Note on Methodology and Data used for the analysis and assessment for the 2023 edition

Disclaimer : "In the field of the environmental impacts of digital technology, we can conclude that a figure is the result of an estimation made under specific conditions, with a specific methodology, uncertainties and sources; the figure represents only what it represents, with all the relevant limits. It is therefore important to be aware of all these limitations and sometimes the conclusion is the unreliability of the figure in question; for example, estimates of the potentially positive impacts of digital technology are based on so many extrapolations and overly optimistic assumptions that they do not really make sense."

Source : QUANTIFIED RESULTS: HOW RELIABLE ARE THEY?

Summary

The purpose of the analysis proposed below is to explain the negative impacts avoided during our actions during the Cyber CleanUps, by drawing up a balance sheet that gives orders of magnitude. In this note, we would like to share with you our

methodological approach, its limits and the choices we made to achieve the impact equivalences.

It should be stated by way of introduction that the essential challenge of the Cyber World CleanUp Day action is to raise awareness and sensitise as many people as possible to the environmental impact of digital technology. The essential message we wish to send is to do everything possible to **extend the life of digital equipment**, and to **allow a second life** for its equipment.

t should also be noted that at present, the various studies conducted on the impact of data storage and transfer show a wide disparity in the results. This is also the case for the figures on impact equivalence across the whole life cycle analysis of digital equipment. In fact, the work we have done is to define which study could best fit the objective of Cyber World CleanUp Day in the different cases:

- Deletion of data by deleting local files stored directly on digital equipment
- Deleting data on a local server
- Deletion of data from the cloud
- Collection of functional digital equipment
- Collection of non-functional digital equipment (WEEE)

Throughout this note, you have access to a number of tables, examples and comparative elements that will help you better understand the methodology applied in each case. And for all the data selected, you will find the sources and associated links.

About the estimated footprint of the Cloud

The footprint we can estimate for data handling in the cloud is still subject to existing studies, the results of which are, once again, disparate. The scope we have set extends mainly to the storage (but not the transfer) of files including emails. We have chosen to use the figures from the Green Cloud Computing study (2021) based on the work of the Umweltbundesamt (the German federal Environmental Agency), which provides a rational approach to the subject. The figures used and their limits are explained to allow a detailed understanding of the subject.

About the estimated impact of extending the life of appliances

As mentioned in the introduction, the real impact of the action is the contribution to the non-renewal of your equipment - the manufacture of equipment accounts for a very large majority of the digital footprint. So, by reducing the amount of data stored on your equipment, you are helping to take care of your equipment and extend its life.

In order to establish a quantified assessment of this action, our work focused on finding the most relevant data on the carbon impact and lifespan of each type of equipment. By associating average life span extensions with this data, we have proposed savings projections for the environmental balance of the equipment.

About the impact of equipment collection

The impact of the collection of functional equipment uses the same data as those selected in the context of extending the lifespan of appliances (see previous paragraph). In Belgium, the vendor/seller will usually limit the warranty period to 1 year, which is the legal minimum. If he/her doesn’t do it, then you are legally allowed a 2-year warranty.
we assumed that each reconditioned piece of equipment would have its lifespan extended by at least 2 years.

However, the impact of recycling non-functional equipment is not calculated in the framework of Cyber World CleanUp Day because it is still very complex to determine.

1 | Our purpose and objectives

The purpose of this analysis is to explain the negative impacts avoided during our actions during the Cyber CleanUps, by drawing up a balance sheet that gives orders of magnitude. In this note, we would like to share with you our methodological approach, its limits and the choices we have made to achieve the impact equivalences.

It should be stated by way of introduction that the essential challenge of the Cyber World CleanUp Day action is to raise awareness and sensitize as many people as possible to the environmental impact of digital technology. The essential message we wish to send is to do everything possible to **extend the life of digital equipment**, and to **allow a second life** for its equipment.

It should also be noted that at present, the various studies conducted on the impact of data storage and transfer show a wide disparity in the results. This is also the case for the figures on impact equivalence across the whole life cycle analysis of digital equipment. In fact, the work we have done is to define which study could best fit the objective of Cyber World CleanUp Day in the different cases:

1. Deletion of data by deleting local files stored directly on digital equipment
2. Deleting data on a local server

3. Deletion of data from the cloud
4. Collection of functional digital equipment
5. Collection of non-functional digital equipment (WEEE)

These five cases do not all have the same impact or purpose.

