Cigref

Digital sobriety:

Managing the digital environmental footprint through measurement

December 2021

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EDITORIAL

The CIGREF report of October 2020, "**Digital sobriety: a responsible business approach**" in partnership with *The Shift Project*, presented concrete guidelines to digital players in companies and administrations by offering a 360 ° view of the entire life cycle of digital products and services, and infrastructures.

This report follows on from last year's report and deals more specifically with **management by measuring the environmental footprint of digital technology.** It strives to meet demand from the departments in charge of digital technology, with the support of CSR departments to establish how to prioritise actions and navigate through the current landscape of measuring the environmental footprint of digital technology.

It is provided at a time when the **legislative framework** continues to grow richer:

- The "Climate and Resilience" law of August 22, 2021 on the fight against climate change and the strengthening of resilience in the face of its effects, aimed at accelerating ecological transition in French society and economy.
- The law of November 15, 2021 known as "REEN", following a proposal by Senator Patrick Chaize, aimed at reducing the environmental footprint of digital technology in France.

I would like to thank all the members of the working group for the quality of the discussions, the experiences and the best practices that they shared; most of them had already been enthusiastic participants in last year's working group.

Finally, we would like to thank the group's coordinator, Flora Fischer, for her remarkable work. She methodically, tactfully, kindly and rigorously maintained the same high frequency of interactions that resulted in the report we are offering to you today.

Happy reading!

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This document was edited by **Flora FISCHER**, Mission Director at Cigref with the contribution of the work's managers and participants.

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OVERVIEW

This document follows on from the previous working group in partnership with *The Shift Project*, resulting in the "**Digital sobriety: a responsible business approach**" report. The report focused on awareness, drivers of action, governance and best practices for implementing digital sobriety approaches within the entire organisation. Cigref's work on digital sobriety then continued, in partnership with the **Institut du Numérique Responsable** (INR), with the aim of addressing the issue of **management via the measurement of the digital environmental footprint** of large organisations. Indeed, the IT departments, with the support of the CSR departments, are asking for common methods and benchmarks for measuring the impact of the digital environmental footprint, approved by public bodies, in order to **better support and evaluate** the current proliferation of digital sobriety approaches.

The issue of measuring the digital environmental footprint is a highly complex one because it requires:

- **Access to knowledge** which is sometimes still within the field of **research**, with the result that many measurements are made using assumptions, especially when it comes to measuring the impact of the entire life cycle of a digital service;
- **Appropriation and awareness** among developers and project managers, but also architecture and infrastructure managers, which means providing them with common, efficient and easy-to-use measurement methods and tools, and knowing how to support them in implementing them;
- **Collaboration and transparency** in the entire ecosystem affected by the life cycle of a digital product or service.

Taking these theoretical and operational limits into account, organisations structure their approaches to measuring the digital environmental footprint around the following main areas: the deployment of **life cycle analysis methodologies,** the **measurement of the impacts associated with IT assets** and **data centres**, the integration of the measure in all new **IT projects**, the development of **Digital environmental KPIs**, the definition of **skills** dedicated to measuring and understanding the environmental impacts of digital technology, and finally the **determination of the environmental ROI** resulting from these steps.

The main areas of examination for 2020/2021 focused on the sharing of **methods and results for the evaluation** of the digital footprint and their management on the basis of **priority actions**, integrating the **drivers of conviction** based on scientific data and shared observations, limits encountered and the formulation of **collective requests to strengthen the need for transparency and sharing of data** regarding energy consumption and greenhouse gas (GHG) emissions, not only for equipment but also for the digital services offered by suppliers.

The partnership with the **Institut du Numérique Responsable** provided additional expertise by offering the working group the opportunity to participate in the "**WeNR**" measurement tool, published in spring 2021 – a common and copyright-free tool, designed and supported by the INR and its partners. The results once again demonstrate the major impact of the manufacture of devices (at least on the scope under analysis: France, Belgium, Switzerland) and the need to develop ambitious policies relating to the lifespan of first-line equipment and software. Regarding this point, Cigref's reports on Software and hardware obsolescence provide guidance to organisations and providers of digital products and services.

Although the question of measurement should be able to take into account all criteria regarding the environmental footprint [emissions of **greenhouse gases** (GHGs), **depletion of non-renewable abiotic**

resources (minerals and fossils), and the impact on **water resources** and on **primary energy**], it is currently wise to focus on the most precise factors that we have at our disposal; that is, the GHG emission factors, with the help of ADEME which also participated in the meetings of the working group.

In addition, given all the uncertainties in calculating GHG emissions, we should not wait until we have an exact measurement of these emissions before starting to take measures aimed at their reduction. Even if they are imprecise, the measurements enable us to identify the main areas in which we can act to reduce our emissions.

INTRODUCTION

In their effective implementation of responsible digital technology, organisations are increasingly confronted with the issue of **measuring digital environmental footprint**. The current factor that will enable companies to **produce a mutually agreed inventory** of the environmental impacts of their digital services is access to **shared open-source measurement tools**, including **inventory data** and **common impact factors** along with **drivers of improvement** and best practice. These tools are necessary for the identification of priority areas for improvement.

But finding reliable and relevant information for calculating digital environmental footprint is a challenge in its own right for every organisation. This presupposes standardising **calculation methods**, creating a framework for **shared data** on the main **impact factors**, and making such data accessible and free to use. In the absence of such standardised and public repositories, organisations are creating their own tools or identifying them in the marketplace. This has the effect of disseminating the initiatives, and makes it more complex to obtain an overview. The next update of the ADEME Base IMPACTS® database, based on data from the Négaoctect consortium,[1] should make it possible to update, standardise and improve the precision of certain indicators concerning uses, equipment and data centre and network infrastructures, despite the fact that a certain amount of data will remain subject to a paid subscription.

