BENCHMARK GREEN IT

2023

benchmark@greenit.fr

SUMMARY

ABOUT

Partners

GreenIT.fr

Created in 2004, the Green IT collective brings together the experts behind the approaches **of digital sobriety**, green IT, responsible **digital, and eco-design of digital service,** and **slow tech**. To structure these approaches, we propose methodologies, evaluation systems, standards of good practices, and other tools that have become, over time, reference tools. As experts, we support public authorities and large organisations and produce reference studies.

Club Green IT

The Club Green IT is the club of digital sobriety and sustainable digital. It brings together public and private organisations that wish to quantify and sustainably reduce the environmental, economic and social impacts of their information system. Created in 2014 by GreenIT.fr, the club is also a place of consensus which, thanks to the expertise of GreenIT.fr and the eyes of members, makes it possible to create repositories such as the "Green IT: the 74 key good practices" repository and the "responsible digital" certification, two reference tools.

AGILE PARTNER

Agile Partner is an independent IT services company created in Luxembourg in 2004 that develops tailor-made software solutions and helps teams to be more efficient in all areas of an organisation. The firm's areas of expertise are software development (web, mobile, cloud), user experience design, and Lean Agile methodologies. Sustainable Digital is a commitment that underpins all its activities (Green IT and eco-design of digital service, accessibility and digital inclusion).

AUXILIA CONSULTING

The Auxilia association is a consulting and support firm that is a pioneer in sustainable development and an expert in socio-ecological transition for 21 years. Auxilia supports local authorities, institutions and companies in their transition towards sustainable and resilient development, on topics such as the evolution of the uses of territories, cities and rural areas (mobility, work, consumption, housing, public spaces), the renewal of built spaces, the preservation of biodiversity, the ecological impacts of digital technology, health, the circular economy, or the emergence of new modes of governance due to the evolution of actors in many of these subjects.

Espelia

Created under the aegis of the Association of Mayors of France 25 years ago, Espelia is a consulting firm expert in the design and operational deployment of public policies in France and internationally. With its 150 consultants committed to defending the general interest, Espelia supports local authorities in all their public policies with a high level of mastery of consulting business expertise (strategy, organisation, economy, finance, legal) and sectoral expertise. The firm thus supports local authorities in their digital transformation and that of their territory (city and smart territory) with the concern for digital sobriety both in their internal functioning and in a territorial approach, as presented in the study "Digital sobriety and local authorities, what challenges".

INNOV'ICTION

Created in 2013, innov'ICTion is a digital, expertise based, service compagny nurturing singularity. Active in the public and private sectors, with local and international actors, innov'ICTion helps organisations strengthen their resilience through their digital challenges: promote Sustainable Digital Technology, including Green IT, extending CSR policies; develop their cybersecurity posture as an embedded part of the company's culture, embracing organisational, practical and technical aspects. innov'ICTion provides guidance and assistance in the design, the organisation, the implementation and the education.

IT'S ON US

IT's on us is a cooperative ecosystem of digital professionals. Its "raison d'être" is to put digital technology at the service of the common good. The speakers (employees of IT's on us, partner companies and independents) support the responsible digital transformation – sober, ethical and useful – of the beneficiary organisations by giving themselves three missions:

(1) reduce the negative impacts of digital technology (training and support for the sustainable digital approach);
(2) support projects that benefit the environment and society (tailor-made digital projects);
(3) co-construct virtuous and efficient business models for IT activities (strategy consulting).

RESILIO

Resilio was born from a common desire of EPFL engineers and GreenIT.fr experts to combine their skills and experience to best support the transition to digital sobriety.

Based in Switzerland, Resilio offers a high level of technical and methodological expertise. It supports its clients on all aspects related to their sustainable digital approach: training, consulting and assessment of the environmental impacts of digital services via its software Resilio Tech and database Resilio DB.

ZEB&WEB

Founded in 2011, Zeb et Web supports SMEs and mid-caps in their development through sustainable digital technology:

- **Consulting**: Transformation and digital strategy, in its technical and marketing aspects
- **Web development**: creation of your eCommerce sites, web, applications
- **Responsible** digital : Sustainable digital strategy, eco-design, awareness

PUBLICATIONS

Studies

- Digital sobriety and local authorities: what are the challenges? study conducted with Espelia, 2020, https://bit.ly/SobNumCollectivites (PDF, 2.5 MB)
- iNum 2020 : Environmental impacts of digital technology in France , 2020
- NumEU 2021 : Digital technology in Europe: an approach to environmental impacts through life cycle analysis , December 2021
- Global Digital Environmental Footprint, study, 2019, https://bit.ly/EENM2020

White Papers

- Digital and environment, collective (Iddri,, GreenIT.fr and WWF), 2018, https://bit.ly/LBNE2018
- WeGreenIT: what Green IT approaches in large French companies, GreenIT.fr with WWF France and Club Green IT, 2018, https://bit.ly/WeGreenIT2018 (PDF, 2 MB)

Books

- Green IT: the 74 key best practices, Editions du Club Green IT, 2022, https://club.greenit.fr/doc/2022-06-GREENIT-Referentiel_maturite-v3.pdf
- Tendre vers la sobriété numérique, Actes Sud, 2021
- Digital sobriety: the keys to act, Buchet-Chastel, 2019, https://bit.ly/SobNum

AUTHOR

- Anne Rabot, Resilio

CONTRIBUTORS

- Frédéric Bordage, GreenIT.fr
- Leo Donse, Espelia
- Sylvain Chéry, Agile Partner
- Auban Derreumaux, innov'ICTion
- Yvan Barnabaux, innov'ICTion
- Laure Alfonsi, Zeb&Web
- Mathias Murmylo, Auxilia Conseil
- Margaux Escande, IT's on Us

LICENSE

SCOPE OF THE STUDY

OBJECTIVES

- Quantify environmental impacts in absolute and relative terms;
- Understand the structure of these impacts;
- Assess the maturity of participants;
- Build a data-driven action plan on an objective basis for each participant.

PARTICIPANTS

- Agile Partner
- Axa Luxembourg
- Bank of Luxembourg
- Consort Group
- Easy Cash
- France Media Monde
- Ifremer
- Kiabi
- LIST
- European Parliament
- Roole
- Tenergy

STUDY

The Green IT Benchmark 2023 is the eighth edition of this study started in 2016 at the initiative of GreenIT.fr. Initially reserved for members of the Green IT Club, the Green IT Benchmark has been opened to all organisations since 2017. Several editions have been conducted with partners such as Cigref, the College of Sustainable Development Directors (C3D) and WWF France.

This collective operation aims to quantify the environmental impacts of the information system of the participating organisations as well as the maturity of the teams (i.e. their ability to implement good practices to reduce these impacts). The data of each organisation is then benchmarked with other participants to create a scale (min, max, average) and to rank each participating organisation on this scale. The deviations from the average and the qualitative analysis of the responses provided by the organisations finally make it possible to build a data-driven action plan, tailored to each organisation. This approach is unique in Europe.