1. Deleting files stored on your equipment has the ultimate objective of extending its life. The challenge is to help reduce the proportion of equipment that is replaced while it is still functional. Naturally, the size of the machine gradually slows it down, or even makes it impossible to update the operating system. This can therefore be identified as one of the causes of equipment renewal, along with marketing invective and, of course, the increasing demand for resources to run applications, web pages and operating systems. Limiting data storage on your equipment is a good way to take care of it so that it continues to work longer without slowing down and therefore feels less need to be changed.
2. Deleting data from a local server is broadly in line with the previous objective. The challenge is to avoid the purchase of a new server (more powerful, larger storage capacity, etc.).
3. Deleting data in the cloud is first and foremost about being aware of all the data being handled and transferred. Storage and transfer are intrinsically linked. The environmental cost of storage in the cloud is, according to studies published to date, a small part of the digital environmental footprint. The environmental cost of transferring data is slightly higher. The challenge is therefore above all to be able to **be aware of the immense amount of data that we handle** without always worrying about the size of each file transferred. However, the

increasing handling of more and more data ultimately leads to several issues:

- ACCESSIBILITY ISSUE : the person who wishes to download the data must have :
    - a good internet connection
    - a computer powerful enough to download it
- ENVIRONMENTAL ISSUE :
    - obligation for the person who wants to access the data to download it. Thus, the heavier the data I use, the more I require a large transfer.
    - When data is ever more numerous and ever heavier, it becomes increasingly necessary for the person who wishes to handle it to have, in addition to a high-performance network, high-performance equipment. This ultimately leads to the renewal of equipment. Is your old computer or smartphone capable of playing the latest videos smoothly?
- WELL-BEING ISSUE : the more data, emails, etc. I store, the more difficult it is to work serenely. The accumulation of data (v1, v2, v - old, v - temp...) decreases our ability to work efficiently. The desired awareness at cloud level is thus: transfer less and less heavy to avoid having to sort. And at the local level: sorting regularly allows you to take care of your equipment and **ultimately** extend its lifespan.

4. Smartphones (ADEME estimates that 88% of French people change their phones while they are still in good condition) or computers are often replaced long before they break down. This old equipment, although still functional, is often left unused in drawers when it could be of use to other people. By proposing to repair and reuse, we participate in the reuse of functional equipment and in the extension of

its life span. This helps to limit the resources used to manufacture new digital equipment.

5. Digital equipment that cannot be repaired or reused is considered waste. To limit the impact of the end-of-life of our digital equipment, it is important to bring it to a standardised WEEE (Waste Electrical and Electronic Equipment) recycling channel. In this way, we participate in :
    - reduce pollution and prevent our equipment from ending up in illegal open dumps
    - limit the extraction of new resources by recovering materials that can be reused during recycling
    - encourage local processing of recycling channels and the associated jobs needed

2 | The estimated environmental footprint of the cloud

The footprint we can estimate for data handling in the cloud is still conditional on existing studies, the results of which are, once again, disparate. The scope we have set is as follows:

- only the cost of storage (not transfer) is taken into account
- only the carbon impact is taken into account (and not the other equally important impacts, such as water)
- not taking into account the impact of deletion (moving the file) or the path taken to access it

- consideration of the fact that when data is deleted, it is really deleted (no more redundancy or other backups).

We have therefore chosen to use the figures from the Green Cloud Computing study (2021) based on the workd of

Umweltbundesamt (the German Federal Environmental Agency),which allows a rational approach to the subject.

Why was this study adopted?

- It describes a simple approach based on the footprint of 4 datacenters that allows a fine-grained approach to the footprint of each of these equipments.
- It takes into account almost the entire life cycle of the servers
- It offers consistent results compared to the Stanford study, which focuses on **transfer** + storage and estimates the cloud's footprint at 400g CO2eq / GB / year
- It is used as a reference (2020 study) by the Interministerial Digital Directorate (DINUM) in its work entitled "The impact of eco-responsible digital practices within your organisation".

Limitations :

- The study is based on a limited scope of 4 data centres in Germany..
- The data centres of very large cloud companies use data centres that could be more energy efficient
- The data is based on the German energy mix. The data of most of the participating organisations should be hosted at least within the European Union for the most part, as is almost mandatory under the GDPR. Data from individuals can be hosted anywhere in the world. Some elements of the energy mix of each zone :

- Europe : 420 g Co2eq/kWh
- Belgium : 220 g Co2eq/kWh
- France : 60 g Co2eq/kWh
- Switzerland : 27 g Co2eq/kWh

- Germany: 460 g Co2eq/kWh
- Netherlands : 415 g Co2eq/kWh
- China : 766 g Co2eq/kWh
- World : 475 g CO2/kWh

Thus, the figure used is that deleting data reduces the data footprint in the cloud by **209.5 g CO2 / GB / year**.