Wishing to avoid adding further complexity to this kaleidoscope of initiatives, the Cigref working group, in partnership with the Responsible Digital Institute[2] (INR), has proposed focusing on the question of **control by measurement**, to better focus for the time being on the priority steps with the greatest impact. Such measurement must make it possible to **assign weightings to digital impacts for improved orchestration.** This assumes the creation of a framework of **governance**, the **prioritisation of actions** and the implementation of **drivers of conviction**. Ownership, awareness and employee training are also essential to the success of this control system, because **the measurement mechanism must feed into implementation objectives and the daily reality of the players within the organisation**, otherwise it will have no effect. In addition, “IT for green” approaches are sources of inspiration for dealing with other areas with a much greater impact than digital technology at the present time. It is of course important to contextualise the environmental footprint of digital technology **within the overall footprint of an organisation’s activities.** Digital technology currently accounts for only 4% of GHG emissions worldwide, and 2% in France[3]. The remaining 96% concern high-impact sectors such as industry, transport, buildings, etc.[4] What characterises the environmental issue of digital technology is not its current scale, but **its exponential curve**, which is unprecedented compared to all other sectors. Not to mention that one of the peculiarities of digital technology is that it is cross-sectoral and plays a part in all our activities. There is therefore a genuine effort to be made to slow down this exponential growth, without which there is no chance of adhering to the Paris Agreement. This is why organisations must now incorporate a digital sobriety policy at the heart of their strategy.

In addition to this consideration, it is important to emphasise the **positive digital externalities**, which can be used for ecological transition via innovations, projects and tools for monitoring and analysing

[1] https://negaoctet.org/ (in French)
[2] https://institutnr.org/ (in French)
[3] https://www.statistiques.developpement-durable.gouv.fr/edition-numerique/chiffres-cles-du-climat-2022/pdf/chiffres-cles-du-climat-2022-integral.pdf (in French)
[4] https://www.iea.org/data-and-statistics/charts/global-co2-emissions-by-sector-2019

environmental data. The IT department can deal with these issues in partnership with CSR departments and business units.

Remember that the scope of analysis is based mainly on **digital GHG footprint**, data for which are the most numerous and reliable available to date, but we will regularly have cause to stress its insufficiency and the **need to strive for the consistent consideration of all multi-criteria indicators** for digital environmental footprint. A multi-criteria approach makes it possible to restore the complexity of the environment and to avoid choices which could result in damage to environments that had not been considered.

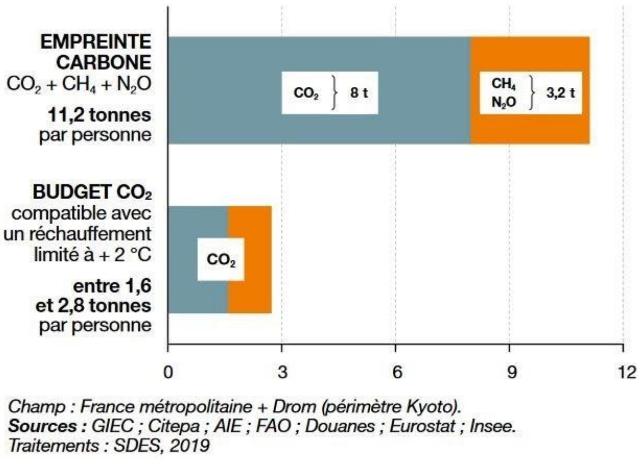
1. CONTEXTUAL INFORMATION

1.1. THE ROLE OF DIGITAL TECHNOLOGY IN A GLOBAL ISSUE

The objectives of the Paris Agreement are based on an equation which holds that, by 2050, no individual may emit more greenhouse gases (GHGs) than ecosystems can naturally absorb. In 2018, in France, each inhabitant emitted an average of 8 tonnes of CO_2 equivalent through their direct energy consumption, and 3 tonnes more if we take their purchases into account. This therefore amounts to 11 tonnes per individual[5]. This means that to meet the Paris Agreement, it would be necessary to reduce per capita GHG emissions by 6% per year over a period of less than 30 years to achieve a volume of annual per capita emissions of around 2 tonnes of GHGs, as shown in the IPCC diagram below:

French carbon footprint in 2018

In t CO2eq, per year and per inhabitant, for carbon footprint, and in t CO2, per year and per inhabitant, for CO2 budget



French carbon footprint in 2018 – CGDD

The role of digital technology in this collective objective must be taken seriously. How can we meet these objectives if our digital systems emit 4% of global GHG emissions, increasing by 8 to 10% every year?

1.2. A REFERENCE POINT IN THE LANDSCAPE OF INITIATIVES

More and more companies want to invest in a common commitment framework to reduce their GHG emissions resulting from digital technology. Many initiatives are flourishing to develop more responsible digital technology, whether through the unification of players and suppliers at international level, or programmes at national level led by recognised bodies in their own field of expertise.

At international level, we can present a non-exhaustive list of a number associations and structurally important initiatives, for example:

[5] CGDD, "French carbon footprint remains stable", 2020 [https://www.statistiques.developpement-durable.gouv.fr/sites/default/files/2020-01/datalab-essentiel-204-l-empreinte-carbone-des-francais-reste-%20stable-janvier2020.pdf] (in French)

- the Green Software Foundation, championed by the Linux Foundation, which seeks to encourage the design of "green" software through the development of standards, and commit digital service providers to reducing their GHG emissions by 45% by 2030,
- the initiative Climate neutral Data Centre Pact which promotes a carbon neutrality charter for data centres, in partnership with professional associations and data centre operators. This initiative takes into account concerns relating to energy efficiency but also to the nature of such GHG-emitting energies, and to the impact on resources (water, metals, etc.), and on the circular economy.

