meet it.
- **Immediate -** Do I need it immediately? If not, I'll wait a few days before deciding.
- **Similar -** Do I already have something similar? If so, this could be just the thing.
- **Origin -** Where does the product come from? I check that it has been made responsibly.
- **Useful -** Will this product really be useful to me? If not, then I can certainly do without it...

1 NEED 2 IMMEDIATE 3 SIMILAR 4 ORIGIN 5 USEFUL

LEARNING OUTCOMES

- Learners understand how digital devices are produced;
- Learners understand the geopolitical, social and environmental impact of the production phase of a digital device;
- Provide best practices to support them in reducing their digital impact on the environment.

MODULE 2

Daily usage of digital devices

SLIDE 24

Section 2.1
The integration of digital devices

OBJECTIVE

- Explain how much and to what extent digital devices are integrated within our daily lives;
- Raise awareness on the impact on the environment of the usage of digital devices.

SLIDE 25

Digital devices ownership of internet users

The prevalence of digital devices in contemporary society is undeniable, with a majority of individuals incorporating them into their daily lives. Among digital devices, the smartphone overwhelmingly dominates as the most utilised digital device.

According to ADEME (2017), 7 billion smartphones have been sold in the world since 2007, and sales grow each year. Smartphones are the most sold digital devices in the world, and the demand for such products keeps growing. In 2023, more than 97.6% of the global internet users from age 16 to 64 possessed smartphones *(DataReportal, 2024).*

Below is an enumeration of the most favoured digital devices on a global scale:

1st - Smartphone:	97.6%
2nd - laptop or computer:	57.7%
3rd - Tablet device:	30.9%
4th - Smartwatch:	30.1%
5th - Game console:	19.1%
6th - TV streaming device:	15.7%

SLIDE 26

Internet usage in the world

With the supremacy of smartphones, the global number of internet users has been increasing over years. A total of 5.35 billion people around the world were using the internet at the start of 2024, equivalent to 66.2 percent of the world's total population.

This represents a 1.8% growth in comparison to 2023's numbers *(DataReportal, 2024).*

Nonetheless, significant disparities persist between regions. Asia emerged as the leading continent in terms of online user population, exceeding 2.93 billion users, followed by Europe with approximately 750 million internet users while North Korea reported very few internet users, ranking at the bottom *(Petrosyan, 2024)*.

Looking at internet usage through a gendered perspective, in 2022, 63% of women were internet users which is six percentage points less than men *(Petrosyan, 2024)*. This indicates persistent obstacles limiting women's access to digital devices. Economic factors also play a considerable role in differences in access to the internet. 92% of the population in high-income countries reportedly use the internet, compared to only 26% in low-income countries *(Petrosyan, 2024)*.

Despite these disparities, internet usage remains prevalent on a global scale, continuing to expand each year.

SLIDE 27

Activity 5
Usage of digital devices

Group work - 5 minutes

Tools: Participants use their notebook for this activity.

STEP 1

Ask the questions to the participants

- How useful are digital devices in everyday life?
- Why do we use digital devices?
- What do digital devices enable us to do?

STEP 2

Make a list of the diverse usage of digital devices according to the participants' responses.

STEP 3 **Encourage learners** to share their thoughts and experiences regarding the purposes and roles of digital devices in their lives.

PROPOSED ANSWERS

To realise the prevalence of digital devices in our contemporary society, it is important to recognise and list every possible usage of digital devices. The main categories of digital devices' usage are:

- **Communication**

  Social media platforms, Email and messaging apps, Video conferencing tools;
- **Entertainment**

  Video games, Streaming video and music, TV, radio, e-books, etc;
- **Productivity**

  Office suites (e.g., Microsoft Office, Google Workspace), Project management tools, Note-taking apps, Cloud storage, file management, remote work;
- **Research and data analysis**

  Data analytics and visualisation tools, Scientific simulations and modelling software, Research collaboration platforms;
- **Learning and Information**

  Web browsing, Search engines, Online databases and libraries, Educational resources, Online courses and e-learning platforms, Virtual classrooms and webinars, Language learning apps;

- **Trade**
  online shopping, banking, stock exchange, retail and food delivery apps;
- **Navigation and location**
  GPS and navigation apps, Location-based services, Mapping and route planning tools;
- **Creativity**
  Photo and video editing software, Graphic design tools, Music production software, 3D modelling and animation software, content creation;
- **Health and well-being**
  Fitness tracking apps and devices, Health monitoring (e.g., heart rate monitors), Telemedicine and health apps;
- **Safety and Security**
  Security cameras and monitoring systems, Antivirus and cybersecurity software, Password managers.

Being used in every category of daily lives, digital devices are intrinsically linked to the way of life of most individuals. This wide range of digital devices' usage shows how much the world is now dependent on digital devices to function. It is not only individuals who constantly reach for digital devices but also structures and institutions. The diversity of use and versatility of digital devices reinforce their necessity nowadays, and it is important to reflect on this issue to use and consume digital devices more sustainably.

LEARNING OUTCOMES

- Learners are aware of the diversity of use for digital devices, and their versatility;
- Learners understand the wide range of purposes digital devices serve in their lives to realise how prevalent it is in our society.

Section 2.2
How usage has an impact on the environment

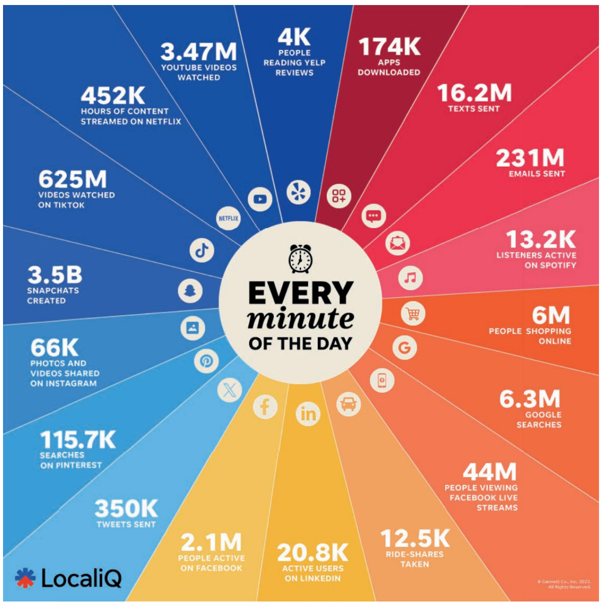
OBJECTIVE

- Explain individual digital environmental impact by focusing on how we use devices.

SLIDE
28

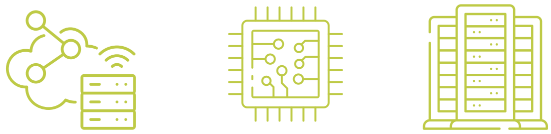
Show the infographic.

It represents usage of digital devices every minute across the world.



SLIDE 29

Usage of digital devices



Even though it is imperceptible, using digital devices has consequences on the environment and often implies mobilising a wide variety of actors and intermediaries.
When using their digital devices, users connect to an intertwined network of actors that they mobilise to access features that digital devices can offer. Digital devices can only be fully functional when they work with humans, softwares and hardware resources required to provide a service.

