ADEME – Arcep study
Assessing the digital environmental footprint in France

SUMMARY

Study based on a rigorous methodology that assesses the digital environmental footprint in its entirety

On 6 August 2020, the Government assigned France's National Agency for the Ecological Transition (hereafter "ADEME") and Arcep with the joint task of measuring the digital environmental footprint in France.

Today, the state of the art in this area includes studies whose methodologies are not harmonised, are lacking in transparency and only examine the digital environmental footprint only partially, i.e. assessing only the digital technology industry's carbon footprint. **The purpose of this study is therefore to address the need for a more complete assessment.**

To achieve this, **it takes a life cycle assessment (LCA)** based approach, drawing on the most comprehensive and ICT-specific public standards and guidelines to have:

- a more all-encompassing scope, by breaking down digital technology into **three hardware building blocks, namely devices, networks and data centres** (this is the **multi-component aspect of the LCA**);
- an assessment of the digital environmental footprint via **11 additional environmental indicators** on top of **carbon footprint** (this is the **multi-criteria aspect of the LCA**)**;**
- An analysis that **incorporates the footprint generated across the life cycle** of each of these three building blocks, namely **production, distribution, utilisation and end of life** (this is the **multi-stage aspect of the LCA**).

According to this approach, and by examining the data collected for this study, it emerges that:

- **of the three building blocks** that make up the scope of the study, **it is devices (and displays and televisions in particular) that account for 65% to 90% of the environmental footprint,** depending on the environmental indicator considered;
- **In addition to the environmental impact tied to energy consumption (including ionising radiation and the depletion of abiotic (fossil) resources which describe around 64% of the footprint) – which are impacts that are common to multiple sectors – the depletion of abiotic resources (minerals and metals) emerges as a relevant criterion to describe (around 27%) of the digital environmental footprint;**
- **of all the stages** in the life cycle of the goods and services **considered, production and utilisation together often account for 100% of the environmental footprint.**

The study also enables a more granular analysis within each of the building blocks, whose findings are included. This study thus creates the ability to obtain a more detailed assessment of the digital environmental footprint, a concrete understanding of the exercise and to identify the greatest obstacles that need to be removed to improve measurement.

The digital environmental footprint[1] is a topic that is attracting a growing amount of attention. A number of reports have been published over the past several years to draw attention to the sector's carbon footprint and how it is progressing. Their conclusions need to be set against the commitments made under the Paris Agreement[2] of 2015 which seeks to limit global temperature increase to below 2° C, and to meeting the targets set by the European Commission for 2030 and 2050.

Digital technologies today thus represent around 3% to 4% of global greenhouse gas emissions (GHG)[3] and 2% of the national[4] carbon footprint[5] (production and utilisation phases included) in France. According to the report from the Senate's fact-finding mission on the digital environmental footprint, digital's **carbon footprint could increase significantly if nothing is done to curtail it** (+ 60% by 2040 or up to 6.7% of the national carbon footprint).

Digital technology also **encompasses other types of environmental footprint** beyond just a carbon footprint, and which have thus far been largely overlooked. The GreenIT.fr[6] study draws particular attention to ICT's consumption of abiotic resources and water.

Lastly, as pointed out by the Regulatory authority for electronic communications, postal affairs and print media distribution (hereafter "Arcep") in its "Achieving digital sustainability" report[7], if all of the studies agree on the overarching trends and orders of magnitude in play, particularly when it comes to the question of carbon footprint, they nevertheless contain sizeable disparities. These disparities can be **largely attributed to the assessment methodologies used and the supporting data employed. These result in inaccurate measurements of how the digital environmental footprint is progressing in those areas where the implementation of targeted public policies would require a finely tuned and granular understanding of the situation.**

It is in this context, and following the adoption in France of the Act against waste and in support of the circular economy of 10 February 2020 (hereafter, the "AGEC Act") that, on **6 August 2020,** the **Government assigned France's National Agency for the Ecological Transition (hereafter "ADEME")**

[1] In the body of the report, the terms environmental impact and environmental footprint are used alternatively to cover the same idea, namely the effects on the environment beyond a mere assessment of greenhouse gas emissions.

[2] "Paris Agreement", adopted on 12 December 2015 in Paris, signed on 22 April 2016 at UN Headquarters in New York, and entering into force on 4 November 2016

[3] The Shift Project, Lean ICT: *Pour une sobriété numérique*, October 2018; GreenIT.fr, *Empreinte environnementale du numérique mondiale*, September 2019; CGE, *Réduire la consommation énergétique du numérique*, December 2019

[4] Senate, Fact-finding report on achieving a Green digital transition – *Pour une transition numérique écologique*, June 2020

[5] The study mentions climate change explicitly but this summary will use the term carbon footprint. As used in the study, the term "climate change" in fact includes carbon footprint which is the source of the observed climate change.

[6] GreenIT.fr, *Empreinte environnementale du numérique mondiale*, September 2019.