At national level, the following non-exhaustive list should be mentioned:

- The Planet Tech'Care initiative which, with the help of a large network of partners (professional organisations, schools, competitiveness clusters, associations, foundations, think tanks) aims to combine stakeholders and expertise in the provision of a common support program (in the form of webinars or workshops/conferences) to all organisations or structures that sign a manifesto committing them to reducing their digital environmental footprint.
- The contribution of increasingly diverse actors to **free resources** and to **free and open tools** is worth noting as an underlying trend. The Institut du numérique responsable (INR – Responsible Digital Technology Institute), a partner of Cigref, is one of the key players in responsible digital technology and today offers, among other resources, a rights-free tool – the "WeNR" – that can calculate the GHG emissions of an organisation regardless of its size and sector of activity.
- The research community has long worked to make open resources available, as evidenced by EcoInfo, the CNRS services group offering numerous resources, in the form of documentation, tools, methodologies, and support for assessing the environmental footprint of digital technology, intended primarily for researchers and computer scientists.
- The independent "Boavizta" working group co-constructs expert and up-to-date resources under free licenses: measurement methodology, data repositories[6] and calculation engines. These "commons" cover digital infrastructures and services, offering a full life cycle assessment and a multi-criteria approach.
- Finally, the development of research and support from public bodies such as ADEME on this subject of measurement form the basis of all joint approaches. ADEME is working on **building a technical base that will enable the assessment of the environmental impacts of digital technology** through the financing of several projects. One such example is the "Perfecto" call for projects, supporting projects aimed at ecodesign research. It runs every year and – in 2018 and 2021 in particular – features themes on the development of methodologies for measuring the environmental impact of digital technology. As part of this program, ADEME has funded projects such as NégaOctet, which is building *Product Category Rules* (PCRs) for measuring digital technology's environmental footprint. This reference base is linked to a database which groups together all the impact factors necessary to carry out these measurements in regard to three aspects: equipment, use and infrastructure. Part of the database, integrated into the "EIME" software, will be accessible upon payment of a user fee. Only the most generic factors will be included in ADEME's Base IMPACTS database®. This (LCA) database also enables ADEME to develop more precise and up-to-date technical bases on the footprint of digital technology. ADEME also participates in the European work of **standardising methodologies for specifying the environmental footprint**

[6] https://github.com/Boavizta/environmental-footprint-data

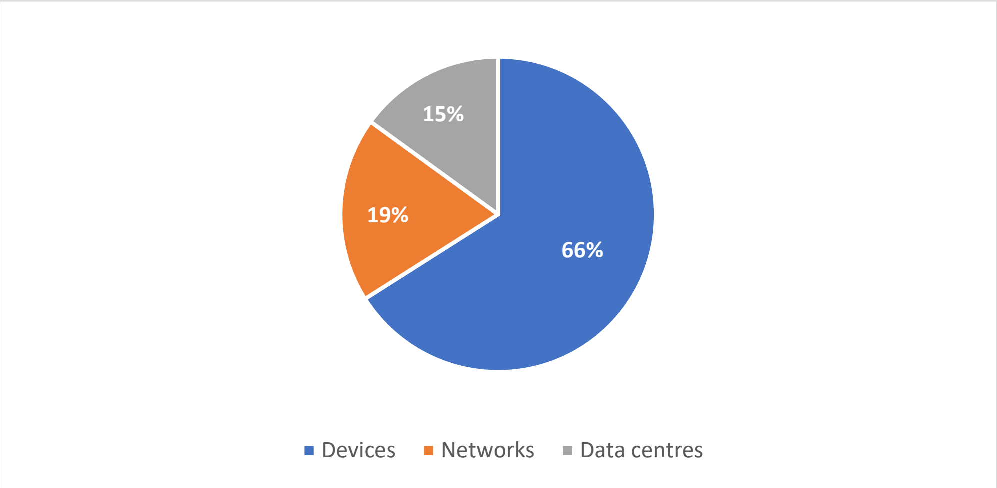
of digital technologies. This will feed into the various projects funded by ADEME, and also the Base IMPACTS® database.

1.3. THE MAIN SOURCES OF DIGITAL IMPACTS

According to a GreenIT study[7] focusing on the "Global digital environmental footprint", the primary sources of global digital impact are users' equipment. Network equipment and data centre equipment actually only take second place. Currently, data concerning the end of life of equipment are not readily available, but it is essential to try to make assumptions, and to initiate joint work with research, in this key area.

The manufacturing phase of digital equipment is responsible for the largest share of the overall digital footprint, be it in terms of **CO2 emissions**, **consumption of non-renewable natural resources** (oil and mineral extraction) or consumption of **water resources.**

Although in mainland France 80% of the energy mix comes from nuclear power, and therefore from low-carbon energy, we must nevertheless beware of a pitfall: the energy balance is not sufficient to assess the **overall environmental footprint** of digital technology. We need to consider the GHG footprint resulting from **equipment manufacturing in other countries**. This data cannot be excluded from the analyses, given that according to studies, manufacturing constitutes around three-quarters of the global digital footprint. This is why the **LCA method** is so valuable for evaluating all impacts, even if it currently lacks proven common databases.



Breakdown of CO2 equivalent consumption for digital technology worldwide (GreenIT study)

According to the aforementioned GreenIT study, the CO2eq consumption of **devices** (smartphones, tablets, PCs, etc.) in 2019 represents 66% of total consumption of the analysed types (network, data centres, devices) and focuses mainly on the manufacturing phase (approximately **40%** of total "devices", compared to 26% for use, which includes data storage and transfer). Conversely, with regard to **networks and data centres**, the impact of the manufacturing phase is lower compared to the impact of their use: respectively, 3% and 1% of their CO2eq consumption results from their manufacture, compared to 16% and 14% during their use phase (out of a total of 19% and 15%, according to the aforementioned typology). This means that the efforts of organisations can focus on **responsible**

[7] "Global digital environmental footprint", GreenIT, 2019 (in French)

purchasing policies, in order to limit the impact linked to manufacturing, and on the **use** of infrastructures (data centres and networks).