For example, sending emails, watching videos on a streaming platform, performing high-performance calculations, carrying out financial transactions, displaying a web page, require the mobilisation of multiple intermediaries that are all interdependent to one another and make the device fully functionable.

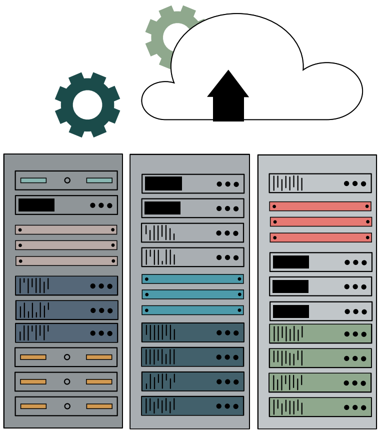
Generally, digital devices rely on *(Club Green IT, 2018)* :

- Softwares,
- Hardwares,
- Infrastructures,
- Other digital services operated by a variety of players (human resources, network and service operators, Internet service providers, users, …).

At the core of this ecosystem lie the requisite softwares and hardwares, essential components for the functionality of any digital device. These elements, while often unnoticed by users, demand substantial energy and resources for development, manufacturing, and ongoing maintenance. The production of hardware components involves extensive mining of raw materials, energy-intensive manufacturing processes, and transportation networks, all of which leave a substantial carbon footprint.

SLIDE 30

The infrastructures supporting digital functionalities, including data centres, servers, and networking equipment, require vast amounts of energy for operation and cooling.



One type of infrastructure that requires the most energy is data centres. Data centres are used to process, organise, secure and store computer data. To fully function, they are composed of a network, storage areas and computing servers. Data centres are dedicated physical infrastructures which house the crucial applications and data of various organisations. Data centres play a vital role in the day-to-day running of businesses and individuals, hosting large quantities of essential data that is vital to their activities *(DATA4, 2023)*.
Data centres have a continuous need for electricity as they operate 24/7. As they process the constant flow of data, data centres also generate colossal streams of heat that need to be abated to prevent the equipment from malfunctioning. Therefore, they require massive cooling systems. In total, data centres consume 1% of the global electricity demand, contributing to 0.3% of all global CO_2 emissions *(DATA4, 2023)*.
The environmental impact of data centres is important to consider when measuring the environmental impact of digital devices, as they are necessary to their usage.
Additionally, the interdependency of various players within the digital ecosystem, such as human resources, service operators, and internet providers, further amplifies the environmental impact through increased resource consumption and emissions associated with their activities.

By taking a look at the life cycle of a digital service itself, from the design phase to the end-of-life phase, it appears clear that it is a complex mechanism that involves multiple intermediaries.
At each of these stages, human and material resources are mobilised, each with its own life cycle, from the extraction of natural resources to distribution, use and end of life.

Many more actors could be added depending on the type of digital service that needs to be developed. This list clearly shows the diversity and multiplicity of the chain of structures, individuals and machines that need to be brought together to have a digital service running effectively. This shows how interdependent the digital sector is, and how collective the ideal of responsible digital is.

SLIDE
31

Activity 6
Impact of the usage of digital devices

Individual/pair work - 15 minutes

Tools: Participants use their notebook for the activity

The different uses of digital devices can be evaluated by using the digital carbon footprint. Even though it does not, in terms of environmental impact, to a distance covered by a light-weighted car.

STEP 1 **Divide participants into pairs.**

STEP 2 **Ask each pair to match each digital action** with the average corresponding CO_2 emissions equivalent to the distance travelled by car.

The digital actions are as follows:

- Sending and receiving 100 emails (without attachments);
- Printing 10 double-sided pages;
- Storing a downloaded series comprising 10 one-hour episodes in the cloud;
- Conducting internet research for 1 hour daily over the span of a week;
- Spending 1 hour on social media each day for a week;
- Watching a one-hour episode of a series daily for a week.

PROPOSED ANSWERS

According to the European Environment Agency (EEA), the average CO_2 emissions from new passenger cars registered in the European Union (EU), Iceland, Norway and the United Kingdom (UK), in 2019 was **122.4 grams per kilometre (g/km).** However, it's important to note that this figure may vary depending on the specific brand and model of the car, as well as driving conditions and habits.

Here are the correct answers:

- Storing in the cloud a series comprising 10 one-hour episodes = 410 m;
- Printing 10 double-sided pages = 530 m;
- Conducting internet research for 1 hour daily over the span of a week = 3.143 km;
- Watching a one-hour episode of a series daily for a week with wi-fi = 3.148 km;
- Sending and receiving 100 emails (without attachments) = 3.3km;
- Spending 1 hour on social media each day for a week = 4km.

LEARNING OUTCOMES

- Learners understand the prevalence of smartphones (and other devices) in the digital sector;
- Learners grasp how usage mobilises a wide variety of actors that are interdependent to make the whole digital industry functional and effective;
- Learners understand how usage of digital devices can have an environmental impact, in terms of CO2 emissions.

Section 2.3
The impact of my daily usage

OBJECTIVE

- Explain how individual usage can have an impact on the environment;
- Provide advice to learners on how to reduce the environmental impact of their practices.

When evaluating the environmental repercussions of daily digital device usage, four particular behaviours emerge as the most impactful.

SLIDE
32

Video streaming stands out as the most energy-intensive and environmentally impactful digital activity.

Videos constitute 80% of the world's usage of web data, with video on-demand platforms such as Netflix and Amazon Prime accounting for 34% of videos and 7% of the digital carbon footprint of the digital sector. 27% of data used originate from adult content streaming platforms which contributes to 5% of the digital carbon footprint. An additional 21% of videos are general audience content predominantly hosted on streaming platforms like Twitch, YouTube, or Dailymotion, representing 4% of the total digital carbon footprint of the digital sector. And finally, social media platforms and other websites hosting videos account for 18% of overall data used to stream videos, representing 4% of the digital carbon footprint. The remaining 20% are used for live videos on platforms like Skype, telemedicine, video surveillance, and other sources *(ADEME et al., 2022)*. Streaming a video requires more energy than watching a downloaded video as it mobilises several equipment to run: Multiple servers, one or several devices at home (screen, computer, tablet, wireless router, etc), and all this stream of data needs to be mobilised again if you want to watch the video again.

SLIDE
33

Social media usage represents over 5% of global internet traffic and is the second most environmentally impactful digital habit.

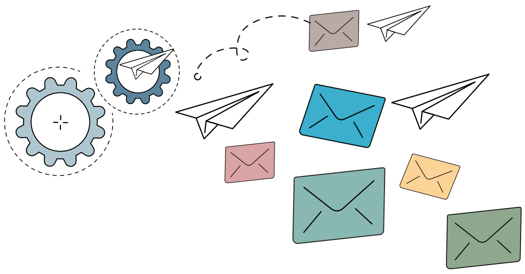
According to a report by Global WEb Index in July 2021, the average time spent on social networks per day is 2 hours and 24 minutes *(Derudder, 2021)*.
The ability to share content among users contributes significantly to environmental impact. The most data consuming content is videos. Metadata, including geolocation and internet activity data stored in data centres, as well as advertisements further exacerbate the environmental footprint of social media.