[7] Arcep, Achieving digital sustainability – how to support the increasing use of ICT while reducing the digital environmental footprint, December 2020.

and Arcep with the joint task of measuring the digital environmental footprint in France. The aims set for the assignment include:

- **qualifying the current and future environmental footprint of fixed and mobile network infrastructures**;
- **identifying and assessing the different factors that make it possible to quantify the digital environmental footprint** (including data centres, devices[8], and the different supported uses);
- **defining levers for action and best practices** for the short, medium and long term to reduce the digital environmental footprint.

This summary sets out the objectives and main findings of the study that was produced by a consortium made up of Deloitte, Negaoctet[9] and IDATE. This consortium combines expertise in the area of environmental assessment, technical skills, forecasting skills and knowledge of the use of digital goods and services and their evolution over time, which are all vital to the realisation of this study.

The study is broken down into three distinct tasks.

The first part of the study includes a bibliographical review of methodologies and studies devoted to assessing the digital sector's environmental footprint. This review is completed by a state of the art of the technologies, and interviews with stakeholders operating in France who are focused on the environmental aspects of digital technologies.

The second part of the study seeks to assess the digital environmental footprint in France, and deliver an evaluation of a the footprint generated by households and businesses over the course of one year through their consumption of digital goods and services in France. The study takes a life cycle assessment (LCA) based approach to covering all of digital industry equipment located on French soil (devices[10], networks and data centres). This LCA is **multi-criteria** to assess other types of impact on the environment other than carbon footprint thanks to the use of **11 other indicators**. It is also **multi-component** to break down the digital environmental footprint into three building blocks (devices, networks and data centres). **This ecosystem is made up of players located both inside and outside the country,** and the dividing line between the Information and Communication Technologies (ICT) sector and the entertainment and media (E&M) sector is clearly drawn. Lastly, it is multi-stage to incorporate the footprint generated across the life cycle of each of these three building blocks (production, distribution, utilisation and end of life). To comply with environmental communication standards and further strengthen the study's credibility, a standards-compliant critical review was performed by three outside rapporteurs.

The third part of the study, which is due out in mid-2022, will pertain to forward-looking works assessing the digital environmental footprint in France up to 2030 and 2050 (including the future deployment of new networks that will come to complete and replace those in existence at the time of this assessment). The projections up to 2050 will be established based on the four ADEME 2050 scenarios for achieving carbon neutrality which were presented on 30 November 2021.

The goal of this summary is to present the key findings of the first two parts of the study.

[8] The user devices employed for the consumption of digital services, such as computers, mobile phones, tablets, displays, TVs, internet boxes, game consoles, smart speakers, connected objects, etc.

[9] Negaoctet is itself a consortium made up of LCIE Bureau Veritas, APL DATACENTER, GreenIT.fr, 3bis – DDemain.

[10] The user devices employed for the consumption of digital services, such as computers, mobile phones, tablets, displays, TVs, internet boxes, game consoles, smart speakers, connected objects, etc.

1 Performing a thorough and rigorous assessment of the environmental footprint requires data to be collected and made openly available

A review of the available literature reveals a tremendous heterogeneity in the methodologies employed by the published studies, which only rarely cite the references, benchmarks and standards that underpin their assessments. **This situation persists despite the existence of dedicated standards** that enable a multi-criteria life cycle analysis of digital goods and services.

Alongside the general quantification benchmarks and guidelines that ADEME used for this publication (ISO 14040, ISO14044[11] and BP-X-30 323-0[12]), the study also identifies recommendations that are specific to ICT, such as those **defined by the International Telecommunication Union** (hereafter "ITU") and broken down through the ITU-T L series[13] that the study considers to be the **most comprehensive approach** available today:

- it enables a harmonisation between the life cycle assessments of various digital goods and services;
- it argues for a multi-criteria approach by recommending a series of indicators to complement carbon footprint measurement;
- it defines the most all-encompassing scope of study possible.

This is the methodology chosen for the assessment performed by this study[14]. Compliance with international LCA study standards was confirmed by the critical review.

Its implementation nevertheless remains **complex as it requires supporting data that are not readily available.** This was confirmed by the interviews that were conducted during which all of the parties interviewed recognised how hard it was to assess the digital environmental footprint due to the sector's cross-cutting nature. **The lack of knowledge about certain aspects of the sector (unitary footprint by type of hardware, number of devices, etc.) and the lack of mastery of shared methodologies** further aggravates the complexity of measuring the impacts.

The work carried out in response to the AGEC Act will help to reduce this complexity by consulting with all of the stakeholders and by creating data "by default," which should bring about a good balance between representativeness and ease of implementation.

ADEME also continues to work on fine tuning existing methodologies for product categories, notably through the definition of Product Category Rules (hereafter "PCR") particularly via the Négaoctet consortium. Two sets of rules have already been produced (Digital Services PCR and Internet Access Provision PCR) and additional work is underway (PCR Business Networks and PCR for data centre and Cloud services). The aim is to support and further develop this approach.