1.4. THE CARBON ACCOUNTING APPROACH® FROM ADEME

The Carbon Base® is the benchmark database for assessing the GHG footprint of a given organisation. It was created by ADEME in 2002.

Digital technology is now an integral part of organisations' "low carbon" strategies, and is included in carbon accounting figures for many organisations. This should also soon be enshrined in European law in the form of the Non-Financial Reporting Directive (NFRD) which is currently being revised; given that Article 4 of the "Chaize" bill for the reduction of the environmental footprint of digital technology in France – which mentioned the inclusion of the environmental impact of digital technology in the CSR reports of organisations – has been deleted.

The Carbon Accounting approach is broken down into several stages. First of all, and as recommended by the ISO 14064-1 standard[8], we need to define the **organisational scope**; that is, the different entities, sites and infrastructures concerned by Carbon Accounting. The first step is to list all GHG-emitting activities across the 3 scopes:

- Scope 1 concerns all direct emissions from activities controlled by the organisation;
- Scope 2 concerns emissions linked to the consumption of energy necessary for the activities of the organisation;
- Scope 3 concerns indirect emissions upstream and downstream of the main activity.

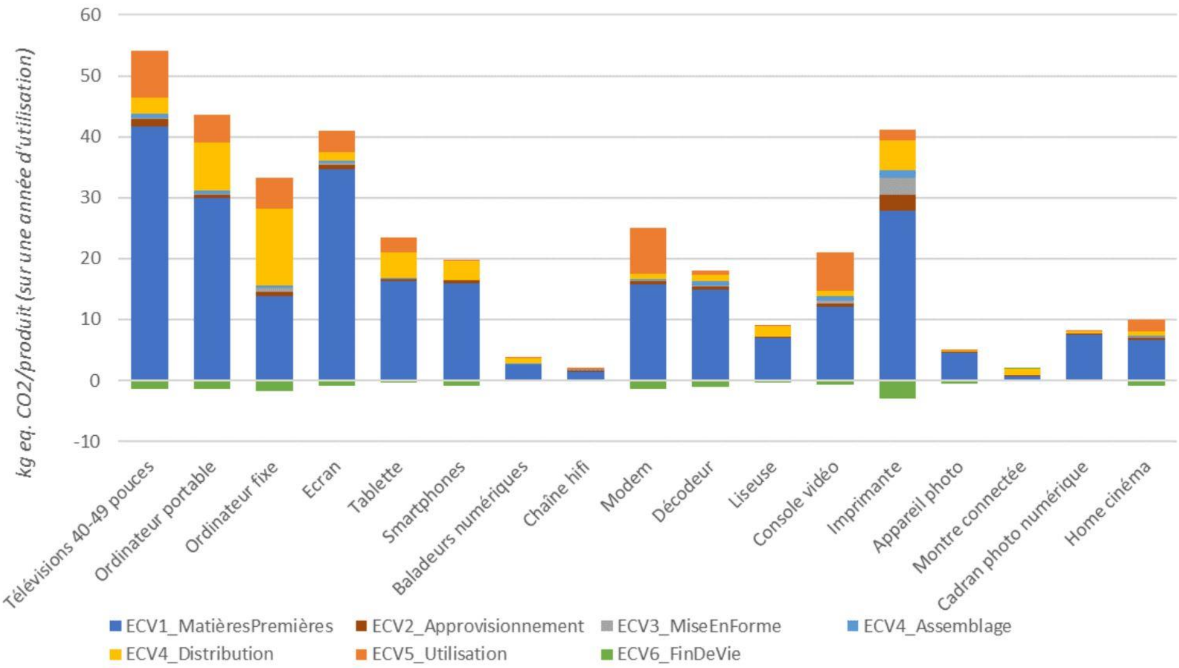
The second step is to apply the following calculation: "Emission factor[9]" multiplied by the "quantity" of products or services concerned. The emission factor corresponds to the kg CO2 equivalent emitted for 1 unit of the activity: for example, if a complete workstation comprising a computer and monitor corresponds to approximately 1 tonne of CO2eq for its manufacturing phase alone, reported over one year for 100 employees, this therefore corresponds to 100 tonnes of CO2 emitted. If the lifespan of the computers is 5 years, then the emission will be 20 tonnes of CO2 / year. The **use phase** must also be taken into account with other emission items and in line with the emission factors for each country.

In a 2018 study, ADEME presented[10] the impact of several phases of the life cycle of electronic equipment, highlighting once again the strong footprint due to the manufacturing phase, and in particular to **the extraction of raw materials**, closely followed by the **use and distribution** phases.

[8] This standard "specifies the principles and requirements, at agency level, for quantifying and reporting greenhouse gas (GHG) emissions and their removal": https://www.iso.org/fr/standard/38381.html (in French)

[9] An emission factor is a coefficient used to convert activity data into GHG emissions

[10] ADEME. J. Lhotellier, E. Less, E. Bossanne, S. Pesnel. March 2018. LCA modeling and assessment of consumer products and capital goods – Report. 188 pages (in French)



Details of carbon emissions from goods "with a significant electronic component" – Extract from the ADEME LCA study on consumer products and capital goods[11]

Regular monitoring of the GHG impact through this method or other assessment tools should provide information on **the main sources of emissions** that we can reduce.

Finally, **other indicators**, found in ADEME's **Base IMPACTS®**[12] database, enable us to take the full scope of environmental impacts into account. This is known as the "multi-criteria" life cycle analysis, which brings together indicators linked to GHG emissions and also to primary energy consumption, water consumption and the use of non-renewable resources.

ADEME **encourages organisations within the same sector to work together to build common benchmarks**, which would thus make it possible to make consistent comparisons between different organisations.