When an individual uses TikTok daily for at least 52 minutes, 49 GB of data are consumed *(Derudder, 2021).*

For instance, Facebook witnesses the daily sharing of 350 million photos and viewing of 8 billion videos. With 2.4 billion active users, Facebook emits an estimated 645 million tons of CO2 annually *(ADEME et al., 2022).*

SLIDE
34

The use of email inboxes ranks as the third most polluting digital action.



Each email, especially those with attachments, travel large distances across data centres, resulting in significant carbon emissions. According to ADEME (2022), an email travels approximately 15,000 KM before reaching its recipient. The carbon footprint of a single email is approximately 4 g of CO2e and can go up to 50g of CO2e with attachments.
Multiplying this impact by the vast number of emails sent globally–293 billion daily, 75% of which are spam–illustrates the environmental burden of emails.
According to ADEME, the world's email traffic generates approximately 90,000 tons of CO2e every day. This is even more alarming as the number of emails sent per day worldwide is expected to rise to 347 billion in 3 years *(ADEME et al., 2022).*

SLIDE
35

Internet research is the fourth most environmentally impactful digital habit.

This is primarily due to the resource-intensive operations of internet search engines, which necessitate the mobilisation of numerous data centres. 1 year of internet research is equivalent to an electricity consumption of 365 kWh, which corresponds approximately to a distance of 1,400 km travelled by car *(Energuide, 2020).*

SLIDE
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Activity 7
Good digital habits

Individual / Group work - 15 minutes

STEP 1

Divide participants in 4 groups, one for each digital action.

STEP 2

Ask each group to write down ideas on how to reduce the negative environmental impact of their usage of digital devices.

STEP 3

The facilitator gives each group the checklist below (without answers).

STEP 4

Each group associates the correct gesture to their digital action and adds their ideas, if not mentioned already.

STEP 5

Each group presents their field of action.

PROPOSED ANSWERS

Present the right answers on the slide. Learners may initially feel daunted by the prospect of making changes to reduce their digital carbon footprint. It is imperative to offer encouragement by emphasising that even small steps are much preferable and impactful than inaction.

Show the video to the participants:
eGreen - Video WP3

Suggestions to reduce your impact
(ADEME et al., 2022)

SLIDE 37

For streaming videos

- Reducing video quality;
- Utilising Wi-Fi instead of cellular data;
- Deactivating auto play features on streaming platforms.

SLIDE 38

For social media usage

- Exercising restraint in scrolling time;
- Being mindful about the content shared online;
- Deactivate notifications.

SLIDE 39

For email management

- Deleting sent emails and spam regularly;
- Installing anti-spam software;
- Unsubscribing from newsletters that are not read;
- Targeting recipients carefully when sending an email;
- Minimising group emails;
- Limiting the transmission of large files.

SLIDE 40

For internet research

- Navigating directly to desired websites rather than using search bars;
- Using concise keywords in searches;
- Bookmarking frequently visited sites;
- Utilising environmentally conscious search engines such as Ecosia, Ecosearch, or Lilo.

LEARNING OUTCOMES

- Learners understand the impact of digital usage on the environment;
- Provide best practice to support them in reducing the impact of their digital practices.

MODULE 3

SLIDE 41

End-of-life of a digital device

Section 3.1
Recycling digital devices

OBJECTIVE

- Provide an overview of the environmental and social impact of E-waste;
- Explain how recycling of digital devices works and why it is not as developed as it should be.

SLIDE 42

E-waste

Electrical and electronic waste, or E-waste, refers to electrical or electronic equipment that is waste, including all components, subassemblies and consumables that are part of the equipment at the time the equipment becomes waste *(UNEP, 2019 in UNDRR, 2023)*. According to the Global E-waste Statistics Partnership (GESP) e-waste volumes have grown by **21%** in a period from 2014 to 2019, when 53.6 million metric tonnes of e-waste were generated. In 2019 e-waste weighed as much as **350 cruise ships** placed end to end to form a line **125 km** long.

According to the most recent GESP estimates, all the unrecycled e-waste often ends up illegally dumped, mainly to low- or middle-income countries, where it is recycled by informal workers *(World Health Organisation, 2021)*.

E-waste contains valuable materials, which make efficient material recovery and recycling of e-waste extremely important for economic value, for environmental and human health. According to the joint report by the PACE and the UN e-waste Coalition *"A New Circular Vision for Electronics – Time for a Global Reboot" (World Economic Forum, 2019)*, the improper handling of e-waste is resulting in a significant loss of scarce and valuable raw materials, including precious metals such as neodymium (vital for magnets in motors), indium (used in flat panel TVs) and cobalt (for batteries).

Neodymium | Indium | Cobalt — **LOSS OF VALUABLE MATERIALS**

From 2014 to 2019: 21% growth of e-waste

2020: Worldwide e-waste = 350 cruise ships in a 125km line

SLIDE
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Environmental impact of e-waste

Every year, millions of tonnes of e-waste are disposed of and treated using environmentally unsound techniques. These resources often end up stored in homes and warehouses, dumped, exported or recycled under inferior conditions.
When e-waste is treated using unsafe techniques and materials, it may produce the release of more than 1000 different chemical substances into the environment. This can include extremely harmful neurotoxicants such as lead to which pregnant women and children are particularly vulnerable due to their unique conditions and their developmental status *(World Health Organisation, 2023)*.

Although efficient material recovery and recycling of e-waste is reducing the world's energy consumption, when done unsafely, it can leave a mark on workers and population living near the recycling centres *(Circular Tech, 2022)*. For example, open-air burning and acid baths, being used to recover valuable materials from electronic components, release toxic materials into the environment.

These practices can expose workers to over 1,000 harmful substances which can lead to irreversible health effects, including cancers, miscarriages, neurological damage and diminished IQs *(World Health Organisation, 2021)*.

SLIDE
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Recycling e-waste

Recycling e-waste remains a highly important challenge as only **17%** of the world's e-waste is effectively recycled and that the e-waste industry is expected to grow by 75 million tons by 2030 *(World Health Organisation, 2021)*.

These numbers reflect that recycling e-waste should become a priority for the digital industry as disparities among regions are staggering.

For example, France recycles **77%** of its e-waste, while the US recycles less than 20%.
In the meantime, The United States, along with a number of economically developed countries, ships the majority of its e-waste across seas to economically developing countries.
It is estimated that these countries ship between 10 to **25%** of their e-waste to countries such as Guatemala, Paraguay, Panama, Peru, Mexico, etc *(Forti et al., 2018)*.

17% of e-waste recycled in 2019 in the world

77% of e-waste treated and recycled in france

The us ships **25%** of its e-waste abroad

SLIDE
45

Activity 8
E-waste management

Group work - 20 minutes

STEP 1

Show the video to the participants:
https://www.youtube.com/watch?v=JX-DrIvShZKU

STEP 2

Divide participants into small groups (3-4 people).
Present the following scenario: Imagine you are cleaning out your room and come across a box of old electronic devices you no longer use. These could include old phones, chargers, headphones, or other gadgets.