---

[11] ISO 14040:2006 and ISO 14044:2006 specify the principles and framework applicable to the performance of life cycle assessments, including definition of the goal and scope of the LCA, the life cycle inventory analysis phase, the life cycle impact assessment phase, the life cycle interpretation phase, reporting and critical review of the LCA, limitations of the LCA, relationship between the LCA phases, and conditions for use of value choices and optional elements.

[12] General principles for an environmental communication on mass market products

[13] Series of ITU recommendations that deal in particular with: "the Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant".

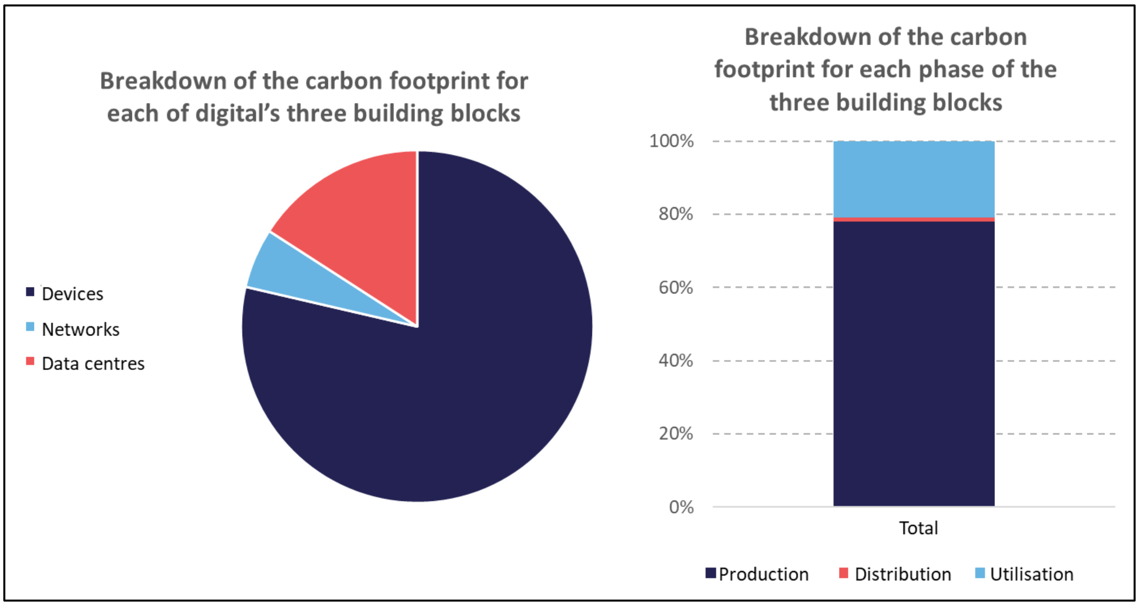
[14] A critical review was therefore conducted parallel to the study by another subcontractor, specifically to verify compliance with ISO 14040 and ISO 14044 requirements and guidelines. The subcontractor also supplied an analysis of compliance with the above-mentioned standards.

On the matter of impact data[15] the “IMPACTS” database made available by ADEME is an invaluable tool. Regarding inventory data[16] in particular, extending Arcep’s data collection powers should create the ability to refine measurement of digital environmental footprint in France **by opening access to some of the needed data**.

In addition, the study underscores the need to train **ecosystem stakeholders to support them in their implementation of the methodology for measuring environmental footprints.**

2 A digital carbon footprint in France of 16.9 Mt CO2 eq. concentrated around devices and the production phase

The carbon footprint of digital goods and services for one year in France currently represents 2.5% of the country’s total annual carbon footprint, or 16.9 Mt CO2 eq.[17]. This footprint corresponds to **253 kg CO2 eq. per year per capita.** Annual energy consumption induced by digital goods and services in France stands at 48.7 TWh or roughly equivalent to **10% of France’s annual energy consumption. The digital carbon footprint is due mainly to devices** (which account for 79%), followed by data centres (over 16%) then networks (around 5%). The hardware production (devices, servers, boxes…) phase accounts for 78% of the total footprint, compared to 21% for the utilisation phase.



The **sensitivity studies carried out for this study nevertheless show real disparities in the findings.** Caution must therefore be applied to the **reliability of the results at a more granular level** (e.g. analysis by type of household or business or by network segment). These results therefore remain estimates, in addition to underscoring the need to **continue to follow through on this work while lifting the identified obstacles to deploying more robust and accurate measurement.**

---

[15] Data on devices’ impact (e.g. carbon footprint generated by a device’s production)

[16] Data inventorying the different types of digital equipment

[17] For a greenhouse gas, CO2 equivalent (CO2 eq.) is the carbon dioxide (CO2) equivalent quantity that would provoke the same radiative forcing as this gas, in other words that would have the same capacity to trap the sun’s rays.