[11] ADEME. J. Lhotellier, E. Less, E. Bossanne, S. Pesnel. March 2018. LCA modeling and assessment of consumer products and capital goods – Report. 188 pages (in French)

[12] https://www.base-impacts.ademe.fr/ (in French)

2. LEADING THROUGH MEASUREMENT: GOVERNANCE AND DRIVERS OF CONVICTION

2.1. CURRENT TECHNOLOGY LEVELS: HOW DO ORGANISATIONS GO ABOUT MEASURING THEMSELVES?

Digital sobriety approaches are making progress in terms of maturity: requirements in terms of **responsible purchasing** are supported via the inclusion of "responsible digital" criteria into calls for tenders and Group contracts. Some are quick to provide training to buyers and prescribers in order to implement these environmental requirements. Employee **awareness-raising** events: more and more people are working on responsible design and digital sobriety. Finally, **reuse policies** for computer equipment are becoming more and more common. These policies require cross-disciplinary and in-depth work between IT and CSR departments. To this end, **what actions are being taken by organisations to measure** their digital carbon footprint at a more or less fine-grained, local or global level?

Organisations are aware that they must be able to optimise their IT systems by working on all relevant components: strategy, development (code), UX, architecture, back end, front end, hosting and infrastructure. But to achieve this, it is essential to strive for an **appropriate governance** approach, in order to **prioritise actions and direct efforts towards activities with the largest footprint**. In this respect, an organisation chart of this type can help to develop a governance strategy for measuring the footprint of digital technology:

Governance for measuring the environmental footprint of digital technology – Cigref 2021 working group

	DESCRIPTION
Requirements	• Ensure that **environmental footprint management through measurement** is consistent with a **pre-existing global governance** mechanism, in terms of methodologies, processes and existing stakeholders, in support of Group **digital strategy** or **CSR strategy**. • Have formulated a **responsible digital technology purchasing policy**. Ensure, especially in all contracts for the purchase of cloud services, the **inclusion of environmental reporting** (Minimum CO2eq), or require eco-responsible criteria by default in every call for tenders.
Steering chain	• Include measurement requirements in **project governance**. • Use benchmark methods and indicators in order to **compare measurements**. • Appoint **sponsors** of suitable quality.
The players concerned	• IT department, CSR departments, Purchasing, stakeholders in the project process, Audit and risks, data users and consumers, developers. • Where the position exists, the "Digital Technology and Environment" manager or the "Chief / Responsible Sustainable Officer" whose affiliation can be a cross-cutting one over the entire organisation.

DESCRIPTION	
Objectives	• Measure to **act better**: measurement data is a magnifying glass and a driving force to highlight the strongest impacts and to better guide decisions. • Have **the most objective possible** measurement system for overall digital footprint (not limited to the use of equipment and solutions, or their energy consumption). This implies the need to draw up an assessment that spans the entire life cycle of digital products and services, and to analyse it in "multi-criteria" mode where possible. • Define **quantitative and qualitative objectives** including a schedule, with the support of the CIO if possible. • Develop a **culture of digital sobriety** (change management) by regularly raising awareness, offering training and promoting these new skills. • Verify **the attainment of completed project objectives** and share quantified feedback.
Irritants and risks	• Acting too quickly, without taking the time to **analyse and interpret** measurements correctly. • **Dependency** on measurement subcontractors: bringing skills in house would make it possible to develop the expertise of the teams over time and ensure follow-up. • Beware of possible **pollution shifting** in the initiatives that will follow a quantified evaluation. • It can sometimes take a long time to collect the data required to assess carbon footprint. This requires **time and resources**, both human and financial. • Difficulty in including the results of the digital environmental footprint in **strategic targets** or **extra-financial reporting**. • Digital technology falls under **risk management**, which must include the control of environmental risks.
Conditions for success	• **Identify the key players**, define their roles, assess the upstream load. • Have already defined an **ROI methodology** for **weighting financial, social and environmental gains**. A strong ROI will ensure good sponsorship. • Maintain an up-to-date applications **inventory** and CMBD (configuration management database). • **Industrialise** and ensure **reliable** measurement feedback, e.g. by acculturating employees to the data life cycle.

Organisations generally estimate the carbon footprint of their IT on scopes 1 to 3 using the **Carbon Accounting methodology®** (ADEME). Based on this methodology, some deploy their own carbon footprint measurement calculator internally, using specific functional units or targets (developers, project managers, etc.). Some have implemented a **technical debt analysis tool** (at application or functional level) to be used to decommission components. Others apply the calculation method issued by the CNRS **EcoInfo**[13] research group.

Developing **life cycle analyses for specific use cases** is also a popular approach, enabling the establishment of scenarios as a first step. To do this, it is necessary to **compare different sources of information** to improve the consistency of indicators and the credibility of scenarios. The

[13] https://ecoinfo.cnrs.fr/ (in French)

implementation of an **application-based metrics system** is initially effective in order to factor in the environmental impact at the earliest possible project stage.

Still others favour, or choose as an addition to their own initiatives, the use of external services to measure the energy footprint of digital services or software applications. For example, Crédit Agricole has drawn up an internal **measuring tools catalogue** to list and identify local measurement-related projects, share feedback and use cases on these tools, and – if the feedback is positive – list the tool in this catalogue, which will thus be made visible to all of the internal IT departments. The organisations that analyse the existing measurement-related offers assess their relevance with regard to criteria such as: the definition of indicators and the methodologies employed, the documentation of measurement rules, support, the development of best practice, in particular regarding development, monitoring or internal benchmarking, real-time assessment, the ability to quickly define the main sources of emissions and to minimise impacts, and lastly, the ability to detect possible reports of pollution.