For this 8th edition of the Green IT Benchmark, we benchmarked 12 private and public organisations, located in France, Belgium and Luxembourg. These organisations operate in the following industries: insurance, audiovisual, banking, commerce, consulting, culture, utility, research, digital services.

PERIMETER

The scope of the study is the organisation's information system. The information system is broken down into 3 tiers:

1. User's work environment (workstation, telephony, printing);
2. Networks (LAN and WAN);
3. Data centre (including cloud).

As we evaluate organisations of very different sizes and sectors of activity, we introduce two complementary scopes to enable benchmarking:

- a full **scope** to assess the impacts of the entire information system, including **its business specific components**;
- a **partial scope to assess** the impacts of a subset of the information system with **common components** for any organisations participating in the Green IT Benchmark.

Unless specified, this report presents the results related to the partial scope , i.e. orders of magnitude to which all organisations can refer on a common baseline. This means that the average impact values should generally be increased by 1% to 10%, depending on the indicator.
On this edition, averages were calculated including 2022 data to increase the sample size. Details can be found in the 2022 Benchmark report.

METHODOLOGY

The methodology chosen is that of simplified Life Cycle Assessment (LCA) screening type, defined by the standards:

- ISO 14040:2006 Environmental Management – Life Cycle Assessment – Principles and Framework
- ISO 14044:2006 Environmental Management – Life Cycle Assessment – Requirements and Guidelines

Details of the methodology are given in the appendix

LIFE CYCLE

In this study, we investigated the following stages of the life cycle:

1. **Manufacturing** : includes the extraction and refining of raw materials, upstream transport and manufacturing and assembly processes;
2. **Distribution** (Dist.): it includes the transport of equipment from the plant to the place of use;
3. **Use** : includes electricity used by digital equipment;
4. **End of Life** (EoL): This includes end-of-life treatment of digital equipment.

STUDY LIMITATIONS

INCLUSION

This study focuses on the information systems of the 12 participating organisations for the year 2023. The results were benchmarked with the figures of these 12 organisations and the 10 from the previous edition, i.e. 22 organisations.

In order to be able to benchmark companies over time, we have chosen to establish a partial footprint, essentially equivalent to their management IS. Besides, participating organisations are invited to work on their global footprint representing their entire information system.

The following equipment and flows are considered:

- **IT Department**: Employee's travel and Service Purchases
- **User environment**: smartphones, desktops and laptops, screens, etc. except video projectors;
- **Printing**: shared and personal printers, paper;
- **Local area network** : IT equipment linked to the local area network (LAN);
- **Wide Area Network (**WAN) and Mobile Network (2G/3G/4G);
- **Cloud**: VMs, storage
- **Data centres** : compute servers, storage arrays, network equipment, etc.

EXCLUSION

The following are excluded from the environmental assessment:

- Flows related to R&D and industrial IS
- Hosting services offered to third parties by the organisation
- Equipment packaging and end-of-life (as a reminder, devices have their own sectoral rules), excluding packaging of equipment made available to users and their end of life;
- Broken or defective equipment;
- Construction and maintenance of infrastructure (building);
- Lighting, heating and facilities of infrastructures (including IT Department);
- Transport systems and infrastructure other than those dedicated to the IT department;
- Deployment of equipment.
- Video projectors because they are present in very small quantities and for which there was no impact factor available at the time of the study.

All of the above are considered outside the scope of the study.

ENVIRONMENTAL INDICATORS

CHOICE OF INDICATORS

Environmental footprints were calculated according to the 16 environmental indicators recommended by the PEF 3.0 methodology. However, to make the results of this study more comprehensive and to focus our recommendations on material topics, we have selected the 8 most significant indicators to present in this report.

In addition to the 8 indicators presented here on the left, recommended in the PCR for Digital Services, the Primary Energy (TPE) flow indicator has been calculated.

Be careful, however, the indicator "Water Use" should be taken carefully. Indeed, a problem of accounting data for water flows in end-of-life (EoL) forced us to exclude this part of the study. However, we have decided to keep this indicator to testify, even partially, on the tensions on this resource to which digital technology contributes.

The full description of the indicators is also provided in the annex.

8 INDICATORS

- **GWP**: Climate change (kg eq. CO_2)
- **PM**: Particulate matter emissions (disease incidence)
- **AP**: Acidification (mol eq. H+)
- **IR**: Ionising radiation, human health (kBq eq. U235)
- **ADPe** : Resource use , minerals and metals (kg Sb eq)
- **ADPf**: Resource Use, Fossils (DOJ)
- **WU**: Water Use (m3 eq)
- **CTUe**: Ecotoxicity, Freshwater (CTUe)

DATA SOURCE

The LCA calculations used two types of data:

- Inventory. Data on the physical characteristics of the studied system (such as the number of smartphones, computers, printers, etc. as well as their lifespan, reuse rate, etc.). These data come from inventories carried out by participating organisations with the support of GreenIT.fr and its partners.
- Impact factors. Data on the impacts of the life cycle of IT equipment (manufacturing, distribution and end of life) or incoming energy flows (impacts of electricity production, impacts of kilometres travelled by IT staff, etc.) in the studied system. These data come mainly from the NegaOctet database and for very few exceptions from the EcoInvent database.

INVENTORY

The inventory reflects the functioning of the information system in 2022.

- **22** organisations
- **64,901** users
- **5,219** IT department employees (including service providers)
- **37,657** m^2 of offices dedicated to the IT department
- **42** kms covered by a CIO employee per day
- **331,636** digital devices

NEGAOCTET

As this study is based on a screening-LCA methodology, the calculations are made from secondary data from the NegaOctet database. NegaOctet is also based on the ISO 14040-44 methodology and the Product Environmental Footprint (PEF) methodology recommended by the European Commission.

NegaOctet is the only database of homogeneous and state-of-the-art impact factors worldwide. These impact factors have also been critically reviewed (ISO 14071) by an independent public scientific research organisation. This critical review ensures the quality of the impact factors.

This 8th edition of the Green IT Benchmark is based for the second time on the NegaOctet database. The benchmark of the results could therefore be made including the sample of the previous edition.

KEY RESULTS

The purpose of this study is to allow companies to rank themselves on a common scale to find out the most significant areas of potential improvement.

In this part, we propose the measurements observed on the 8 focused environmental indicators for this report as well as the flow indicator on primary energy consumption.