3 The digital environmental footprint is not confined to carbon footprint

This study also assess the **digital environmental footprint in France for the first time via 12 environmental indicators:** depletion of abiotic resources (fossils, minerals and metals), acidification, ecotoxicity, carbon footprint, ionising radiation, fine particulate emissions, ozone creation, raw materials, waste production, primary energy consumption, final energy consumption.

The study **begins by providing quantified assessments of the digital environmental footprint indicators (expressed at this stage in different units, depending on the indicator: kg CO2 eq. for carbon footprint, MJ[18] abiotic (fossil) resources depletion, kg Sb eq[19]. for natural abiotic resource depletion, kBq U235 eq[20]. for ionising radiation, etc.)**. To be interpreted relative to others and identify the **environmental indicators that are not heavily affected by digital technology, the quantified results of this assessment are standardised[21] by their global per capita equivalent[22] then weighted.** It should nevertheless be stressed that there is no scientific consensus on how to compare these indicators with complete accuracy[23].

As a result, alongside the environmental footprint, notably the one generated by energy consumption (which includes carbon footprint, ionising radiation and abiotic (fossil) resource depletion which describe around 64% of the footprint) **which are effects that are common to multiple sectors, the depletion of natural abiotic resources (minerals and metals) emerges as a relevant criterion for describing** (around 27% of the) **digital environmental footprint.**

Carbon footprint is thus far from being the only source of environmental footprint which, in turn, justifies the use of a multi-criteria approach.

It is also worth noting that the energy mix has an influence on several of these indicators, beyond just carbon footprint. An energy mix based on nuclear power, like in France, will influence the decreased share of the carbon footprint (with a lower carbon energy source) and the increased share of ionising radiation.

This study also serves to highlight the substantial environmental footprint of the:

- **production phase** in the depletion of natural abiotic resources (minerals and metals) and so the carbon footprint;
- **the utilisation phase** on the depletion of natural abiotic resources (fossils) and ionising radiation.

---

[18] A joule is the unit derived from the International System of Units to quantify energy. For abiotic (fossil) resources, this corresponds to the quantity of primary energy contained in the different fossil resources extracted from the Earth.

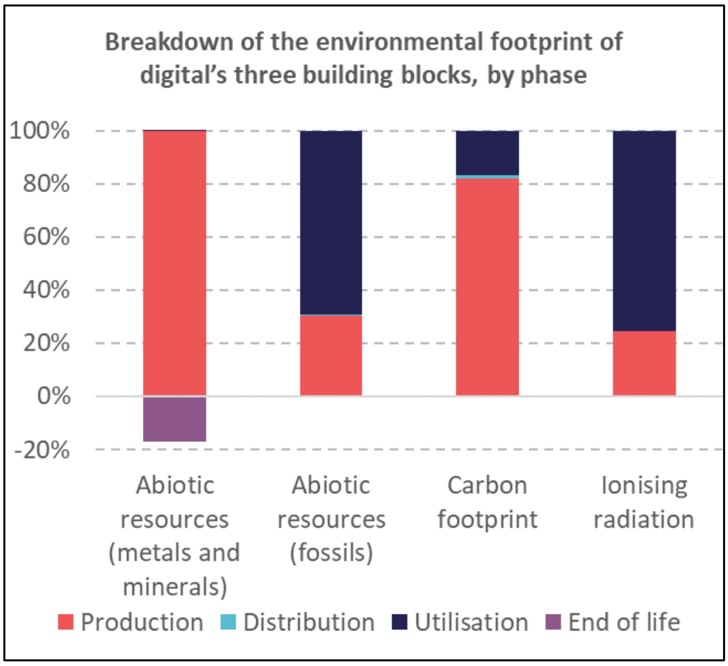
[19] A weighted coefficient is attributed to each kg of natural abiotic resource extracted, based on scarcity. Antimony (Sb) was chosen as the benchmark scarce resource, and attributed an agreed-upon scarcity value, or coefficient, of 1.

[20] Le becquerel (Bq) is the unit derived from the International System of Units to describe the activity of a certain quantity of radioactive material, in which one nucleus decays per second.

[21] JRC (Joint Research Centre) PEF/OEF method (EF 3.0) published on 20 November 2019