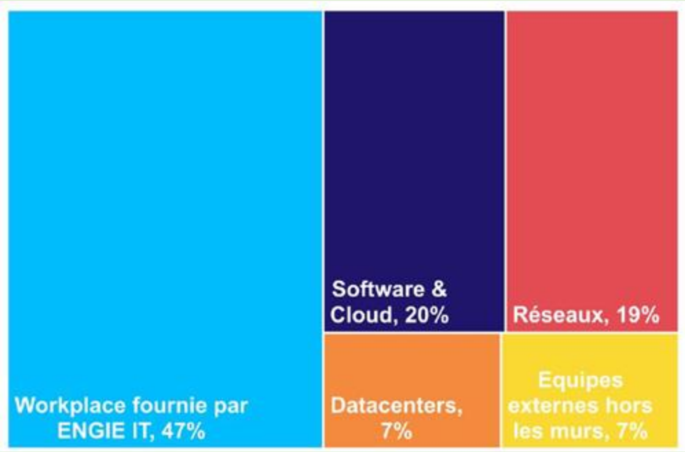
Finally, it is proving invaluable to create **annual benchmarks** regarding footprint and maturity, as this provides an ability to assess areas of progress and how they change over time.

ENGIE IT feedback: Measuring ENGIE IT's IT carbon footprint

In conjunction with the IJO firm, an exhaustive analysis of greenhouse gas emissions was carried out to understand the different orders of magnitude by IT business unit: data centre, workplace, network, software and cloud computing, and external teams (outside the company), including emissions produced by ENGIE IT customers.

"Before starting the study, we were convinced that physical infrastructures (data centres, workstations and networks) would be the biggest contributors to environmental footprint.

However, we were astonished to observe the impact of offshore software and teams with respect to emissions from physical equipment:



"Measuring ENGIE IT's IT carbon footprint" Engie IT – IJO

Software, SaaS and associated intellectual services account for 1/5 of ENGIE IT's total environmental footprint. And the software / SaaS footprint is not limited to the infrastructure footprint: to measure it, it is necessary to take into account the many sales or development teams whose environmental footprint could be improved.

Offshore 3PM (third party application maintenance) teams, often operating in countries where energy is highly carbon-intensive, generate a carbon footprint up to 5 times larger than their French counterparts and also contribute to the environmental footprint.

Our belief is that there are still untapped sources of environmental performance which we could exploit through a closer examination of the performance not only of software service providers but also of intellectual service providers, in particular offshore.

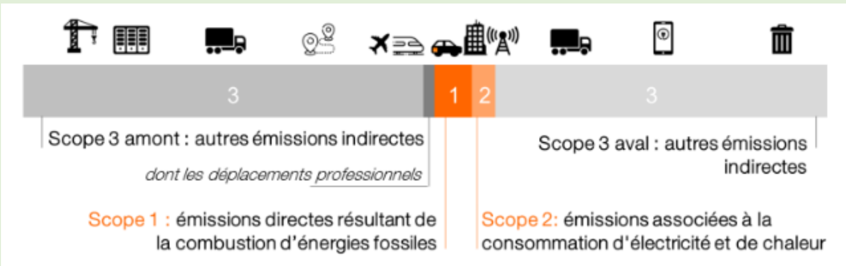
NB: the breakdown of IT emissions at ENGIE IT is specific to its positioning as an IT operator for the ENGIE Group."

Olivier Servoise, ENGIE IT Project Director
and **Aurélie Gracia Victoria**, General Manager, IJO

Experience feedback from ORANGE: Energy modelling of digital uses

"In December 2019, the Orange Group set itself the ambitious target of being net zero carbon by 2040, and in this way obtain a ten-year lead on the sector's objectives, as the GSMA (Association of mobile operators - *Global System for Mobile Communications Association*) has committed to 2050. In its pursuit of this 2040 objective, the Group has set itself an initial intermediate target of a 30% reduction in direct CO_2 emissions in 2025 compared to 2015. These commitments are being made within the framework of the "Net Zero Initiative" (1).

At Orange France level, using the international carbon accounting methodology of the GHG Protocol (2) which classifies greenhouse gas emissions under 3 scopes, 93% of carbon emissions come from Scope 3 (indirect emissions upstream and downstream); meanwhile, Scope 1, linked to the company's activity (combustion of fossil fuels such as gasoline, diesel, vehicles, fuel oil for generators, gas) accounts for 3%; and Scope 2, which is linked to the company's activity (electricity consumption), covers 4% of carbon emissions. The energy consumption for the network, which is linked to customer uses, is an essential component of the Group's carbon footprint reduction policy because it relates to Orange's own activity and therefore generates direct emissions over which it has control.



Before you can take action, you first need to measure. Orange has therefore set itself the objective of measuring so that we can understand what each "part" of the network consumes. Then, we set ourselves the objective of measuring and understanding how our customers' usage influences our networks' consumption patterns. To do this, work to model the energy consumption of IT systems and Orange France networks has been undertaken so that we can **understand and put a figure on the energy consumption of digital technology usage for each of the mobile and fixed networks (including Liveboxes)**.

The classic use case is watching a streaming video on a mobile terminal, via the mobile network, or via a fixed access point (Wi-Fi). Orange's electricity consumption is segmented by network segment and then divided by the volume of consumption in gigabytes for all Orange customers. Putting all of these together results in the end-to-end use case. The result shows that the power consumption of an hour of streaming strongly depends on the access network used (fibre, DSL or Mobile). FTTH (optical fibre to the home) is, for example, the most energy-efficient network:

on the basis of **2020 Orange electricity consumption in France**, the delivery of an hour of streaming video at standard quality (SD at 1.6 Mbps) consumes, in terms of energy, approximately:

- **360 Wh** end to end **for the mobile network**, excluding the mobile device and the video provider's streaming platform. By comparison, 100 Wh is equivalent to running a 9W LED bulb for 11 hours,
- **31 Wh** end to end **via Wi-Fi, using an ADSL connection**, including the power consumption of the box, but excluding the consumption of the mobile device and the consumption of the video provider's streaming platform,
- **17 Wh** end to end **via Wi-Fi, using a fibre connection.**

These electrical consumptions are obtained using a calculation approach known as "full energy cost" (fixed cost + variable cost). The value is an average across all customers. On the other hand, it is worth noting that the structure of energy consumption for mobile is essentially linked to installed capacity to satisfy usage, but ultimately varies relatively little at present compared to the traffic itself (this dynamic variability for traffic will increase in the future). On fixed lines, energy consumption varies almost exclusively as a function of the type of access technology (DSL vs fibre) as well as the type of box, but depends very little on traffic.