STEP 3

Ask each group to discuss and answer the following questions:
1. What are the different options available for disposing of these e-waste items in your community? (e.g., throwing them away, recycling, donating)
2. What challenges might you face in responsibly disposing of your e-waste?

STEP 4

Brainstorming solutions:
Each group brainstorms and lists down potential solutions and individual actions that can promote responsible e-waste management.

STEP 5

Sharing and discussion:
Each group presents their list of challenges and solutions to the larger group. Facilitate a discussion about the different perspectives and encourage participants to share their own experiences and knowledge about e-waste management.

PROPOSED ANSWERS

There are currently no worldwide, EU-wide or fully harmonised options to dispose and effectively recycle. It is up to each local community to develop options to dispose of e-waste sustainably and encourage recycling. Recent EU laws incentivised municipalities to take care of the disposal of digital devices. Individuals are advised to contact their local landfills and check whether they can dispose of their digital devices there.

A variety of challenges regarding the disposal of digital devices can be experienced such as limited access to recycling facilities, lack of awareness about proper disposal methods, etc.

SLIDE
46

To counter these obstacles, a solution is to research and utilise available e-waste collection and recycling facilities in your local area.

Such facilities can be:
- Supermarkets,
- Dedicated stores,
- Online shops may offer to recollect devices in exchange for money, or to recycle for free.

Even if our societies achieve much better recycling habits, the recycling rate for ICT metals remains low: less than 50% for more than half of them, and less than 1% for some.
Therefore, recycling does not cover 100%

of our raw material needs, without counting losses during melting.
In any case, 100% coverage of our needs is not possible in a context where the demand for materials to manufacture our equipment continues to grow *(Grosse, 2018).*
Recycling has to be adopted along with all the other practices pertaining to production and usage of digital devices.

LEARNING OUTCOMES

- Learners understand the challenges posed by the impact of E-waste on the environment and the importance of its management;
- Learners understand the importance of recycling e-waste and how they can recycle their devices.

Section 3.2
Disposal of digital devices

OBJECTIVE

- Raise awareness on reparability and obsolescence;
- Inform learners about the various types of obsolescence;
- Highlight on-going initiatives trying to tackle obsolescence and facilitate reparability.

SLIDE **47**

Activity 9
Effects that accentuate the disposal of digital devices

Individual/Group work - 15 min

Tools: Participants use their notebook for the activity

STEP 1 Connect each definition with the right explanation

- What is functional obsolescence?
- What is psychological obsolescence?
- What is planned obsolescence?
- What is irreparability?

PROPOSED ANSWERS

Remind participants to write down important facts in their notebook!

- What is **functional obsolescence?** A product that no longer meets new expectations for technical (e.g. incompatibility with new equipment), regulatory and/or economic reasons.
- What is **psychological obsolescence** ? When a product no longer meets the needs of users who wish to acquire a new model due to a change in functionality or design.
- What is **planned obsolescence** ? A strategy through which the standard lifespan of a device is deliberately reduced from the design stage for economic reasons.
- What is **irreparability**? Devices that are designed in ways that make them difficult or impossible to be repaired. For instance, soldering major components together to make upgrades and repairs impossible.

The increasing number of disposed digital devices can be in part explained by different phenomena: functional and psychological obsolescence, retrievability and irreparability.

SLIDE 48

Functional obsolescence: Product that no longer meets new expectations for technical (e.g. incompatibility with new equipment), regulatory and/or economic reasons.

The rise of smartphones exemplifies this challenge. Since the early 2000s, smartphone technology has witnessed exponential growth, with new models with superior features, faster processing power, and improved functionalities. This rapid evolution makes older models functionally obsolete even if they remain physically usable. As a result, a significant portion of smartphones become outdated within a short period. In France alone, over 113 million unused smartphones lie dormant in households, highlighting the scale of this issue (SOFIES et al., 2019). Functional obsolescence raises concerns about e-waste and recycling as 63% of smartphones in use are less than two years old, indicating a trend towards frequent upgrades and discarding of old functional devices. This effect also raises questions about the sustainability of our current consumption patterns.

SLIDE 49

Psychological obsolescence: When a product no longer meets the needs of users who wish to acquire a new model due to a change in functionality or design.

The phenomenon of psychological obsolescence creates a sense of urgency or desire for the latest product, even if the current device is still functional and relevant. It operates more on the level of consumer perception and desire. That is why this strategy is not limited to the technology itself but is part of a marketing strategy including marketing campaigns and events that build anticipation for new products.

"Big data companies" are often cited as examples of businesses that contribute to the phenomenon of psychological obsolescence (Spinney et al., 2012). New versions of their products are released annually with upgraded features and latest innovations.

SLIDE 50

Planned obsolescence: A strategy through which the standard lifespan of a device is deliberately reduced from the design stage for economic reasons.

This strategy is suspected to be used in the technology sector, where devices like smartphones and computers are frequently updated with software updates and/or new models, even if the older ones are still functional. The replacement cycle therefore reduces drastically, and prevents consumers from guaranteeing, durable lifespan for their digital devices.

Combating planned obsolescence requires understanding and tackling all forms of obsolescence. Three main stakeholders can generate change:

- Consumers can make informed choices by opting for products with longer lifespans and repairability options;
- Companies should be incentivised to build devices that last longer, that are repairable easier and inform consumers on how they should be repaired;
- Policymakers also have a role to play by setting objectives and regulating such practices. A recent example is that France has officially defined planned obsolescence (Article L. 213-4-1 du code de la consommation) and recognised it as an offence that may lead to prosecutions.

SLIDE 51

Irreparability: Devices that are designed in ways that make them difficult or impossible to be repaired. For instance, soldering major components together to make upgrades and repairs impossible.

Mainstream smartphone manufacturers do not necessarily provide publicly available replacement parts, making it difficult for users to repair their devices themselves or through third-party services. Additionally, even though EU regulations enforces a 2 year warranty on all digital devices, warranty terms of devices do not necessarily cover repairs for issues considered as normal fatigue and that can lead to a cycle of device replacement rather than repair.
To tackle this issue, measures have been implemented by national / European governments. In 2021, the French government issued a repairability index (a similar index will be implemented within the EU) that highlighted the following factors to measure the repairability of a device:

- Availability of documentation,
- Ease of disassembly of the product,
- Availability of spare parts,
- Price of spare parts,
- Specific criteria of the product (smartphone, computer, tablet, etc).

https://monindicedereparabilite.fr/home
An EU wide index is to be introduced in 2025 to inform the public about the repairability of a device and its lifespan performances.

SLIDE 52

In 2023, the EU parliament voted on two regulations (Lex-Europa, European Commission) aiming to extend the lifespan of smartphones and tablets by establishing several rules that will be enforced in June 2025.