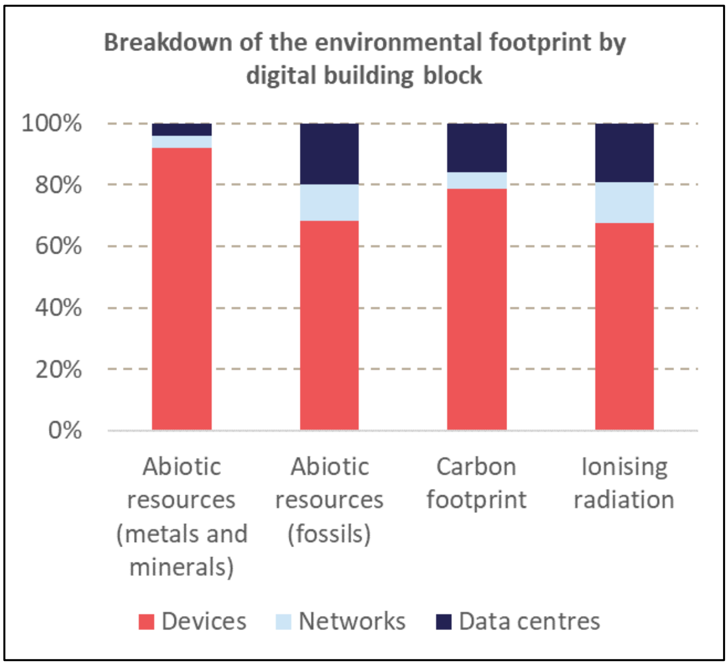
[22] In other words, the footprint is calculated by factoring in the number of people generating the same level of impact, applying an homogeneous distribution of those impacts across everyone living on planet Earth. For instance, a carbon footprint with a value of 50 means that the associated environmental footprint is equal to the annual carbon footprint of 50 people living on the planet.

[23] Greenhouse gas emissions are measured in kg CO2 eq., for instance, whereas abiotic (fossil) resource depletion is measured in MJ. The ability to compare kg CO2 eq. to MJ (and other indicators expressed in different units) therefore requires a standardisation/weighting step which can resulted in certain biases when interpreting the results, and therefore means that these "comparisons" of environmental footprint need to be viewed with some caution, in the absence of a scientific consensus on the methodology to apply.



The breakdown of the environmental footprint of digital's three building blocks, between the utilisation, production, distribution and end of life[24] phases is roughly the same for the devices and data centres building blocks. In other words, the production phase generates the bulk of the carbon footprint and consumes the most natural abiotic resources (metals and minerals), whether for devices or data centres[25].

Lastly, **devices generate the largest footprint for all of the indicators studied, followed by data centres then networks**.



[24] The study's findings on the breakdown of the environmental footprint of all three of digital's building blocks between the different life cycle phases has been standardised to facilitate readers' interpretation of them.

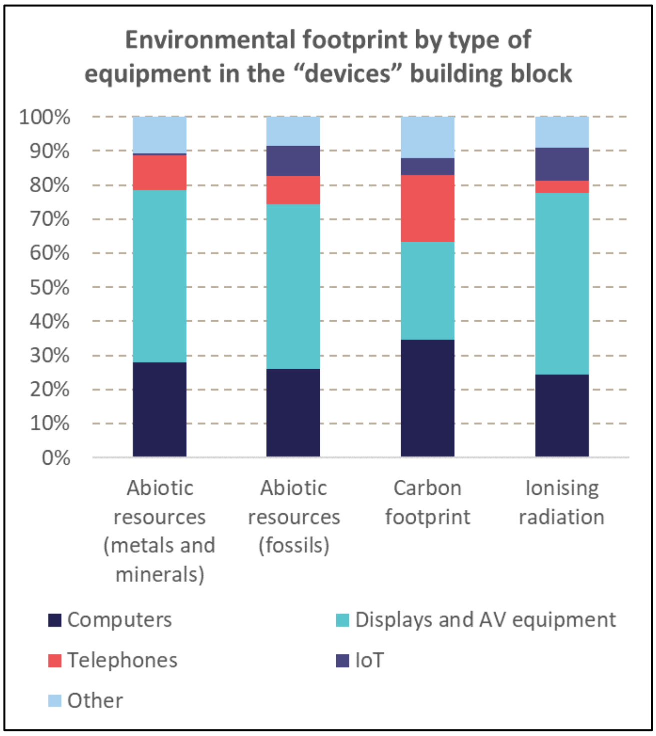
[25] But the utilisation phase of devices and data centres concentrate the greatest impact in terms of consumption of natural abiotic resources (fossils) and ionising radiation.

4 An environmental footprint concentrated around devices

As mentioned above, the largest digital environmental footprint comes from **devices**, regardless of indicator among the four that were studied. They represent **at least 65% of the footprint, and up to more than 90% when it comes to the** depletion of natural abiotic resources (metals and minerals).

Devices include a wide variety of equipment[26] with disparate environmental footprints. The **"displays and audiovisual equipment" category accounts for the largest footprint for all of the indicators studied** (followed by the "computers" category).

If the **impact of telephones[27] is substantial, it is far from being the largest one.** Measures being taken to **extend the life of devices must therefore be applied to more than just phones.**