Indicator	ADPe	ADPf	AP	CTUe	GWP	IR	PM	TPE	WU
Unit	g Sb eq.	MJ	mol H+ eq.	CTUe	kg CO2 eq.	kBq U235 eq.	Disease occurrences (per 10000)	MJ	m3 eq.
Minimum	7,84	5 234	0,71	2 813	112	191	0,04	4 695	51
Weighted average	**15,3**	**12 598**	**2,03**	**7 841**	**364**	**554**	**0,14**	**13 845**	**220**
Maximum	61,2	68 420	6,02	26 432	1 772	3 316	0,47	74 623	807

Table 1 - Benchmark of organisations by indicator

In this table, the average has been weighted by the number of users in each organisation. The values are therefore lower than the arithmetic mean.

IT AND SERVICE PROVIDERS: A VERY STRONG IMPACT OF BUSINESS TRAVEL

The people without whom the information system would not work defines the “IT staff” of the "IT department". To assess their environmental impacts, we take into account the kilometres travelled by the IT staff and its service providers, and the purchase of IT services.
Like the previous years, the IT Department has a significant environmental impact, mainly on the resource use (minerals and metals), greenhouse gas emissions, particulate matter emissions and water use of the information system. It is therefore crucial to take into account this source of impacts within the environmental balance of the information system.

A WIDER GEOGRAPHICAL SCOPE

In this edition, organisations based in Luxembourg and Belgium participated in the study.
Differences in results could be observed in particular due to the electricity mix of these countries. Greenhouse gas emissions are significantly higher during the use stage due to the part of coal in the mix for these two countries.

ELECTRICITY PRODUCTION, A MAJOR ELEMENT OF THE FOOTPRINT

The required electricity production for the use of computer equipment is responsible for 70% of primary energy consumption. The presence of many data centres outside France and the use of the cloud increase the impact of power consumption in the overall footprint.
As the electricity mixes of the North American or Asian territories are 6 to 11 times more emitting greenhouse gases than the French electricity mix, "on premise" servers or cloud, located outside France increase the quantities of greenhouse gases emitted (GWP) and use of fossil resources (ADPf) and contribute to a higher demand for primary energy.

A DIFFERENT ALLOCATION OF IMPACTS

The allocation of companies' environmental impacts in this study is different from allocations usually found in digital studies. This is especially true for impacts in the use stage, 60%, while the manufacturing stage is usually preponderant. This difference is explained by the differences between the business and private usages:

- inclusion of employee’s travels
- Longer lifespan of IT equipment in companies
- Inclusion of the companies' data centres

> Calculating the environmental footprint of our IT system was a very interesting exercise to better understand where the impacts are (natural resources, water, energy, greenhouse gases, pollution, etc.) and thus help us prioritize our actions, whether on the choice of equipment, the management of its lifespan or the overall management of our digital resources.

Participants' opinions - Laurianne Coutant, France Médias Monde

DISTRIBUTION BY IS DOMAINS

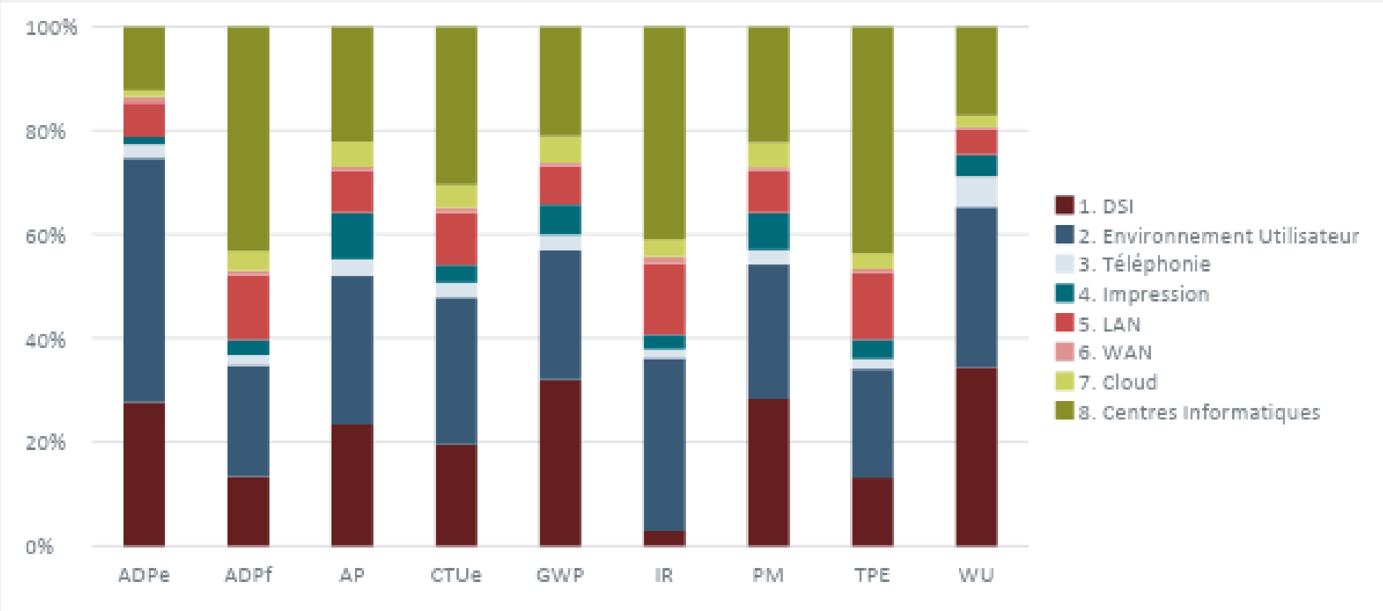

Figure 1 - Allocation of impacts by major IS areas

IT Domain	ADPe	ADPf	AP	CTUe	GWP	IR	PM	TPE	WU
1. IT Department	28%	13%	23%	20%	32%	3%	28%	13%	34%
2. User Environment	47%	21%	29%	28%	25%	33%	26%	21%	31%
3. Telephony	3%	2%	3%	3%	3%	2%	3%	2%	6%
4. Printing	1%	3%	9%	3%	6%	3%	7%	4%	4%
5. LAN	7%	12%	8%	10%	7%	14%	8%	13%	5%
6. WAN	1%	1%	1%	1%	1%	1%	1%	1%	0%
7. Cloud	1%	4%	5%	5%	5%	3%	5%	3%	2%
8. Data Centers	12%	43%	22%	30%	21%	41%	22%	44%	17%