Both regulations aim to incentivise the production of eco designed smartphone and tablets, as well as a harmonised labelling:

- These devices should have better resistance to accidental drops or scratches, protection against dust and water;
- The use of batteries that are sufficiently durable. Batteries must withstand at least 800 charge and discharge cycles while retaining at least 80% of their initial capacity;
- Rules on disassembly and repair, including the obligation for producers to make essential spare parts available to repairers within 5 to 10 working days, and up to 7 years after the end of sales of the product model on the EU market;
- Availability of operating system upgrades for longer periods: for at least 5 years after the product is placed on the market;
- Creation of an EU-wide energy labelling for smartphones and tablets;
- All smartphones and tablets in the EU will have to show a repairability index.

LEARNING OUTCOMES

- Integrating the concepts of functional, psychological, and planned obsolescence, as well as retrievability and digital moderation;
- Learners understand how to avoid falling into the pitfalls of such effects.

Section 3.3
Extending the lifespan of digital devices

OBJECTIVE

- Raise awareness on bad habits that may reduce the lifespan of digital devices;
- Provide tips and methods to preserve digital devices and extend their lifespans.

SLIDE **53**

Activity 10
Maintenance of digital devices

Group work - 15 minutes

STEP 1 Divide participants into small groups (3-4 people).

STEP 2 Ask each group to discuss and answer the following questions:

- How to take care of your digital device to extend its lifetime?
- Smartphone,
- Tablet,
- Laptop,
- TV / monitors,
- Smartwatches.

In case you need to get the discussion started, start by asking the following sub-questions:

- In your opinion, why is taking care of your device important?
- When was the last time you had to change a device?
- What was the reason why you changed it?

STEP 3 Brainstorming solutions

each group brainstorms and creates a maintenance checklist for each device.

STEP 4 Sharing and discussion:

each group presents their checklists to the group.
Facilitate a discussion about the different perspectives and encourage participants to share their own experiences and knowledge about the maintenance of digital devices.

PROPOSED ANSWERS

SLIDE **54**

The list contains best practices to implement to extend the lifespan of digital devices *(ADEME, 2023 in Guide Longue vie aux smartphones)*

- **Prevent overheating and damages**

If the device is portable, it is recommended to equip it with a hull or case, and glass to protect it from knocks and scratches. There are also waterproof cases for high-risk activities (water sports, DIY, etc.). Additionally, it is important to remember that devices are extremely sensitive to heat. Smartphones, tablets, or computers should not be left in direct sunlight or near electromagnetic waves (e.g. from microwaves). During hot weather, in case a device overheats after using the GPS or playing with it for too long, it is important to give it time to cool down.

- **Clean your devices**

To clean a device with a screen, it is necessary to use a microfiber cloth or a glasses cloth. It should be avoided to use alcohol or detergent in any case. For computers, it is crucial to clean out vents regularly to avoid them being blocked by dust and cause overheating. Anti-dust spray or a mini hoover plugged into your computer's USB port will help to eliminate dust and other debris stuck in the keys and air vents. To remove stains, it is important to use a microfiber cloth.

Maintenance should also be done carefully with the data: contents of devices should be cleaned out every month by deleting unnecessary apps and files, and transferring photos and videos to an external hard drive. From the beginning of the life of a device, it is crucial to clear any unnecessary data (downloads, history, cookies, etc.). At least 20% of free space is the guarantee of the optimal performance of a device.
Maintenance of smartphones is estimated to reduce by 40% the chances of breakdown of a device.

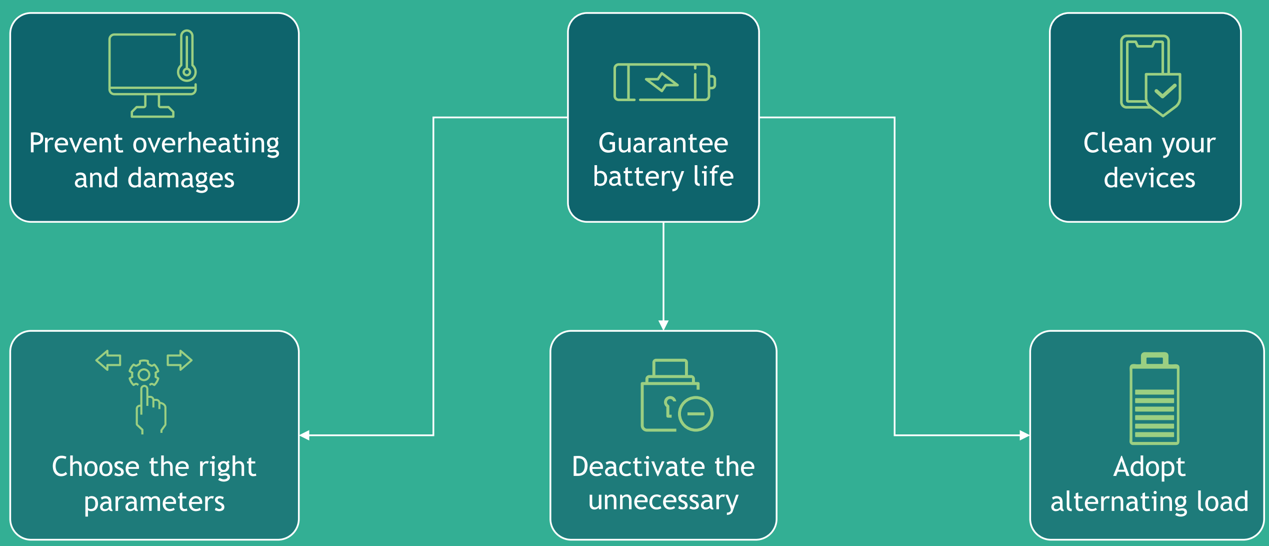
- **Guaranteeing battery life**

- Choosing the right parameters
Using Energy-saving modes (brightness reduction, automatic sleep mode, etc.) can reduce the impact of intensive use on a battery. Wifi is also always a better alternative than 4G, as it is 3 times more energy-consuming.

- Deactivating the unnecessary
Features that consume battery constantly should be turned off: geolocation notifications, background applications in the background, automatic updates and downloads, etc. At night, Aeroplane mode should be turned on, or switching off the device completely can be a solution.

- Adopting alternating load
ADEME researchers advise to keep the battery of a device between 20 and 80%. It is not recommended to wait until the phone is flat or to charge it overnight. It is also very important to use the original charger intended for the device.

Extend the lifespan of digital devices



SLIDE
55

If, despite all precautions, the smartphone stops working, it is important to implement environmentally friendly practices regarding the disposal of digital devices

- Disposing of digital devices only when they are unusable and irreparable;
- Finding recycling options for devices no longer in use;
- Upcycling unused digital devices when possible.