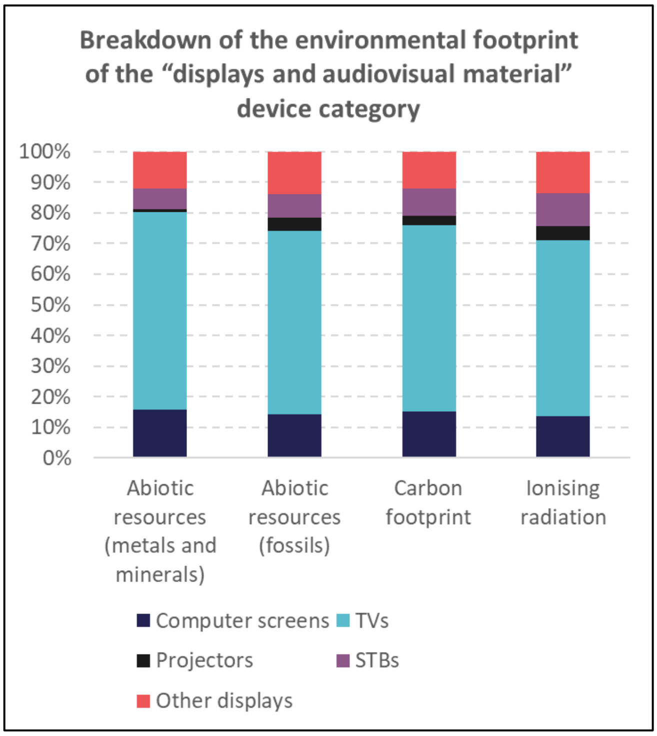
IoT hardware currently represents a relatively small percentage (less than 7%) of devices' footprint. Their **market growth potential nevertheless also increases their possible future impact on the environment,** which will be addressed in the upcoming forward-looking part of the study.

Within the "displays and audiovisual equipment" category, set-top boxes represent a relatively marginal share of the environmental footprint, whereas televisions represent an overwhelmingly large share (no doubt due as well to a rate of ownership amongst French households that exceeds that of other types of display), followed by computer displays. **It therefore seems necessary to address the environmental footprint of every device and particularly the most ubiquitous among them (televisions, computers, etc.)**.

---

[26] Hereafter, a non-exhaustive list of the devices examined in the study, such as desktop and laptop computers, tablets, smartphones, landline phones, computer displays, projectors, set-top boxes, home and handheld video game consoles, etc.

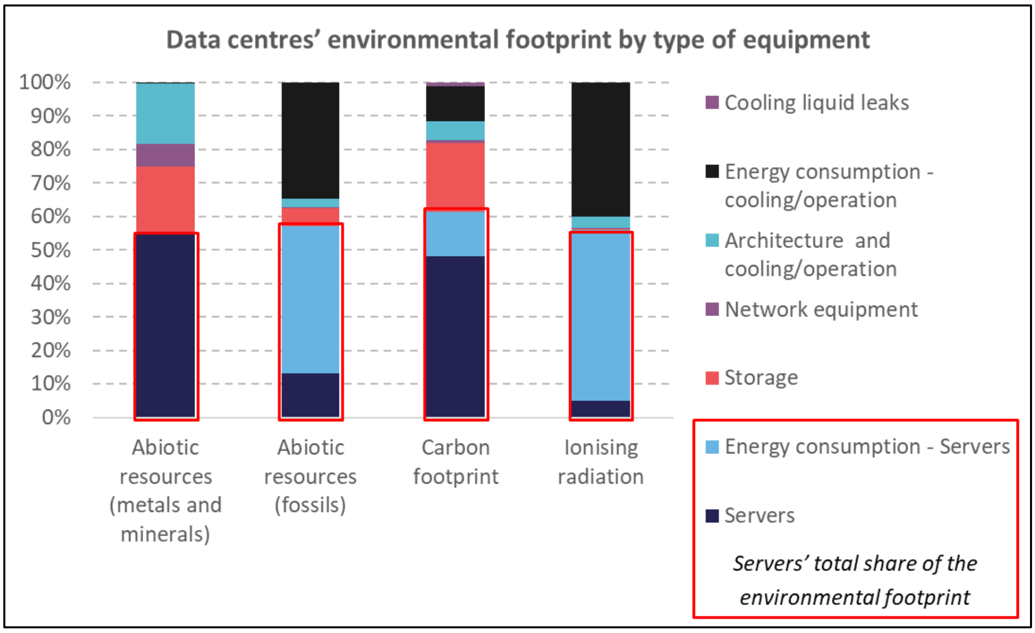
[27] The "telephones" category is broken down into in smartphones, feature phones and landline phones. For virtually every environmental indicator, smartphones account for 80% to 90% of the footprint (except in the area of ionising radiation where the energy consumption of landlines decreases this share to 32%).