In the light of this new data, the results of the 2020 and 2021 editions (assessments and infographics produced) will not be comparable with the results of this 2022 edition. It seemed necessary to us, on the one hand, to use the latest publicly available data, and on the other hand, to address a methodology that would allow us to provide a balance sheet reflecting the most accurate picture possible of the impact of the actions carried out through the Cyber World CleanUp Day in relation to environmental issues related to digital technology.

<u>Calculation of our post operation Cyber CleanUp balance sheet Data :</u>

We provide Cyber CleanUp organisers with a calculator based on the estimates mentioned above, in order to obtain a carbon equivalent of the impact avoided following the deletion of data in the cloud, based on a total weight of data submitted via the balance sheet form.

The calculation is therefore as follows:

- Total weight (GB) = weight of deleted emails (GB) +weight of deleted files located in the cloud (GB)
- Impact avoided over 1 year (g CO2eq) = Poids total (GB)* 209,5

This means, for example, that for a Cyber CleanUp operation that deleted a total of 500 GB of data, an impact of 104.75 kg CO2eq. per year of storage was avoided.

From https://monconvertisseurco2.fr, we propose equivalences to help raise awareness of the impact avoided - in our previous example this represents :

- 539 km travelled by car
- 3,2 new smartphones manufactured

3 | The estimated impact of extending the life of the equipment

As mentioned in the introduction, the real impact of the action is the contribution to the non-renewal of your equipment. Thus, by reducing the amount of data stored on your equipment, you contribute to taking care of your equipment and extending its life.

The manufacture of equipment accounts for the vast majority of the digital footprint. The **average material and resource requirements for the manufacture of office equipment represent more than 70% of its life-cycle environmental footprint** over an average period of use of 5 years. (Source ADEME)

For example, to manufacture a 2 kg computer, 240 kg of fossil fuels, 2.2 kg of chemicals, 1000 L of “blue” water and 500 kg of materials are needed. *(See material breakdown in the appendix)*

Some figures to compare the manufacturing footprint and environmental savings of different types of equipment:

The latest ARCEP/ADEME study of 2022 provides updated figures on the carbon footprint of digital equipment.

The results used in the Base Carbone® to calculate the impact of manufacturing on climate change (in kg CO_2eq / product) correspond to an extended "cradle to gate" perimeter that accounts for emissions linked to :

- Extraction of raw materials
- Sourcing
- Shaping
- Assembly
- Distribution

The carbon footprint of the equipment once manufactured is irreducible. On the other hand, extending the life of the equipment helps to limit the need to manufacture new equipment. For example, since the average life of a (fixed) computer is 6 years, we save the manufacturing balance of 3 computers every time we extend the life of 10 computers by more than 2 years. This represents **a saving on the environmental balance of the equipment of about 33%** (source: ADEME).

Based on the average lifespan of each type of equipment, and assuming that we extend the lifespan of each piece of equipment by 2 years, we draw up the following table to deduce a saving on its environmental balance:

Type of equipment (segmentation)	Manufacturing impact (kg CO_2eq / product generated)	Initial average life span (years)	Assumption: 2 year extension of life span (%)	-> Carbon footprint savings (kg CO_2eq / product)
Desktop computer (office equipment 6kg)	265	5	40%	106
Laptop (2 kg)	176	6	33%	58,1
Smartphone (0,3 kg - 5 inches)	88,5	2,5	80%	70,8
Tablet (0,8 kg - 9 to 11 inches)	98,3	3	66%	64,9

Calculation of our post operation Cyber CleanUp balance sheet Equipment :

We provide Cyber CleanUp organisers with a calculator based on the above-mentioned estimates, in order to obtain a carbon equivalent of the impact avoided following the collection of functional equipment to which a second life is allowed, based on the number of equipment according to its type reported via the report form.

It is assumed that all functional equipment collected will have their life extended by 2 years - the legal guarantee of conformity on reconditioned products in France is 24 months. Thus, we can associate a saving in their environmental balance equal to the ratio of the extension of the initial average life of each type of equipment - see previous table.

The calculation is therefore as follows:

- SFC = Savings of a fixed computer (kg CO2eq) = 106 * No. of fixed computers in use
- SL = Savings of a laptop (kg CO2eq) = 58.1* No. of working laptops
- SS = Saving of one smartphone (kg CO2eq) = 70.8 * No. of functional smartphones
- ST =Total impact avoided (kg CO2eq) = SFC + SL + SS + ST

For example, for a Cyber CleanUp operation that collected a total of

- 20 fixed computers
- 100 laptops
- 50 smartphones
- 10 tablets

a potential saving of 12,116.8 kg CO2eq. or more than 12 tonnes CO2eq!