SLIDE 56

Suggestions to reduce your impact
(ADEME, 2017)

Preserve devices as long as possible

Repair devices

Buy reconditioned devices

Donate devices

Avoid second screens

Switch off unused devices

Disable notifications, synchronisation, high-resolution streaming

Regularly clear data

Work from home

Guarantee battery life

1. Preserving digital devices (computers, mobile phones, games consoles, etc.) for as long as possible avoids manufacturing new ones. Keeping a computer for 4 years rather than 2 reduces its impact by 50%.
2. Similarly repairing devices instead of buying a new one avoids producing new devices.
3. Buying a reconditioned phone rather than a new one can reduce environmental impact by up to 90% and avoids the extraction of 82 kg of raw materials per year.
4. Donating digital devices or selling them if they are still working. If out of order, it has to be recycled or donated. Today, only 5% of phones are collected for recycling, even though they contain precious materials.
5. Second screens when working, screens in waiting rooms or stores can be avoided.
6. Switching devices off completely as soon as they are no longer in use, at home or at the office will enable energy savings and environmental benefits as well.
7. Lowering the resolution of streaming videos, deactivating notifications and automatic video playback, disabling automatic synchronisation with cloud services, conducting meetings using audio rather than video are all gestures that can have lessened the impact of digital devices.
8. Maintenance should also be done carefully with the data : contents of devices should be cleaned out every month by deleting unnecessary apps and files, and transferring photos and videos to an external hard drive. From the beginning of the life of a device, it is crucial to clear any unnecessary data (downloads, history, cookies, etc.). At least 20% of free space is the guarantee of the optimal performance of a device.
9. By working from home, we contribute to reducing the volume of travel by 69% compared to a day spent at the workplace. And that's no mean feat when you consider the impact of commuting on the environment, both in terms of greenhouse gas emissions and air quality.
10. See content "Guaranteeing battery life".

LEARNING OUTCOMES

- Learners understand how to extend the lifespan of digital devices
- Learners gain practical tips to keep steady maintenance and expand the lifespan of digital devices at best

RECAP

QUIZ

SLIDE 57

Activity 11: QUIZZ

Individual work - 15 minutes

STEP 1

The facilitator presents the quiz to the participants who answer the questions.

1. In 2019, approximately how many smartphones were sold worldwide?

A. 500 million
B. 750 million
C. 1 billion
D. 1.5 billion

Answer: C.

2. During the production phase of a digital device, which step requires the excavation of 200 kg of minerals?

A. Conception
B. Extraction and transformation
C. Manufacture of components
D. Construction

Answer: B.

3. From production to distribution, how much does a smartphone travel before being sold to the customer?

A. Equivalent to a round-trip by plane from Brussels to Rome
B. Equivalent to a round-trip by plane from Paris to Moscow
C. Equivalent to doing a full world tour by plane
D. Equivalent to doing 4 world tours by plane

Answer: D.

SLIDE 58

4. What percentage does the production phase represent for the overall carbon emission of a digital device?

A. 44%
B. 56%
C. 68%
D. 78%

Answer: D.

5. Which digital activity stands out as the most energy-intensive and environmentally impactful, constituting 80% of web data?

A. Video streaming
B. Social media usage
C. Email communication
D. Internet research

Answer: A.

6. What is the average carbon footprint of the emails sent daily worldwide according to ADEME?

A. 1,000 tons of CO_2e
B. 20,000 tons of CO_2
C. 50,000 tons of CO_2e
D. 90,000 tons of CO_2

Answer: D.

SLIDE 59

7. What percentage of e-waste produced in 2019 reached formal management or recycling facilities, according to the Global E-waste Statistics Partnership (GESP)?

A. 10%
B. 17%
C. 25%
D. 33%

Answer: B.

8. What is psychological obsolescence primarily driven by? (two answers)

A. Changes in functionality or design
B. Physical wear and tear
C. Consumer perception and desire
D. Marketing strategies

Answers: C. -D.

9. What are some maintenance tips recommended for prolonging the lifespan of digital devices?

A. Regularly cleaning vents and deleting unnecessary data
B. Leaving devices in direct sunlight for better performance
C. Using any type of cleaning solution on screens
D. Allowing devices to overheat occasionally for optimal functioning

Answer: A.

MODULE 4

SLIDE 60

The future of digital technology Initiatives and actions

Section 4.1 Digital moderation

OBJECTIVE

- Give rendition of future scenarios for the impact of the digital sector;
- Explain digital moderation;
- Provide simple digital moderation measures to adopt.

SLIDE 61

Future scenarios

Based on current tendencies, a report from ADEME published in March 2023 exposes that the negative impact of the digital sector on the environment will grow exponentially:

CARBON FOOTPRINT (in millions of tons)

2020	17.2
2030	25
2050	49.4

RESOURCES USED (in millions of tons)

2020	63.7
2030	88
2050	178

ENERGY CONSUMPTION (in TWh)

2020	52
2030	54
2050	93

CONSUMPTION OF METALS AND MINERALS (in tons)

2020	952
2030	1 081
2050	1 508

SLIDE 62

Digital moderation

Given estimated future scenarios, it is crucial to change the course of projections and take actions to reduce your environmental impact. Digital moderation is an approach that frames how you can take actions as an individual to reduce your overall digital impact on the environment.

Digital moderation: Reducing the environmental impact of digital technology by limiting the use and reliance on digital devices.
The digital moderation approach consists of moving from a digital world where the use of digital devices is instinctive, to a world that becomes conscious and thoughtful of the environmental impact of the digital sector. It is necessary to identify the useful societal contributions of digital technology, so that resources can be allocated to them as a priority, to preserve and develop them further. On the other hand, it is necessary to identify practices where digital technology is not required.
Digital moderation includes a whole range of actions, particularly public actions, that have

to be developed and implemented, from initial digital education of individuals to the regulation of design techniques of digital devices. The Shift project also advocates for the implementation of campaigns to prevent "digital obesity", the overconsumption of digital devices, and aims to support organised structures (companies, public bodies, local authorities) on a systemic level to enable effective implementation of digitally sustainable measures.

FROM A DIGITAL TO A ENVIRONMENTALLY CONSCIOUS WORLD

PUBLIC ACTIONS
- Digital education
- Regulations of design techniques
- Information campaigns
- Implementation of sustainable measures in organisations

SLIDE 63 SLIDE 64

Activity 12
Digital moderation measures

Individual work - 15 minutes

Tools: Participants use their notebook for the activities

STEP 1

Each participant fills in the tables and give a **note from 1 to 4 to assess whether they implement or intend to implement such measure**

How to fill in the tables: Do you implement/ do you intend to implement such measures ? (1 = No at all / 4 = Very consistently)

STEP 2

Share in group discussion the insights of participants and discuss why they would tend to implement measures over others.

STEP 3

Provide a document that explains why each measure has an important impact and can effectively reduce the impact of digital devices on the environment.

Do you ? (1 = No at all / 4 = Very consistently)	1	2	3	4
Keep your digital devices for as long as possible by taking care of them				
Have your phone or computer repaired rather than buying a new one.			27	5
Consider buying reconditioned equipment			21	4
Find a second life for unused equipment (by selling, recycling, upcycling, etc)			18	4
Avoid using unnecessary screens				
Do not leave devices on standby				
Use the least data possible				
Clean up your data regularly				
Use digital technology to reduce commuting from home to work / school				
Take care of the battery life of your digital devices				

LEARNING OUTCOMES

- Learners understand digital moderation and know simple measures they can adopt.

Section 4.2
Digital sector - Initiatives

OBJECTIVE

- Help learners to feel involved in the green digital transition;
- Encourage learners to implement initiatives to reduce their carbon digital footprints.

SLIDE 65

Several institutions at the international, european and national level have stated the importance to consider the green and digital transitions together.