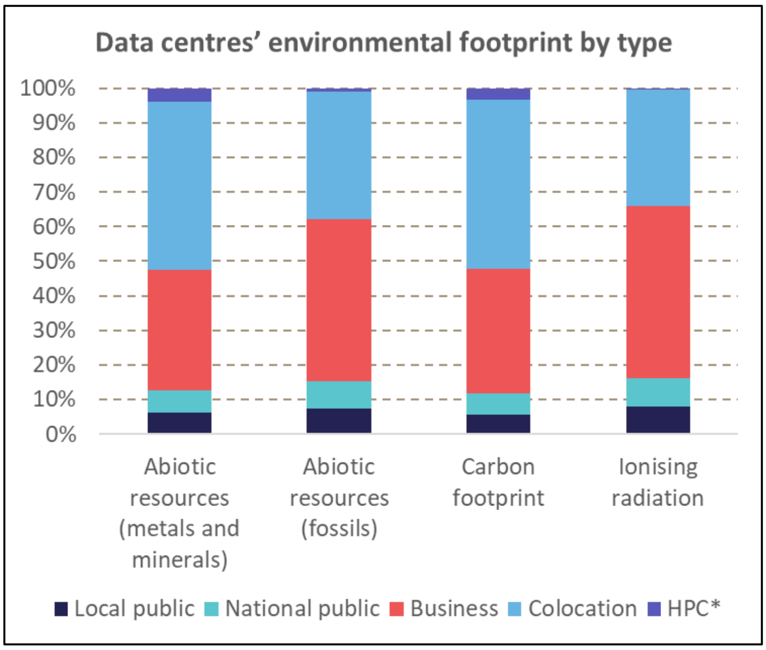
5 Data centres' environmental footprint: lion's share for servers

Data centres represent the second largest source of environmental footprint for three of the four indicators studied.

A more detailed analysis of the equipment that makes up a data centre reveals that it is servers in particular, and storage to a lesser extent, that have the greatest impact on the depletion of natural abiotic resources (metals and minerals) and in terms of carbon footprint. Data centres' impact on the depletion of natural abiotic resources (fossils) and ionising radiation is due essentially to servers' and cooling/operating systems' energy consumption. **In any event, it is servers that have the largest footprint through their production and their utilisation.**



Lastly, the **study highlights the role of business and colocation** (data centres where multiple customers house and operate their own IT equipment) **servers which are responsible for the greatest impact on the environment** (more than 80% for each environmental indicator). The study does not, however, make it possible to determine the extent to which these results are due to a "volume" effect tied to the number of business and colocation servers, or whether one issue in particular needs to be addressed. It should also be noted that it is only data centres located inside the country that are modelled[28].



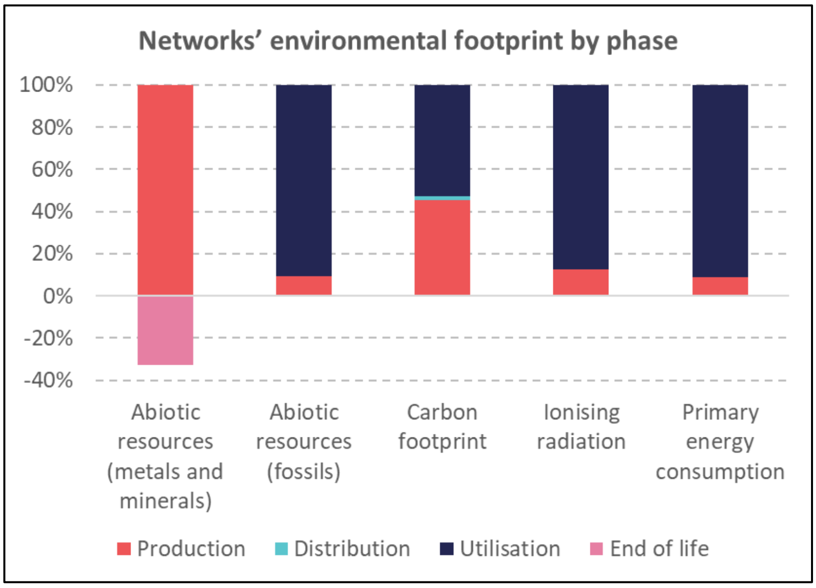
** HPC: High Performance Computing*

[28] Modelling does not include the environmental footprint of foreign data centres employed for uses in France, and does not exclude the environmental footprint of national data centres employed for uses outside the country.

6 Networks’ environmental footprint dominated by the utilisation phase, and modelling in need of further refinement

For all three building blocks, **networks represent the final source of environmental footprint** for the indicators studied: around 5% of the digital environmental footprint in terms of carbon footprint and depletion of natural abiotic resources (minerals and metals), and just over 10% for depletion of natural abiotic resources (fossils) and ionising radiation.

The report produced by the firm Citizing on behalf of the Senate’s fact-finding mission on the digital environmental footprint[29] states that **primary energy consumption was due largely to the utilisation phase (87% versus 13% for the production phase)**. These findings align with those of the present study, but **the latter’s multi-criteria approach also reveals the sizeable impact associated with networks’ production phase for some of the criteria studied[30]**. Networks’ production phase[31] is in fact responsible for the entire impact in terms of depletion of natural abiotic resources (minerals and metals) and a relatively large impact (of around 45%) in terms of carbon footprint. For the remainder, it is essentially the utilisation phase that generates the largest environmental footprint.