Table 2 - Allocation of environmental impacts by area of the information system

BREAKDOWN BY TIER

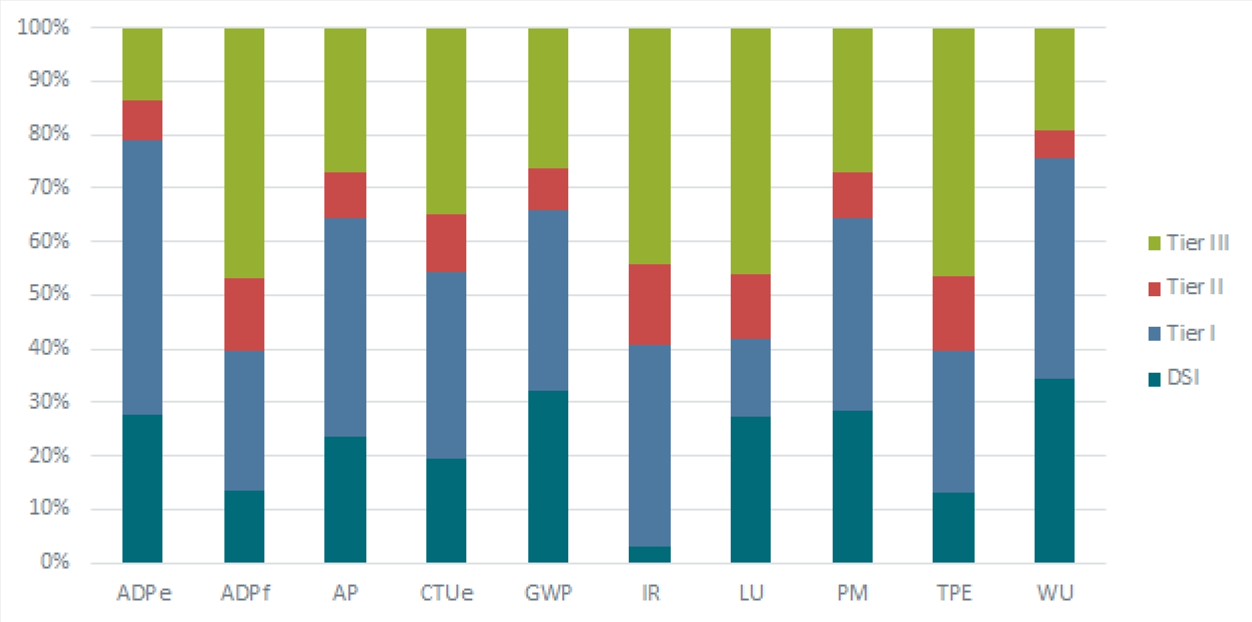

Figure 2 - Allocation of impacts by tier of the information system (Tier I: User environment; Tier II: Network; Tier III: Cloud and Data Centers)

The structure of environmental impacts is distributed among the different Tiers of the information system:

- Tier I: A large part of the environmental impacts comes from the user environment with the manufacturing of computers, monitors, smartphones and printers.
- Tier III: The power consumption of data centres concentrates many impacts. This is due to both the amount of electricity consumed and the nature of the electricity consumed. Indeed, we have taken into account several data located outside France, particularly in Luxembourg, North America or Asia, whose national electricity mix is more carbon-intensive.
- The IT department: IT staff'travels represent an important part of the impacts, particularly on the greenhouse gas emissions indicator

BREAKDOWN BY LIFE CYCLE STAGE

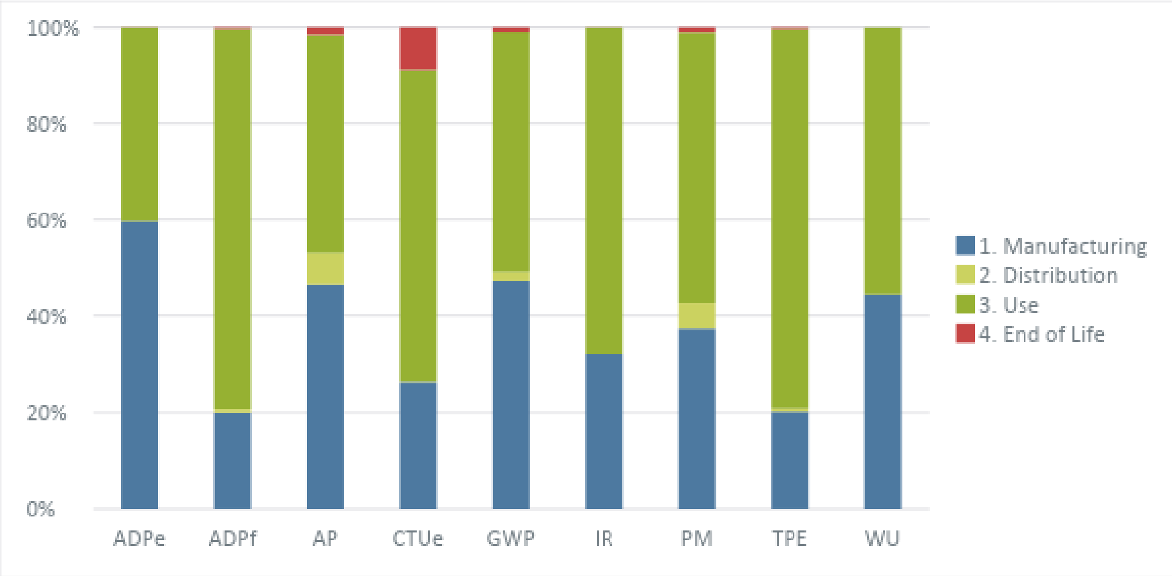

Figure 3 - Allocation of impacts by life cycle stage

Step	EPDA	ADPf	AP	CTUe	GWP	IR	PM	TPE	WU
Manufacture	60%	20%	47%	26%	47%	32%	37%	20%	44%
Distribution	0%	1%	7%	0%	2%	0%	5%	1%	0%
Usage	40%	79%	45%	65%	50%	68%	56%	79%	56%
Later life	0%	0%	2%	9%	1%	0%	1%	0%	0%

Table 3 - Allocation of impacts by life cycle stage

Distribution and end-of-life have very few direct impacts. This is in line with other studies on digital technology. Nevertheless, the end of life of the equipment leads to the manufacture of new ones to replace them, so it is important not to neglect this part.

The strong representation of the use stage can be explained by 2 factors:

- A longer lifespan of equipment in companies than in homes, amortising the manufacturing stage over a longer period of time
- The higher number of employees and Data centres outside France, particularly in Luxembourg and on the North American and Asian continents. As the national electricity mix is more impactful, the use stage is strengthened.

