Study

The environmental footprint of the digital world

Summary

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THE TEAM

GreenIT.fr brings together the Green IT actors since 2004. We structure the community in France and in Europe and we publish quality information at the crossroads between digital and sustainable development. As the reference Francophone media on the subject, GreenIT.fr regularly publishes exclusive studies by teams of experts and contributors.

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PREAMBLE

This study, conducted by GreenIT.fr between December 2018 and July 2019, with the support of the *Institut du Numérique Responsable* (INR), focuses on the world's digital equipment, or in other words, all electronic equipment that processes binary data.

It is based on a screening lifecycle analysis (LCA) methodology to quantify the environmental impact associated with digital equipment on a global scale.

This study looks at both the global digital footprint in 2019 and its evolution from 2010 to 2025.

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01 THE DIGITAL WORLD IN 2019

34
BILLION PIECES OF EQUIPMENT

4.1
BILLION USERS

There are **34 billion pieces of digital equipment in the world in 2019, with 4.1 billion users.** The mass of this digital world amounts to **223 million tonnes - the equivalent of 179 million cars (5 times the number of cars in France).**

1.1 FOOTPRINT

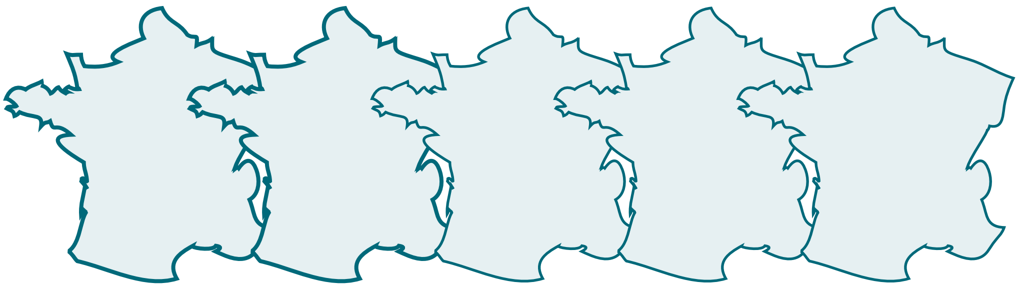
In 2019, the global digital environmental footprint equates to the following:

→ **6,800 TWh of primary energy (PE)**
→ **1,400 million tonnes of greenhouse gases (GHG)**
→ **7.8 million m^3 of fresh water (water)**
→ **22 million tonnes of antimony (ADP)**

Technical and flow indicators

→ **223 million tonnes (mass), i.e. 179 million cars weighing 1.3 tonnes!**
→ **1,300 TWh of electricity consumed**

This represents a **7th continent 2 to 5 times the size of France,** depending on the indicator observed.



The digital world's contribution to the footprint of humanity is far from negligible:

PRIMARY ENERGY CONSUMPTION (PE):	GREENHOUSE GAS EMISSIONS (GHGs):	WATER CONSUMPTION (WATER):	ELECTRICITY CONSUMPTION (ELECTRICITY)*:
4.2 % [1]	**3.8 %** [2]	**0.2 %** [3]	**5.5 %** [4]

*N.B.: electricity consumption is not a relevant environmental indicator.

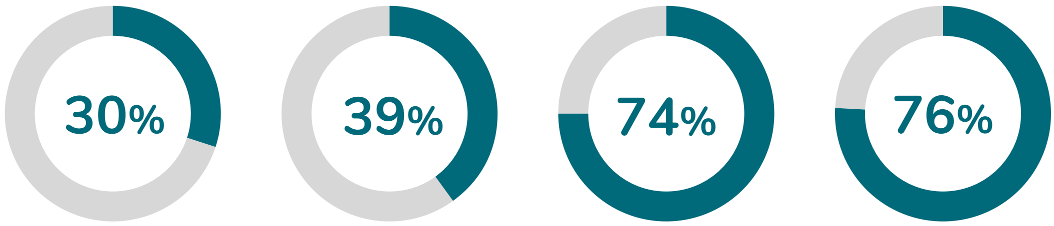
By the way of comparison, this amounts to the following:
→ **GHGs: 1.5 billion French employees going to work for 1 year**
→ **Water: 242 billion packs of mineral water (9 litres)**
→ **Electricity: 82 million electric heaters (1000 Watts each) running constantly**

[1] IEA, *World Energy Outlook*, 2019
[2] IEA, *World Energy Outlook 2018 Electricity*, 2018
[3] *Our world in data, Freh water use*, 2017
[4] *Global Carbon Project, Carbon budget 2018*, 2019

1.2 BREAKDOWN OF IMPACT BY TIER AND BY LIFE CYCLE STAGE

There are typically 3 tiers in the digital architecture, namely users, data centers that host servers, and the network that connects users to each other and to data centres.