Moreover **it is fixed networks that generate the largest footprint** (between 75% and 90% of the footprint depending on the indicator). However, **proportionate to the GigaByte (GB) of traffic consumed** by each network, **fixed networks have a smaller environmental footprint than mobile ones. Per GB of traffic consumed, mobile networks have a footprint that is close to three times that of fixed networks, for all of the environmental indicators studied**. Here, the study’s finding align with those of previous studies on this topic. This is, however, an accounting-type allocation of the footprint (per GB) for illustrative purposes **and not a comparison of fixed and mobile networks’ efficiency.** Indeed, **networks’ energy consumption is largely unchanging and independent of the volume of traffic being relayed** (and more a function of the levels of geographic coverage). **An increase in traffic therefore decreases the environmental footprint per GB,** and can increase the networks’ overall resulting environmental footprint but not in a proportionate fashion.

[29] Citizing, “*Empreinte carbone du numérique en France: des politiques publiques suffisantes pour faire face à l’accroissement des* usages ?” (Digital carbon footprint in France: can current public policies handle increasing usage?) June 2020.

[30] The study’s results on the breakdown of the environmental footprint of the networks building block between the different life cycle phases were standardised to facilitate readers’ interpretation of them.

[31] STBs were incorporated into the networks building block.

Additional work would need to be done to delve deeper into these findings **at a more granular level. When conducting this study, it was impossible to obtain more detailed data on networks' consumption for each segment** (access, backhaul and core networks), even though the utilisation phase typically represents the main source, or is at least the largest generator, of the environmental footprint. In addition, networks' energy consumption used to calculate the digital environmental footprint is taken from worldwide consumption[32] which was first made proportionate to consumption across Europe by the ICT report[33], then proportionate to consumption in France in this study. This approach results in some uncertainty over this dual extrapolation (in the absence of France-specific data) and highlights the need for reliable data to be able to refine network modelling. **The data that Arcep collects from electronic communications operators will thus help complete this modelling exercise over time** with measurements taken at the national level, thereby avoiding potential biases resulting from extrapolation.

[32] IEA-4E, Intelligent Efficiency For Data Centres & Wide Area Networks, Report Prepared for IEA-4E EDNA, May 2019

[33] ICT report: European Commission, ICT Impact study, Final report, prepared by VHK and Viegand Maagøe for the European Commission, July 2020, p.73

Conclusion

This study makes it possible to obtain a more detailed assessment of the digital environmental footprint. In addition to the assessment itself, the study **confirms how complex an exercise it is, and identifies the main obstacles that need to be lifted to improve measurement.** This assessment work is one step in a longer-term workstream devoted to:

- **refining and disseminating a proven and operational methodology:** some aspects need to be made clearer and the methodology more widely adopted. Few measurement and testing practitioners are aware of the specificities of digital technologies and of the relevant recommendations and methodological standards;
- **enabling access to a broader array of** (inventory and impact) **data.** Inventory data are often protected by business secrecy and include what is sensitive information for the sector's players. As to impact data, there is not yet a database that is sufficiently exhaustive, audited and widely available. **ADEME has sought to change this with the creation of its impact database. Expanding Arcep's data collection powers should also prove an important contributor** to greater efficiency in the future. Lastly, it is absolutely vital to draw on **existing expertise with the ecosystem** via the multiple initiatives launched by the sector's stakeholders.

This **study represents an original work, in its multi-criteria approach.** It thereby helped identify four relevant environmental indicators to describe the digital environmental footprint in France, and so underscore the need to take a multi-criteria LCA approach:

- ionising radiation,
- depletion of natural abiotic resources (metals and minerals),
- depletion of natural abiotic resources (fossils),
- carbon footprint.

It **confirms that devices represent the vast majority of the footprint (65% to 90%)**, for every indicator, followed by data centres (4% to 20%) then networks (4% to 13%). It therefore seems imperative to examine the environmental footprint of all devices and particularly the most ubiquitous among them (televisions, computers, etc.). Despite which, the matter also needs to be tackled as a whole. This breakdown of the footprint must not overshadow digital technology's ecosystemic dimension: the interdependence of devices, networks and data centres created by the different uses must be taken into account when crafting public policies aimed at tackling the digital environmental footprint in its entirety. Every member of the ecosystem must do their part in working to achieve digital sustainability.

The multi-stage analysis also serves to reveal **the weight of the production phase, which often has the largest impact on the environment (over 80% of the footprint) – and thus confirms the importance of policies aimed at extending the life of digital devices** by improving products' durability, their reuse, refurbishment, and the functionality and repair economy. Depending on the indicators studied, **the utilisation phase can also be the main source of the digital environmental footprint (up to around 80% for the depletion of natural abiotic resources (fossils) and ionising radiation)**.

The work that the two institutions have already begun should help remove some of the identified obstacles. In particular, **the work being done by ADEME to refine existing methodologies** for certain product categories is ongoing. **Arcep, meanwhile, continues to enhance its annual survey "Achieving digital sustainability".** Finally, ADEME and Arcep will continue to collaborate on producing the final volume of this study, devoted to forward-looking scenarios, and more generally on common works on the digital environmental footprint pursuant to the REEN Act.