BREAKDOWN BY DOMAIN AND LIFE CYCLE STAGE

Indicateur	ADPe				ADPf				AP				CTUe			
Etape du CV	BLD	DIS	USE	EOL	BLD	DIS	USE	EOL	BLD	DIS	USE	EOL	BLD	DIS	USE	EOL
1. IT Dep.	1%	0%	27%	0%	4%	0%	9%	0%	9%	0%	14%	0%	2%	0%	17%	0%
2. User Env.	45%	0%	2%	0%	9%	0%	12%	0%	21%	1%	5%	1%	14%	0%	8%	6%
3. Phones	2%	0%	0%	0%	1%	0%	1%	0%	3%	0%	1%	0%	2%	0%	1%	1%
4. Printing	1%	0%	0%	0%	2%	0%	0%	0%	4%	5%	0%	0%	2%	0%	0%	1%
5. LAN	4%	0%	2%	0%	1%	0%	11%	0%	3%	0%	5%	0%	2%	0%	8%	1%
6. WAN	1%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	1%	0%
7. Cloud	0%	0%	1%	0%	0%	0%	3%	0%	1%	0%	4%	0%	1%	0%	4%	0%
8. DC	4%	0%	8%	0%	3%	0%	41%	0%	6%	0%	16%	0%	4%	0%	26%	1%

Indicateur	GWP				IR				PM				TPE				WU			
Etape du CV	BLD	DIS	USE	EOL	BLD	DIS	USE	EOL	BLD	DIS	USE	EOL	BLD	DIS	USE	EOL	BLD	DIS	USE	EOL
1. IT Dep.	12%	0%	20%	0%	0%	0%	2%	0%	5%	0%	23%	0%	4%	0%	9%	0%	1%	0%	33%	0%
2. User Env.	19%	1%	5%	1%	22%	0%	12%	0%	18%	1%	6%	1%	8%	0%	12%	0%	27%	0%	4%	0%
3. Phones	2%	0%	0%	0%	1%	0%	1%	0%	2%	0%	1%	0%	1%	0%	1%	0%	6%	0%	0%	0%
4. Printing	5%	1%	0%	0%	2%	0%	0%	0%	3%	4%	0%	0%	3%	0%	0%	0%	4%	0%	0%	0%
5. LAN	2%	0%	5%	0%	3%	0%	11%	0%	2%	0%	6%	0%	1%	0%	11%	0%	1%	0%	3%	0%
6. WAN	0%	0%	0%	0%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%
7. Cloud	1%	0%	4%	0%	0%	0%	3%	0%	1%	0%	4%	0%	0%	0%	3%	0%	1%	0%	2%	0%
8. DC	6%	0%	15%	0%	3%	0%	38%	0%	5%	0%	17%	0%	3%	0%	41%	0%	4%	0%	13%	0%

Table 4 - Allocation of impacts by IS domain and life cycle stage

Legend: BLD = manufacturing, DIS = Distribution, USE = Use, EOL = end of life

The root cause analysis of impact highlights two main contributors: the user environment and data centres. Typically, the user environment concentrates impacts associated with manufacturing (ADPe, GWP, WU) while the power consumption of data centres concentrates other impacts on the use stage (GWP, AP, IR, PM, ADPf).
However, the WU indicator "Water Use" should be considered with care. Indeed, a problem of data accounting for water flows in end-of-life (EoL) forced us to exclude it from this part of the study.

> “This benchmark allowed us to have more visibility on the LCA of our IS as part of our ISO 14001 approach. With this audit, we now have a relevant inventory and an efficient measure of our maturity. This benchmark was useful and formative for us, especially since this year, we carried out our carbon footprint. The transition plan will be able to build on the recommendations made to us.

Participants' opinions: Mylene Peronet, Consort France

PLANETARY BOUNDARIES

	ADPe	ADPf	AP	CTUe	GWP	IR	PM	WU
	kg Sb eq.	MJ	mol H+ eq.	CTUe	kg CO2 eq.	kBq U235 eq.	Occurrences of diseases	m3 eq.
Planetary limit (Budget per person)	48%	39%	1%	41%	37%	1%	18%	1%

Table 5 - Share of IS footprint within planetary boundaries

The Paris Agreements have set a target of 2 tons per French individual with the hope to limit global warming to +1.5°C. The carbon footprint of a French person today is about 9.5 tons of CO2 equivalent (imported emissions included)

The European Commission’s JRC working group[1] defined a greenhouse gas emissions budget of 985 kg CO2e per European in order to remain within sustainable planetary limits.

In this study, a user consumes 37% of this annual budget in terms of greenhouse gas emissions just by using his company's information system.

Similarly, the JRC sets a budget of 3.18^{E-02} kg SB eq to respect planetary boundaries. A user of our study therefore consumes 48% of his budget in abiotic resources.

[1] https://publications.jrc.ec.europa.eu/repository/handle/JRC113607

MATURITY

REPOSITORY

The maturity assessment is based on the third edition of the Green IT best practice framework developed by GreenIT.fr as part of the Green IT Club and published in March 2022, as well as the associated evaluation system (score out of 100). https://club.greenit.fr/outils.html

CMMI SCALE

The rating system is based on a standardised scale from 1 to 5 and a weighting system according to the importance of each of the good practices implemented:

1. **Initial** : The action is not yet applied or in an unpredictable, unorganised or controlled manner.
2. **Reproducible** : the good practice is beginning to be mastered and has been initiated on part of the system.
3. **Defined** : Processes are clearly identified and defined.
4. **Mastered** : an indicator, qualitative or quantitative KPIs measuring the performance.
5. **Optimised** : Continuous improvement practices are implemented

AVERAGE MATURITY OF ORGANISATIONS

Maturity - average score	2022 & 2023
1. Responsible purchasing	38%
2. Lifespan and end of life	49%
3. Governance	33%
4. Workstation	47%
5. Telephony	43%
6. Printing	52%
7. Tools and uses of the workstation	44%
8. Software	44%
9. Digital Services and Business Applications	37%
10. Data Centres	36%
11. Network	31%
	41%

Table 6 - Level of maturity by information system domain

> This audit approach allows us to become aware of our impact and gives us ideas for optimization to improve our footprint. Data inventory highlights the need for organization and quality monitoring inherent in a continuous improvement approach. The Green IT Benchmark is a good start for any organization wishing to improve its environmental performance.