The greatest impact is caused by user equipment, the manufacturing of which has the most significant impact, accounting for the following:

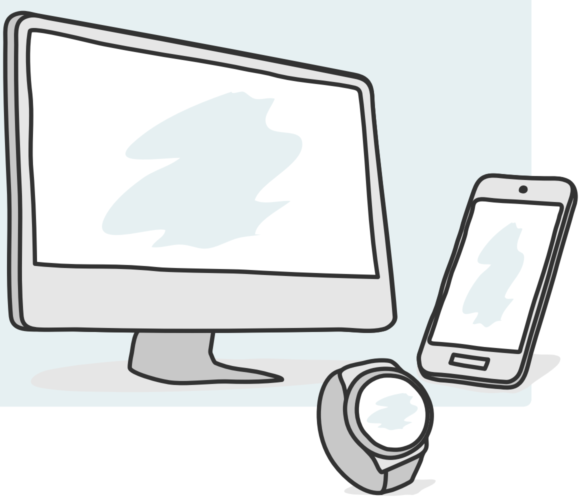


- 30% OF THE GLOBAL ENERGY BALANCE
- 39% OF GHG EMISSIONS
- 74% OF THE WATER CONSUMPTION
- 76% OF THE CONTRIBUTION TO THE DEPLETION OF ABIOTIC RESOURCES

If we include the impact associated with the production of the electricity they consume, user equipment (excluding DSL / fibre modems) accounts for between **59% and 84% of the total impact!**

In 2019, the hierarchy of sources of impact is as follows, in descending order of importance:

1. Manufacturing of user equipment
2. Power consumption of user equipment
3. Power consumption of the network
4. Power consumption of data centers
5. Manufacturing of network equipment
6. Manufacturing of equipment hosted by data centers (servers, etc.)



02 EVOLUTION FROM 2010 TO 2025

The digital world will grow by a factor of **3 to 5 between 2010 and 2025.**

Almost 3 times as many users (from 2 billion in 2010 to 5.5 in 2025) will use 'only' **1.5 times more equipments** because, with the exception of connected devices (IoT), the number of devices in use - computers, screens, smartphones, etc. - will increase moderately (compared to previous years) between 2015 and 2025 with an increase of 'only' **30%** expected to be observed over a 10-year period.

This moderate growth is explained by the low equipment level of emerging countries compared to that of developed countries. **The average equipment level is thus expected to halve in 15 years.**

2.1 FOOTPRINT: DOUBLE TO TRIPLE IN 15 YEARS

This expansion will result in the environmental impact of the digital world doubling or even tripling (depending on the observed indicator) in the space of 15 years. This is an unprecedented increase in terms of both its scale and its speed.

Between 2010 and 2025, the digital footprint is expected to increase from **2.5% to almost 6% of the total human impact**. The largest increase is the contribution to greenhouse gas emissions, which will increase from **2.2%** in 2010 to **5.5%** in 2025.

In absolute terms, there is evidence of a strong progression in all of the indicators between 2010 and 2025:
→ **Energy (PE): x2.9**
→ **GHGs: x3.1**
→ **Water: x2.4**
→ **ADP: x2.1**
→ **Electricity: x2.7**

In relative terms, compared to the total footprint of humanity, which will also increases, the progression is slower. However, it remains much faster than most other sectors of the economy.
→ **Energy (PE): x2.4**
→ **GHGs: x2.5**
→ **Water: x2.1**
→ **Electricity: x1.9**

2.2 NEW SOURCES OF IMPACT

As in the previous 15 years, most of the impact by 2025 will come from users. For example, **62% of digital GHG emissions** will be user-related, 35% of which will originate from equipment manufacturing.

However, while computers and associated display devices accounted for around **40%** of the total digital impact in 2010, a new trend appeared in 2015 and will continue to accelerate until 2025, with the following **3 primary new sources of impact:**

1. TELEVISION SETS:

5 to 15%

OF THE IMPACT IN 2010
AS OPPOSED TO

9 to 26%

IN 2025

2. SMARTPHONES:

2 to 6%

OF THE IMPACT IN 2010
AS OPPOSED TO

4 to 16%

IN 2025

3. CONNECTED OBJECTS:

1%

OF THE IMPACT IN 2010
AS OPPOSED TO

18 to 23%

IN 2025

Apart from the growth in the number of users, the increase in the size and footprint of the digital world is therefore mainly due to the following:

- **connected devices, which will increase in number** by a factor of 48 between 2010 and 2025;
- **the doubling of the average screen size** (including television sets) between 2010 and 2025;
- **declining energy efficiency gains;**
- **the electricity production of emerging countries,** which often has a greater impact than that of Western courntries.