From https://monconvertisseurco2.fr/, we propose equivalences to help raise awareness of the impact avoided - in our previous example this represents :

- 62,782 km travelled by car
- 369 new smartphones manufactured

4 | Appendix - some figure on the manunfacturing process of a computer

Material breakdown in % for the manufacture of a desktop computer :

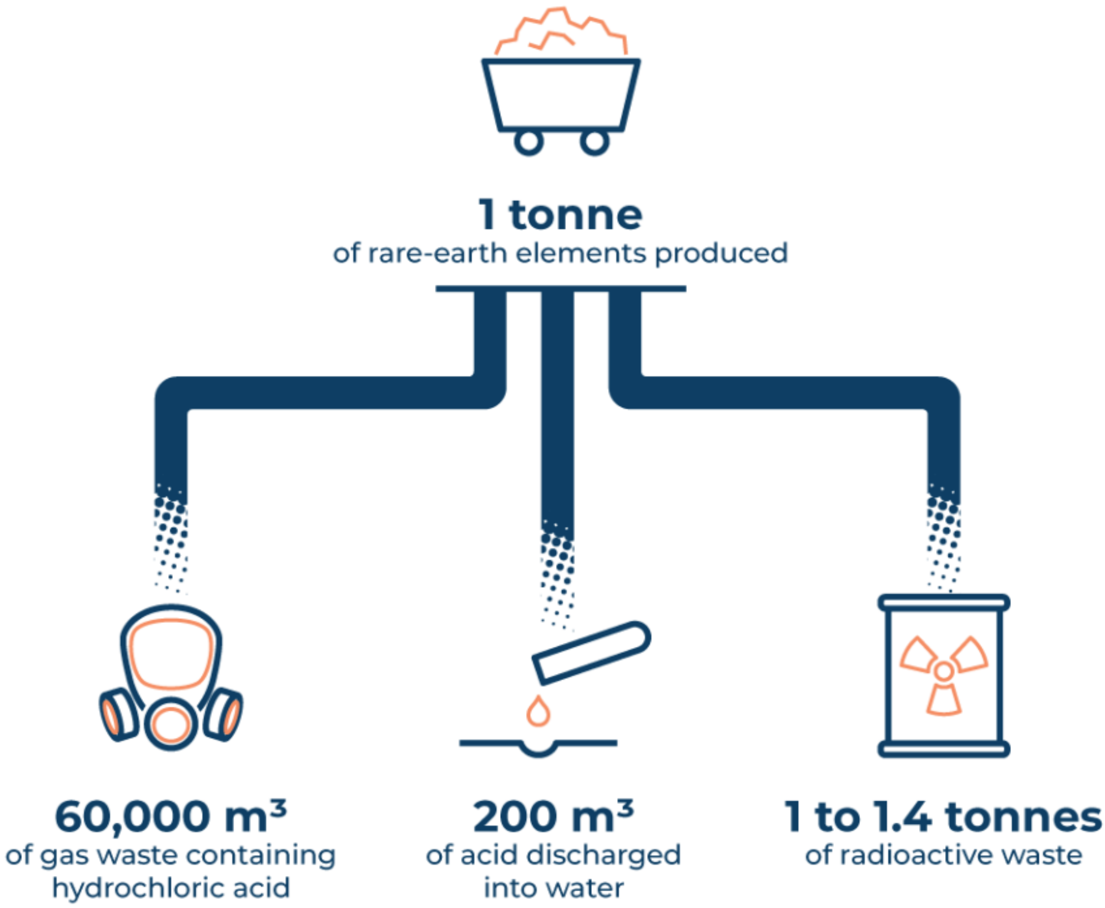
Materials	Proportion (%)
Plastic	23%
Refractory oxides (silicium, etc.)	25%
Copper	6%
Iron	20%
Rare earths*	2%
Nickel	2%
Lead	6%
Aluminium	7%

*The environmental impact of rare earth extraction

1200 Tons of rock for 1 Kg	**Lutetium**
8 Tons of rock for 1 Kg	**Vanadium**
16 Tons of rock for 1 Kg	**Celium**
50 Tons of rock for 1 Kg	**Gallium**

It is necessary to purify the extracted rocks with large quantities of water: **200 m³ of blue water per ton of rocks.**
Rare earths have very similar properties and their separation requires acid products. To obtain one ton of rare earths, we end up with **60,000 m³ of gas waste** with hydrochloric acid, we **release 200 m³ of acid** into the water and we generate **1 to 1.4 tons of radioactive waste**.

Source (FR) :
http://multimedia.ademe.fr/infographies/infographie-terres-rares-ademe/



Source : https://cyberworldcleanupday.fr/

From the 2022 edition of the Digital CleanUp Day, Called "Cyber CleanUp Day" at the time.

DIGITAL CLEANUP DAY