The opinion of the participants: Valentin Klein di Giacomo, Easy Cash S.A.S

CHANGING ORGANISATIONAL MATURITY

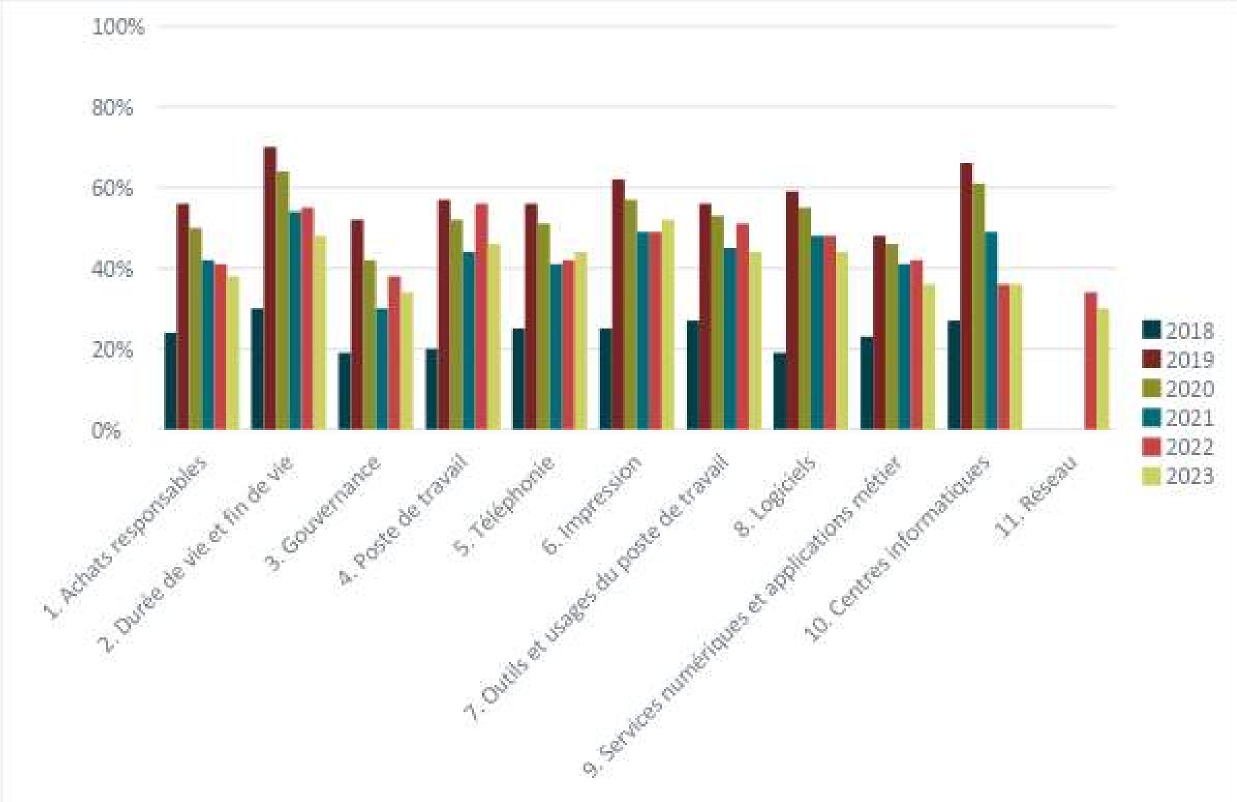

Figure 4 - Evolution over time of maturity by domain

There are significant gaps in maturity between organisations and the average maturity of organisations does not improve significantly from year to year.

Several factors explain these results:

- organisations participating in the Green IT Benchmark are often at the beginning of their journey and have therefore not undertaken the implementation of best practices.
- A stricter application of the CMMI scale compared to previous years

RECOMMENDATIONS

Given the main results of this study, the key recommendations, by major area of the information system, are essentially the same as last year (2022) to reduce the environmental impacts of an organisation.

USER ENVIRONMENT

WATCH OUT FOR SCREEN TECHNOLOGY!

PRIORITY ★★★

IMPLEMENTATION ⚙⚙

The usage of a second external monitor is a disaster from an environmental point of view when it is LED/OLED technology: it is much less when LCD technology is used. When an employee is equipped with a laptop and two external 24-inch LED/OLED displays, the screens contribute to about 2/3 to 3/4 of the workstation's environmental impacts (depending on the observed impact indicator). It is therefore crucial to avoid generalisation of the second screen, a fortiori LED / OLED, unless absolutely necessary. The difficulty lies in the fact that almost all screens sold today are based on LED technology.

DO NOT RENEW SCREENS AS LONG AS THEY STILL RUN

PRIORITY ★★★

IMPLEMENTATION ⚙

Given the impact of monitor manufacturing, the most effective approach is to only renew them when they break down. With such an aggressive policy, some organisations may easily reach a lifespan of more than 10 years while overall average of about 8 to 9 years for the entire fleet. Obviously, this practice will be even more effective if we do not generalise the 2nd screen (or to a lesser extent if we limit its size), otherwise addressing this bad practice is very limited.

MAKING THE SECOND LIFE OF EQUIPMENT SYSTEMATIC

PRIORITY ★★★

IMPLEMENTATION ⚙⚙

The equipment rate and the lifespan of the material are the two main parameters that determine the user's digital footprint. It is therefore necessary to massively refurbish equipment when they go out of the organisation. On average, 80% of the exiting equipment is still running and can be reused. Systematisation and industrialization of reuse practice require to be integrated from the procurement of new equipment and to define a first use lifespan, which is short enough to maximise its residual value from both financial and usage perspective. In general, companies define the depreciation plan based on the warranty period, 3 or 5 years. To systematise reuse, it seems necessary to identify a serious partner in IT asset disposal .
Organisations working internationally will have additional evangelisation efforts towards countries that are unfamiliar with IT disposal.

PRINTING

PRIORITY ★★★

IMPLEMENTATION ⚙

PREFER BLUE ANGEL OR FSC LABEL WITH RECYCLED PAPER

Although the printing sector is not the most impactful in the footprint, due to the sharp decrease in equipment and printing, the rate of recycled paper is rather down (41%). The choice of paper has an effect on freshwater consumption as well as on other impact indicators related to pollution of aquatic ecosystems (eutrophication, etc.). To reduce the impact, We recommend to buy 100% recycled unbleached paper labelled by Blue Angel or FSC. In 2021, quality recycled paper no longer poses any technical problems (powdering, tearing, etc.) for recent printers.

TELEPHONY

PRIORITY ★★★

IMPLEMENTATION ⚙

ENSURING SMARTPHONES A SECOND LIFE

Telephony does not appear to be a major source of impact at the scale of a company's information system. Nevertheless, the smartphone has become the symbol of planned obsolescence. The growing success of refurbishment helps to mitigate this concerning observation. It is therefore interesting to encourage users to take care of their professional smartphone and give a chance for a second life.

PRIORITY ★☆☆

IMPLEMENTATION ⚙

DO NOT REPLACE LANDLINE PHONES

The decline in landline telephones that began in recent years continues. It is now a common practice to no longer deploy desktop phones and to migrate to softphone solutions. This good practice limits the environmental impacts associated with manufacturing. It is also more user-friendly. It is now necessary to decommission the fleet towards the right disposal sectors.

NETWORK

PRIORITY ★★☆

IMPLEMENTATION ⚙⚙

SET UP THE STANDBY MODE FOR NETWORK DEVICE

The systematic purchase of equipment with easy standby mode features (Energy Efficient Ethernet) and their effective configuration could significantly reduce electricity consumption and the associated environmental impacts (tension on fresh water, resource use, etc.) related to the network.

Data Centre

PRIORITY
★★★
IMPLEMENTATION
⚙⚙

EXTEND ASHRAE CLASSES A3 TO A4

The energy efficiency of data centres of organisations, both private and public, has been significantly improved over the last 15 years, with a PUE (Power Usage Effectivness) often halved. However, it is possible to go a step further by systematically deploying IT equipment compliant with ASHRAE Class A3 to A4 requirements. Hence, it enables to raise the temperature above 24 ° C and to cool the equipment with natural cold (free cooling). However, this good practice requires the equipment to be 100% in accordance with these technical specifications. Its deployment is therefore easier in the context of a new data centre or a major equipment upgrade.