To achieve this twin transition, different initiatives have been implemented and promoted on multiple levels.

- **United Nations (UN) Initiatives**

The UN's Sustainable Development Goals, particularly SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (responsible consumption and production) and 13 (Climate Action), encompass efforts to mitigate the environmental impact of the digital sector. This includes promoting energy efficiency in technology and addressing e-waste.
To that end, in April 2023, United Nations Environment Programme (UNEP) released a statement to launch the Global Digital Compact. It is a framework designed to support countries, regions, and businesses to transition to a green digital economy.

It has been elaborated to guide the sustainable development of digital technologies and services while addressing environmental challenges. The compact outlines a set of principles and actions that can be implemented by governments, businesses, and other stakeholders to ensure that digital technology development is environmentally sustainable:

- Building a planetary dashboard of trusted environmental data for real time transparency and situational awareness;
- Harnessing digital tools to align global finance and capital markets to environmental sustainability goals;
- Measuring the sustainability performance and circularity of supply chains;
- Incentivising sustainable consumption practices;
- Harnessing sustainable procurement of digital technologies and infrastructure to close the digital divide;
- Identification of best practices and standards in the greening of information and communication technologies.

The objective of the Global Digital Compact (GDC) is to bridge the gap between countries, public and private actors to pioneer new environment-friendly practices and implement sustainable technology projects on a large scale. The GDC recognises the importance of harnessing the power of emerging technologies, and their application in the environmental domains, but at the same time, acknowledges the need for implementing responsible practices, ethical standards, data standards, regulatory frameworks, measurement methods and impact assessments on a global scale to ensure effective impact.

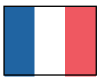
- **European Union (EU) Initiatives**

The European Union has repeatedly claimed that it intends to reduce the environmental impact of digital technology through various means. This effort is deeply intertwined with the broader European Green Deal which recognises that digital transformation and environmental sustainability are not separate challenges but rather two sides of the same coin.

In its green digital strategy, the EU highlights the potential of digital technologies to reduce carbon footprints, through videoconferencing, energy monitoring, and sustainable farming practices. However, it also recognises the need to ensure that digital technologies do not consume more energy than actually enable to save. Currently, digital technologies account for between 8-10% of Europe's energy consumption and 2-4% of greenhouse gas emissions (EU Commission).

To address this, the EU is exploring measures such as extending the lifetime of smartphones, switching to 5G networks, and ensuring data centres are climate-neutral, energy-efficient, and sustainable by 2030 at the latest.

Along with measures to extend the lifespan of digital devices and tackle planned obsolescence (see Module 3.2), the EU parliament has adopted an unprecedented law that will generalise the use of USB-C cables and connectors by the end of 2024. The EU has been promoting this text for more than 10 years and claims that it will greatly reduce the number of e-wastes and extend the lifespan of digital devices.



FRA

- **National initiatives**

ADEME, the French Environment and Energy Management Agency, is a driving force in France's transition to a sustainable future. Founded in 1991, this governmental organisation focuses on reducing carbon emissions and advancing environmental-friendly practices. ADEME promotes initiatives across various sectors, including energy, transportation, waste management, and sustainable development.

ADEME investigates the environmental impact of digital technology by conducting research to quantify and understand the carbon footprint of digital devices and infrastructures. This research informs policy recommendations. ADEME also collaborates with industry stakeholders to develop standards and labels, encouraging manufacturers to adopt more sustainable practices throughout the lifecycle of digital devices. Moreover, the agency provides guidance on best practices for responsible digital usage, including recycling of electronic waste, and digital moderation strategies. Finally, ADEME invests in innovation in sustainable digital technologies through funding programs with research institutions and startups.

ADEME plays a crucial role in mitigating the environmental impact of digital technology, creating a shift towards the green digital transition. ADEME's influence extends internationally through cooperation with other countries and organisations, contributing to global efforts to combat climate change.

ITA

Italy's ecological transition plan (PTE), also known as the 'National Recovery and Resilience Plan' (PNRR), is a broadly financed strategy to guide the country towards a more sustainable and digital future as part of a larger EU financial stimulus package. The PTE plan includes a series of investments and reforms to modernise the Italian economy, promote environmental sustainability, and accelerate digitalisation.

Key aspects of the Italian ecological transition plan

- **Energy transition**

The plan emphasises a shift from fossil fuels to renewable energy sources. It includes investments in solar, wind, and hydroelectric power, aiming to increase the share of renewables in the national energy mix.

- **Sustainable mobility**

The PTE promotes the adoption of electric and hybrid vehicles, expanding charging infrastructure and enhancing public transportation systems to decrease reliance on fossil fuels.

- **Circular Economy**

Efforts to implement circular economy principles are central, focusing on waste reduction, increased recycling rates, and the lifecycle management of products to minimise environmental impact.

Integration of digitalisation in the Ecological Transition Plan

- **Sustainable digitalisation and digital transition**

The PTE integrates digital transformation as a fundamental component to achieve sustainability goals. This includes funding for digitising public administration and infrastructure to enhance energy efficiency and reduce environmental footprints.
Particular focus is on developing «smart cities» that utilise digital technologies to optimise resource management and improve urban living standards.

- **Proper use of polluting digital systems**

The plan addresses the issue of electronic waste and digital pollution. Initiatives are included to promote the recycling of electronic devices and to minimise the environmental impact of data centres through energy-efficient solutions.

- **Education and innovation**

The PTE invests in education and skills development to support the digital transition, focusing on digital literacy, which is necessary for adapting to and implementing sustainable technologies.
In summary, Italy's Ecological Transition Plan aims to reduce the country's ecological footprint and to integrate digitalization sustainably. This includes enhancing energy efficiency, promoting digital education, and mitigating the adverse effects of digital systems on the environment.

EST

Green Tiger (Rohe Tiiger in Estonian) is a cross-sectoral collaboration platform which is creating a basis for a green economy, just as the Tiger Leap project jump-started the development of Estonia's technology sector. The Green Tiger is a representative organisation that unites over 80 Estonian companies.
The idea of the representative organisation of the Green Tiger is to share knowledge and tools to implement sustainable changes and to provide a collaborative platform for sharing experiences, successes and lessons learned.
Green Tiger combines the societal demand for a sustainable Estonia and accelerates the system innovation that is needed to achieve that. Green Tiger's vision: A sustainable world which preserves social welfare while focusing on the conservation and restoration of nature. Green Tiger's mission is to create and implement nature-friendly practices in all sectors and develop a balanced economy.

To reach a balanced economy, Green Tiger prepares roadmaps in five different areas. The Energy Roadmap and the Construction Roadmap have already been completed, and the Transportation, Circular Economy and Land Use Roadmap will be completed by the beginning of 2025.
The roadmaps are industry-specific practical guidelines for making changes. The creation of the roadmaps involves companies operating in the sector, professional associations, researchers and state representatives.
Roadmaps are work tools created for the state to use: for example, some of the points outlined in the Construction Roadmap were also included in the Estonian government's coalition agreement.