To encourage a virtuous approach that limits CO_2 emissions, Orange recommends using Wi-Fi at home, where available, rather than the 4G or 5G mobile network.

Such measures also ensure it is possible to model any type of digital use, provided it can be characterised by traffic in the form of individual units.

Finally, the use of this type of energy modelling of digital usage made it possible to launch in December 2020 – more than a year before the obligation of the AGEC Law (3) – the "My Carbon Footprint" tool which notifies mobile customers of the carbon footprint of the data usage for their mobile phone in line with the usage phase in the Orange network (Scope 2, electricity consumption)."

Christophe Bâlé, Director of Strategic Programmes
and **Florence Chavaren**, Director of Economic Planning,
Strategy Department of the Technical Division of Orange France

(1) The Net Zero Initiative collective brings together companies and scientists, led by the Carbone 4 consultancy. It has worked to establish demanding criteria and international benchmarks.
(2) GHG: Greenhouse Gas protocol https://ghgprotocol.org/about-us
(3) The February 2020 anti-waste law for a circular economy (AGEC): establishes a repairability/durability index, and imposes a requirement on operators to display the amount of data consumed and the equivalent greenhouse gas emissions.

2.2. ORGANISING AND PRIORITISING ACTIONS

For most organisations, measurement of the environmental footprint of digital technology involves a choice of methodology, an implementation of the measurement (at different scales), and a strategic adaptation, at entity or Group level, making it possible to monitor the development of approaches and gains or losses in terms of GHG emissions over time. We will therefore develop the main actions below in order to better manage digital sobriety approaches. This non-exhaustive list includes: deployment of the life cycle analysis methodology; measurement of IT assets and data centres; integration of the default measurement for each new IT project; development of environmental KPIs; definition of appropriate skills; and finally, demonstration of the ROI resulting from these approaches.

2.2.1. The life cycle analysis (LCA) methodology

LCA is a standardised method for multi-criteria environmental analysis, featuring all the stages of the life cycle of a product or service (upstream, during the production phases, during use, and finally, at the end of life or reuse).

LCA is described by the **ISO 14040**[14] standard, and is developed according to four main stages: definition of the LCA objectives and scope; the life cycle inventory phase; life cycle impact assessment phase; and lastly, interpretation, via a critical review, if necessary, of the analysis results and recommendations[15].

This standard is not to be confused with the **ISO 50001**[16] standard concerning the implementation of an energy management system, which takes no account of life cycle analysis. As a result, pollution transfers between different impact categories or in the value chain are not necessarily identified. Some cloud providers are ISO 50001 certified, so this is not necessarily a sign of maturity in the consideration of environmental impacts.

Measuring the footprint of LCA IT systems is a complex task and requires both human and financial investment. It calls for the intervention of **external and internal LCA experts** in digital technology, and several months' worth of computing **resources** to process and format the results. This is why it is vitally important **to clearly define this study's objective and scope**. Organisations often choose to start with certain major areas such as the work environment of employees, data centres, or restrict themselves to specific entities or geographical areas. One of the objectives is to **be able to make these LCAs parameter-driven and generic** in nature so that they may be applied to a greater number of departments and directorates.

One of the key considerations that should not be overlooked for any international company is that **emission factors vary by country**: the emission factor associated with electric kWh in Germany is 400 kg of CO2eq, in France it is 69, and in England or Spain around 250 kg[17].

In addition, LCAs should ideally take into account criteria other than **CO2**, especially: **depletion of non-renewable resources**, the impact on **water resources** (water stress) and the impact on **primary energy** (what has to be taken from nature in order to produce energy).

Today, organisations must enter into discussions to obtain cloud providers' CO2 reports, which **must be supplied to the European authorities in cases where their data centres are in Europe**, in accordance with the framework of European regulations on GHG emissions[18]. Organisations can no longer make do with annual CSR reports, which sometimes border on "green washing".

[14] https://www.iso.org/fr/standard/37456.html (in French)
[15] https://www.iso.org/fr/standard/37456.html (in French)
[16] https://www.iso.org/fr/iso-50001-energy-management.html (in French)
[17] Source: International Energy Agency.
[18] Regarding the EU-ETS quota market: https://www.bilans-ges.ademe.fr/fr/accueil/contenu/index/page/EU-ETS/siGras/0 (in French)

2.2.2. Measuring: the two main areas

2.2.2.1. Measuring the user base

Measuring the **carbon footprint of IT equipment over its entire life cycle** is the first approach adopted by most businesses. Various studies (WeGreenIT, WeNR, etc.) show that **IT equipment is the primary source of GHG emissions in a large organisation**. Measuring IT equipment, including employee **devices** and **digital services**, turns out to be the priority. If the organisation is just starting out, it can begin with macroscopic estimates, based on the number of computers. The drivers for countering overconsumption of this item are sometimes entirely controllable – e.g. where possible, extending the length of use of the equipment (including not only computers, but also cell phones and screens), of buying less new equipment and on a less regular basis, or turning to the secondary market (sale of second-hand hardware and software) – and sometimes less controllable, e.g. the version upgrade policies of certain suppliers, which lead to premature equipment obsolescence[19].