03 RECOMMENDATIONS

In this context of unbridled growth, the following simple measures could significantly reduce the global digital environmental footprint by 2025:

1 **REDUCING THE NUMBER OF CONNECTED DEVICES**
by promoting the pooling and substitution thereof and by opening their APIs to extend their lifespan.

A. **Pooling is the first lever for reducing impact** and creating value for economic players who could seize this opportunity. This involves, for example, aggregating by building all DSL / fibre modems and associated TV boxes via a single centralised device, which would significantly reduce the impact of the network.

b. **APIs are programming interfaces that are used to exchange data between the connected devices and the servers of the manufacturer or its partners.** These communication interfaces are currently closed, much like a television that might be blocked on a single channel. Encouraging (or requiring) manufacturers of connected devices to open their APIs, it would guarantee that the device could still be used even if the data/content provider disappeared, simply by switching channels!

2 **REDUCING THE NUMBER OF FLAT SCREENS**
by replacing them with other display devices, such as virtual reality glasses, LED video projectors, etc.

3 **INCREASING THE LIFESPAN OF EQUIPMENT**
by extending the legal warranty period, promoting reuse, and fighting against certain economic models (telephone operators in particular).

4 **ECO-DESIGNING DIGITAL SERVICES**
to reduce the need for digital equipment and resources.

Had they been implemented as of 2010, these 4 measures would have **reduced the global digital footprint** over the period observed by **between 27% and 52%**, which would have helped maintain the 2025 digital footprint at its 2018 level despite the addition of **1.1 billion additional users.**

Public authorities can act,
especially through simple actions such as the following:

1. Requiring manufacturers of connected devices to open their APIs
2. Mandating the distinction between corrective and evolutionary software updates
3. Introducing a deposit/refund scheme for EEE, to increase the capture rate of WEEE
4. Prohibiting almost-free equipment linked to telecom contracts
5. Creating a 'Reuse directive' to complement the WEEE directive

These proposals are detailed in section 4 of the report.

You too can contribute in the following ways:

1. By avoiding over-equipping yourself and buying used/reconditioned equipment wherever possible;
2. By extending the lifespan of your equipment by repairing and reusing it;
3. By turning off your modem (DSL/fibre) and the associated TV box when you are not using them;
4. By limiting your use of Cloud and video streaming, especially in 4G;
5. By using DTT rather than DSL/fibre to watch TV.

04 **CONCLUSION**

The above recommendations are essential both because they help compensate for the decrease of energy efficiency gains, and because the two main recommendations - longer lifespan and eco-design - are also avenues of competition for France (and other countries).

However, we are still very far from the factor 4 or 5 needed for sustainable development. As a reminder, in 2019, the GHG emissions of the average digital user are approximately 356 kg CO_2 equivalent, or 20% of the user's 'annual GHG package' of 1.7 tonnes of CO_2 equivalent. This is still too much.

Given the issues raised, it is no longer acceptable to voluntarily increase our digital footprint only to boost the economy, which is ultimately the main reason for the unbridled growth of digital impact.

It is vital that we switch as quickly as possible to a new model of sobriety not only in terms of digital use but also in the technologies themselves.

At the current rate, digital technology, which depends directly on depleting abiotic resources, will be considered **a non-renewable, critical resource** in less than a generation.

This is no longer, therefore, an economic or environmental issue but rather a matter of resilience; how will we protect in the long term our knowledge and culture that are stored digitally, despite the increasing rarity of the resources required for this storage?

Beyond the simple and easy-to-implement recommendations presented above, we therefore advocate the following:

1. the development of a 'low digital technology'
2. effective coordination between 'low' and 'high' digital technology
3. the radical eco-design of digital services

The idea of a **low digital technology** is to use robust, simple, low-impact and very widespread digital technologies such as 2G, SMS, etc. to meet daily needs. Most feedback gathered over the last 10 years shows that this approach is not considered as a regression but is instead well-received by users and it creates economic value.

Radical eco-design aims to coordinate the use of low- and high-tech digital resources to best meet the needs of humanity while significantly reducing our digital footprint. To conclude with a simple example, it is not necessary to have a latest-generation smartphone connected in 4G or 5G to access weather forecasts. A simple SMS allows the forecast to be transmitted on a 2G mobile phone. On the other hand, calculating weather forecasts requires the use of advanced technologies.

Only by adopting this posture of sobriety and cleverly coordinating low and high digital technology will we be able to build a more enviable digital future and make it an effective tool for improving humanity's resilience to the already on-going collapse.