IRL

The Department of Further and Higher Education, Research, Innovation and Science in Ireland funds and creates policy for the higher and further education and research sectors. They also oversee the work of the state agencies and public institutions operating in these areas. Their role is to make sure that these sectors support and encourage Ireland's social and economic development. They make sure that public investment and policy in these areas give opportunities to everyone, including the most vulnerable in society.

The department develops and implements policies related to further and higher education, research, innovation, and science in Ireland. This involves setting priorities, establishing frameworks, and ensuring alignment with national goals and objectives. It allocates funding to educational institutions, research organisations, and innovation initiatives.
This includes funding for universities, colleges, research centres, and programs aimed at promoting innovation and scientific advancement.

The department is responsible for ensuring the quality and standards of education and research in Ireland. This involves developing accreditation processes, conducting inspections, and promoting excellence in teaching, learning, and research. It focuses on developing and enhancing the skills of the workforce to meet the needs of the economy.
This includes initiatives to promote lifelong learning, vocational training, and skills development in emerging fields.

The department supports research and innovation activities across various sectors. This includes funding for research projects, promoting collaboration between academia and industry, and facilitating the commercialisation of research outcomes. It works to ensure equal access to education and opportunities for all individuals, regardless of background or circumstance. This includes initiatives to support disadvantaged students, promote diversity in higher education, and address barriers to participation.

LEARNING OUTCOMES

- Learners understand digital moderation and measures they can adopt;
- Learners gain a comprehensive understanding of the on-going initiatives on multiple levels.

Final activity

SLIDE **66** SLIDE **67**

Activity 13
Green digital action plan

Group work - 30 minutes

Tools: Participants use their notebook for the activity

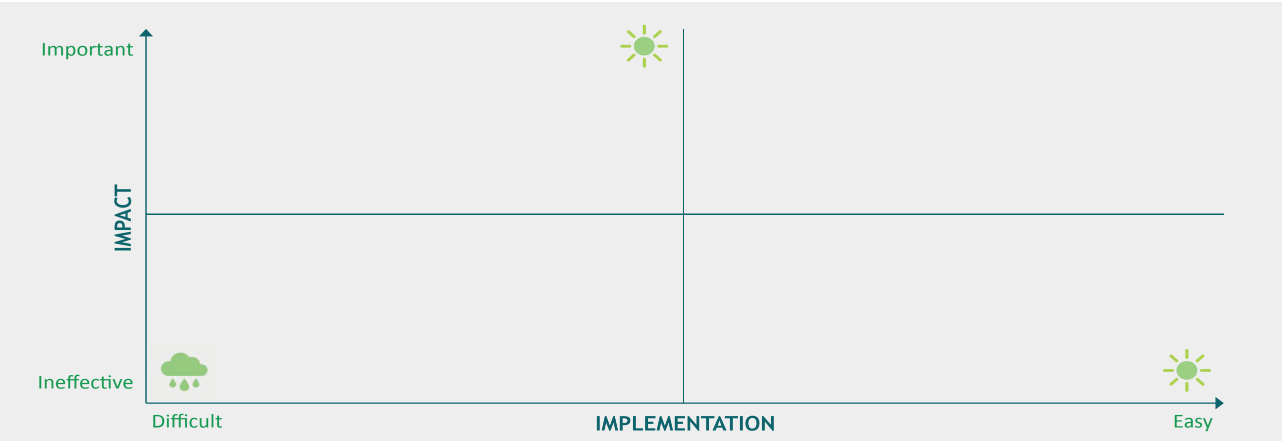
STEP 1

Present the axis of the green digital map to participants

- Positive impact,
- Facility to implement.

STEP 2

Ask participants to assess the list of positive practices depending on the ease of implementation and the importance they consider it could have.
Indicate them on the map according to their opinion. Not all of the actions are individual, the objective is to encourage participants to think both individually and collectively.



Here is the following list

- Limit the quantity of owned digital devices;
- Adopt a digitally moderate way of life;
- Reduce digital usage;
- Extend the duration of the warranty of a digital device;
- Design sustainable digital infrastructures and devices;
- Repair digital devices;
- Protect and maintain digital equipment;
- Share digital equipment (ex: internet box shared within a building);
- Contribute to collective actions (charity, digital clean-up day, initiatives, etc);
- Regulate production, usage and disposal of digital technology;
- Raise awareness on environmental impact of digital technology in your social circle
- Improve the longevity and repairability of digital devices (from design to end-of-life);
- End software discontinuance;
- Reduce the number of screens and their size;
- Systematically recycle or donate unused equipment;
- Buy second-hand devices;
- Develop new digital technologies.

STEP 3

Present the map to the whole group and discuss it together.

Encourage a class discussion on the collective potential of individual actions and how these plans contribute to the green digital transition.

LEARNING OUTCOMES

- Learners are able to apply the green digital transition concept in practice;
- Learners gain ideas of initiatives they can implement in their daily life and/or professional life;
- Learners are inspired to change their digital behaviour.

SLIDE 68

RECAP - Final suggestions to reduce your impact

To reduce the environmental impact of the **production of digital devices**, the main suggestion is to limit the quantity of owned digital devices. In order to do so:

- Buy only when it is necessary;
- Choose repair over buying a brand-new product;
- Buy second-hand or reconditioned devices.

To reduce the environmental impact of the **usage of digital devices**, the main suggestions are:

- When streaming video, reduce its quality and watch it utilising Wi-Fi;
- Limit your time spent on social media and the amount of content you share;
- Clean your email inbox regularly by deleting sent emails and spams.

To reduce the environmental impact of the **disposal of digital devices**, the main suggestions are:

- Find recycling options for digital devices in your local area;
- Preserve devices as long as possible by taking precautions to maximise its lifetime: clean your devices, prevent damages, switch off your devices when unused…;
- Guarantee battery life: choose the right parameters, deactivate unnecessary features, adopt an alternating loan…

SLIDE 69

Invite the participants to test their knowledge and digital habits at the end of the training

The participants will discover which digital profile they are, with a set of actions recommended to limit their digital environmental impact.

Website:

▶ egreen.adice.asso.fr

Available in english, estonian, french, and italian.

SLIDE 70

Practical tools

To find out more about the environmental impact of digital technology, learners can be redirected to the following website:

egreen.adice.asso.fr

Each tool is available in English, Estonian, French and Italian.

On this website participants will find several tools they can consult online or download:

- **A cross-country study on the green digital transition in the European Union**

With this tool, participants can find out about the good practices of over 250 professionals from the VET sector from Ireland, France, Estonia and Italy. This study includes a set of recommendations around 8 themes:

- Emails,
- Cloud storage,
- Streaming media,
- Social media,
- Producing electronic devices and tools,
- Cyber-security,
- Using apps, platforms and internet browsers,
- Printing and digitalising of documents.

- **A kit to reduce the impact of digital practice on the environment**

With this tool, participants can get informed on the 8 themes mentioned above, get access to practical tools easy to implement and a checklist to verify their impact.

- **An interactive tool to support learners in reducing their digital impact**

With this tool, participants can test their knowledge on the environmental impact of digital technology and measure their own impact. The test also includes a set of recommended actions to further reduce the impact of their digital practice.

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