PRIORITY
★★☆
IMPLEMENTATION
⚙⚙⚙

OPTIMISE PHYSICAL ARCHITECTURE

Rather than opting for standard server configurations, it may be interesting to adapt the architecture to use. This dedicated architecture optimises performance, cost and energy efficiency.
Virtualizing under capacity servers saves space, hardware, and energy, and provides greater agility to increase time-to-market.
Finally, the eco-design of digital services contributes to significantly reducing the physical infrastructure required to operate the information system.

IT Department

As observed in this study, IT staff generates a major source of greenhouse gas emissions and primary energy consumption.

PRIORITY
★★★
IMPLEMENTATION
⚙

SET UP A MOBILITY PLAN

Primary energy mainly comes from the vehicle's fuel. Thus it results in significant greenhouse gas emissions: to reduce overall GHG emissions of the information system, acting on IT staff's travel is unavoidable. Setting up a Mobility Plan consists of playing on the quantity and quality of kilometre s travelled by IT employees and service providers. Two approaches are particularly effective: promoting carpooling with more than 2 passengers per car and maximising the use of public transport and soft mobility.

PRIORITY
★★☆
IMPLEMENTATION
⚙⚙

PROMOTING REMOTE WORK

Remote work can improve employees' comfort while reducing the impacts associated with their travel. However, it requires implementing appropriate technical conditions while avoiding underlying health risks and rebound effects (increase in digital equipment, increase in personal travels, overconsumption of energy at home, intensive use of videoconferencing, etc.).[2].

[2] ADEME, 2020: https://librairie.ademe.fr/mobilite-et-transport/3776-caracterisation-des-effets-rebond-induits-par-le-teletravail.html

ANNEXES

METHODOLOGY

Life cycle assessment is an environmental assessment method in the same way as carbon footprint or impact assessments, but it has specificities that make its holistic approach unique. Indeed, used since the late 1990s and standardised in the ISO series 14040:2006 and 14044:2006, this method proposes to establish the ecological baggage of a product or service according to an approach:

- **Multicriteria:** Several environmental indicators are to be systematically considered through the Climate Change, the Resource use, the creation of photochemical ozone, water, air and soil pollution, human ecotoxicity and biodiversity. The list of indicators remains open but depends on the sectors of activity.
- **Life cycle:** in order to encompass the impacts generated during all stages of the life cycle of equipment, from the extraction of natural resources, often less accessible, to the production of waste through energy consumption in the use phase...
- **Quantitative:** each indicator is qualified in a quantified way in order to be able to put on the same scale all the externalities of a product or service and to make objective decisions.
- **Functional:** the object of study is defined by the function it performs in order to be able to compare different technical solutions.
- **Attributional** or consequential: Life cycle analysis makes it possible to characterise the direct environmental impacts of a solution via attributional life cycle analysis but also indirect or systemic environmental impacts through consequential life cycle analysis. As part of the Green IT Benchmark, we apply the attribution method.tag.

Performing the Life Cycle Assessment of an information system amounts to quantifying its materiality in order to deduce its environmental externalities. It is relevant to apply this method to:

- Establish a quantitative diagnosis of the direct environmental impacts of an information system
- Identify the most significant improvement levers to deploy a Green IT strategy
- Communicate objectively about performance and improvements
- Manage its Green IT strategy and integrate the digital services footprint into company reports

LCA is a powerful decision-making tool at the level of both state and corporate strategy

Only direct impacts are taken into account in this study. Indirect, positive and negative impacts (such as direct or indirect rebound effects, substitution, structural changes) are out of scope. This constitutes an attributional LCA.

MODEL

Even if LCA is initially more applied to the field of products, its scope of actions has been expanded in recent years. First thanks to the ETSI 203 199 standard[3] and today thanks to the many works carried out by professional telecommunications organisations such as the ITU[4], by the NegaOctet consortium[5] for digital services or by the Ecodesign Pole[6] for services in general. This work now feeds French regulations and in particular the implementation of Article 13 of the AGEC law (anti-waste and circular economy)[7] which aims to oblige telecommunications network

[3] https://www.etsi.org/deliver/etsi_es%5C203100_203199%5C203199%5C01.03.01_60%5Ces_203199v010301p.pdf

[4] https://www.itu.int/en/action/environment-and-climate-change/Pages/default.aspx

[5] https://negaoctet.org/

[6] https://www.eco-conception.fr/

[7] https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000041553759/

operators to communicate to the general public the environmental impacts associated with data transmission.

Moving from a product to an information system means maintaining the multi-criteria and functional philosophy but moving from a circular approach (from cradle to grave) to a matrix approach integrating the life cycle of all the equipment constituting the three tiers (terminals, networks, datacentre) allowing the information system to function. Hence, such an environmental diagnosis enables us to avoid transfers of pollution from one stage to another but also from one tier of the information system to another .

ENVIRONMENTAL INDICATORS

Impact category	Abbreviation	Model	Unit	LCA Method Recommendation Level
Climate change	GWP	IPCC 2013, GWP 100	kg eq. CO_2	I
Depletion of the ozone layer	ODP	World Meteorological organisation (WMO), 1999	kg CFC-11 eq.	I
Particulate matter emission	PM	Fantke et al., 2016	Incidence of disease	I
Acidification	AP	Posch et al., 2008; Seppälä et al. 2006	mol eq. H+	II
Eutrophication, freshwater	Eth	Struijs et al, 2009	kg P eq	II
Eutrophication, marine	EPM	Struijs et al, 2009	kg N eq	II
Eutrophication, terrestrial	EFA	Posch et al, 2008; Seppälä et al. 2006	mol N eq	II
Ionizing radiation, human health	IR	Frischknecht et al. 2000	kBq eq. U235	II
Photochemical ozone formation, human health	POCP	Van Zelm et al., 2008, as applied in ReCiPe, 2008	kg eq. NMVOC	II
Human toxicity, non-cancerous	CTUh-nc	USEtox (Rosenbaum et al., 2008)	CTUh	III
Land use	READ	Soil quality index (based on Beck et al. 2010; LANCA, Bos et al., 2016)	pt	III
Resource use, fossils	ADPf	ADP for energy carriers, based on van Oers et al. 2002 as implemented in CML, v. 4.8 (2016)	MJ	III
R esource use, minerals and metals	APDe	ADP for resources (minerals and metals), based on van Oers et al. 2002 as implemented in CML, v. 4.8 (2016)	kg Sb eq	III
Water use	WU	AWARE 100 (based on Boulay et al., 2018)	Global M3 Eq	III
Ecotoxicity, freshwater	CTUe	USEtox (Rosenbaum et al., 2008)	CTUe	III/Interim
Human toxicity, cancer	CTUh_nc	USEtox (Rosenbaum et al., 2008)	CTUh	III/Interim

Table 7 - Indicators recommended by the FIP method

Resource Use, **mineral and metals**	**Climate change**
• Indicator type: Problem-oriented impact indicator (mid-point) • Abbreviation: PEF-ADPe • Unit: kg Sb equivalent (kgeqSb)	• Indicator type: Problem-oriented impact indicator (mid-point) • Abbreviation: GWP • Unit: kg equivalent C02 (kgeqCO2)

● Evaluation method: ReCiPe 2018 Industrial exploitation leads to a decrease in available resources with limited reserves. This indicator assesses the amount of resources (minerals and metals) removed from nature as if they were antimony.	● Evaluation Method: IPCC Methodology 2013 Greenhouse gases (GHGs) are gaseous compounds that absorb infrared radiation emitted by the Earth's surface. The increase in their concentration in the Earth's atmosphere contributes to global warming.
Water Use ● Indicator Type: Impact Indicator ● Unit: m3 ● Abbreviation: PEF-WU ● Unit: m3 world eq ● Evaluation method: Available Water REmaining (AWARE) as recommended by UNEP, 2016 Impact related to freshwater consumption (lakes, rivers or groundwater);	**Particulate matter** ● Indicator type: Problem-oriented impact indicator (mid-point) ● Abbreviation: PEF-PM ● Unit: Disease incidence ● Evaluation method: PM method recommended by UNEP (UNEP 2016) The presence in the air of fine particles of small diameter, especially those with a diameter of less than 10 microns - represents a human health problem, since their inhalation can lead to respiratory and cardiovascular problems.
Acidification ● Indicator type: Problem-oriented impact indicator (mid-point) ● Abbreviation: PEF-AP ● Unit: mol H+ eq ● Evaluation method: Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008) Air acidification is related to emissions of nitrogen oxides, sulphur oxides, ammonia and hydrochloric acid. These pollutants turn into acids in the presence of moisture, and their fallout can damage ecosystems and buildings.	**Ionising radiation** ● Indicator type: Problem-oriented impact indicator (mid-point) ● Abbreviation: PEF-IR ● Unit: kBq U235 eq ● Evaluation method: Human health effect model as developed by Dreicer et al. 1995 (Frischknecht et al, 2000) Radionuclides can be released during a number of human activities. When radionuclides decay, they release ionizing radiation. Human exposure to ionizing radiation damages DNA, which can lead to various types of cancer and birth defects.
Resource use, fossil ● Indicator type: Problem-oriented impact indicator (mid-point) ● Abbreviation: **PEF-ADPf** ● Unit: **MJ** ● Evaluation Method: CML 2002 The indicator represents the consumption of primary energy from different non-renewable sources (oil, natural gas, etc.).	**Primary energy consumption** ● Indicator type: Flow indicator ● Abbreviation: CED ● Unit: MJ cumulative primary energy. Primary energy is the first form of energy directly available in nature before any transformation: wood, coal, natural gas, oil, wind, solar radiation, hydro or geothermal energy, etc.

Table 8 - Description of selected impact indicators

LEXICON

- **Life Cycle Assessment** (LCA): standardised assessment method (ISO 14040 and 14044) to perform a multi-criteria and multi-stage environmental assessment of a system (product, service, company or process) over its entire life cycle.

- **WEEE**: Waste Electrical and Electronic Equipment. In the area of responsible digital, particular attention is paid to categories 3 (computing and telecommunications) and 4 (consumer equipment).
- **Data Centre**: physical location where computer servers are grouped for processing and storing computer data.
- **Ecodesign**: also, "eco-design". According to the international standard ISO 14062, "eco-design consists of integrating the environment from the design of a product or service, and at all stages of its life cycle".
- **IT Ecolabel**: Ecolabels are intended to promote the design, marketing and use of products and services with a lower impact on the environment at each stage of their life cycle.
- **Rebound effect**: The Jevons paradox states that as technological improvements increase the efficiency with which a resource is used, the total consumption of that resource can increase instead of decrease.
- **Embodied energy**: Embodied energy is the sum of the energies needed to manufacture a product or service.
- **EPEAT**: IT Ecolabel that covers the entire life cycle of equipment, from equipment design, to its use, including its end of life. Site: EPEAT.net
- **End of life**: The stage in the life cycle of an object from which it is considered as no longer used. The end of life itself includes different sub-stages: collection, sorting, reconditioning, remediation , recycling, recovery (incineration) and landfill.
- **GHG** (Greenhouse Gases): Greenhouse gases are gaseous components that absorb infrared radiation emitted by the Earth's surface, contributing to the greenhouse effect. The increase in their concentration in the Earth's atmosphere is a factor suspected of being at the origin of global warming. Global warming contributes to climate change, which is reflected, among other things, in the collapse of biodiversity. There are about ten GHGs including methane (CH4), carbon dioxide (CO2), water vapor (H2O), sulfur hexafluoride (SF6), etc.
- **Green IT governance**: organisation set up by a company to manage its Green IT action plan. Steering consists of defining objectives, financial and human resources, responsibilities, milestones and progress indicators. The steering committee is responsible for the smooth running of the process(es) to achieve the set objective.
- **Green IT**: Continuous improvement approach that aims to reduce the environmental, social and economic impacts of digital technology. The official term in France (very little used) is eco-ICT.
- **IT infrastructure**: All equipment, software, and third-party services shared across an organisation's information system. This term basically includes the network (WAN/LAN) and data centers.
- **Kilowatt-hour** (kWh): unit of measurement of an amount of energy. Alternative to the Joule, ISO international unit. For example, the power consumption of a computer is measured in kWh per year.
- PCR (or PEFCR): Product Category Framework derived from the LCA methodology to describe the application of this methodology to a particular product or service.
- **Ecological backpack**: Also called "ecological ruck-sack" and translated as MIPS (Material Intensity Per unit of Service), this indicator measures the resource intensity of the manufacture of an object. It compares the weight of raw materials needed for manufacturing with the weight of the finalproduct. The ratio is, for example, 16,000:1 for a computer chip versus 54:1 for a car.

- **Virtualization** (of servers): This approach involves creating a software image of underusedphysical servers and running those virtual servers on a single physical server. By reducing the number of physical servers, the underlying environmental impacts are reduced.

SOURCES OF THIS LEXICON:

- Bordage Frédéric, Digital sobriety: the keys to act, Buchet-Chastel, 2019, https://www.greenit.fr/2019/09/10/sobriete-numerique-les-cles-pour-agir/
- Bordage Frédéric, From Green IT to responsible digital, Club Green IT, 2018, https://www.greenit.fr/2018/05/31/green-it-numerique-responsable-lexique-termes-de-reference/
- Bordage Frédéric, Lexicon, GreenIT.fr, 2004-2021, https://www.greenit.fr/2008/05/21/glossaire/