2.2.2.2. Measuring data centres

PUE (*Power Usage Effectiveness*) is the reference value for evaluating **the total energy efficiency of a data centre** (including IT and all related cooling, electrical power, protection, redundancy, etc.) by dividing it by IT consumption only. A PUE is by definition greater than 1. The advantage of the PUE is that it is very well defined, simple and widely recognised, despite its drawbacks: for example, it does not factor in the consumption of renewable energies (produced on site or nearby), nor heat recovery. PUE measures the performance of resources associated with the data centre, but not its own performance in absolute terms. It is therefore necessary to remain critical with regard to this PUE parameter insofar as it does not take into account the geographical situation regarding data centres, or reflect exogenous impacts; e.g. drawing water which allows the servers to be cooled, without having to use electricity. PUE then improves, but this does not take into account the impact on a resource which is set to become increasingly scarce, and on its ecosystem. Some advocate "***Water Usage Effectiveness***"[20] (WUE) as a means of taking data centres' water footprint into account on an equivalent level to energy efficiency.

In addition, the main actions undertaken by organisations to measure the footprint of data centres or SaaS services (application solutions hosted in the cloud) are:

- Measurement of direct impacts (via energy consumption) including consumption by data centres, estimates of consumption by LANs, also estimates of consumption by equipment;
- The CO2 reporting requirement for service providers in SaaS mode;
- Energy consumption of services with the help of service providers;
- Using data from reporting or hypotheses, measurement of Scope 3 of hosting (emissions in the manufacturing phase and during waste treatment in particular);
- Measurement of the energy consumption of applications in data centres;
- Measurement of the impact of decommissioning activities in data rooms;
- Collection of data on server consumption;
- Development of comparative measures on different types of hosting;
- Automation of compliance inspections for best practice in responsible design.

[19] See Cigref 2021 reports on software and hardware obsolescence https://www.cigref.fr/software-and-hardware-obsolescence-recommendations-for-organisations-and-proposals-for-providers
[20] https://datacenter-magazine.fr/la-question-de-leau-dans-le-datacenter-vers-un-wue/ (in French)

Experience feedback from PÔLE EMPLOI: Energy optimisation of data centres

Pôle Emploi has been working for many years to improve the energy efficiency of its data centres. Many projects incorporate this optimisation. Because it hosts its own applications, Pôle Emploi is **in control of its own optimisations**, and projects can have a **high value, with a high ROI**. The projects relate in particular to:

- **Containment**: data centre cooling systems have been optimised by separating cold and hot air flows, with cold and hot aisle containments.
- **Reduction in air conditioning**: temperatures in technical rooms have been raised from 26° to 28°.
- **Modularity of technical installations** in order to adapt power use to IT demand.
- **Monitoring** via the installation of PDUs (power distribution units), monitored across all racks and hosting solutions. The measurements are fed back and centralised on an efficient BMS (Building Management System). The objective is to measure as closely as possible to the servers and act more responsively if there is a discrepancy in electricity consumption. The PUE which measures the energy efficiency of the data centre, although open to discussion, remains a unit of measurement and comparison. 5 years ago, the PUE at one of Pôle Emploi's data centres was more than 2; today, it has dropped to 1.7 and plans are under way to reduce it further.
- **Complete carbon accounting**: in 2020, a full carbon audit of the two Pôle Emploi data centres was conducted to measure and observe progress, with the implementation of optimisation projects.
- **Adherence to the *Code of Conduct***: 80% compliance with best practice, with an annual audit.
- **Recovery of waste heat**: this makes it possible to heat tertiary premises at a Pôle Emploi site by injecting recovered heat into the heating network. The ROI is attractive: heat recovery has made it possible to achieve a tenfold reduction in the energy bill.

Jean-Bernard Marquais, Head of the Data Centre Division
and **Michel Bezy**, Head of Centralised Infrastructure Engineering Department, Pôle Emploi

2.2.3. Integrate measurement into each digital project

For each new digital project, the environmental footprint of digital technology should be taken into account from the upstream phase, **just as economic, safety or user experience criteria would be**. This requires consideration of **changes in project governance criteria, as well as in purchasing**, with **environmental performance indicators**. Organisations are increasingly seeking to define and systematise LCA processes to enable them to analyse the benefit of new projects and **to make decisions on projects according to their impacts**. Where to start assessing projects that are being launched? Which criteria should be prioritised? The following example from Air France KLM illustrates one possible approach.

AIR France experience feedback: Provision of a social values calculator to project managers

An internally designed solution, the “Social Values Calculator”, ensures a balance between financial benefits and CSR costs in future IT projects, on the basis of 5 criteria with a score ranging from 0 to 5 (5 being the most desirable rating): reduction of CO2 equivalent emissions; non-hazardous waste; diversity & inclusion; employee engagement; and talent and skills management. In each category, we will progress from an initiative without any ambitions regarding criterion (0) to an initiative whose evaluated criterion is the essential reason for the initiative, and the target results are reported (5). Some criteria are still qualitative rather than quantitative.

Information Economics Criteria	Score	Rationale
Social Value	4	
Planet - CO2 reduction ground	3	
0= Unknown environmental impact		
1= No change for the environmental footprint of the IT organization (0 - 0,1 tCO2e)		
2= A small decrease of the environmental footprint of the IT organization (0,1 - 0,5 tCO2e)		
3= A moderate decrease of the environmental footprint of the IT organization (0,5 - 1 tCO2e)		
4= A significant decrease of the environmental footprint of the IT organization (1 - 5 tCO2e)		
5= A minimization of the environmental footprint of the IT organization (> 5 tCO2e)		
Planet - Non-hazardous waste	3	
0= Unknown change in office waste		
1= No change in the office waste		
2= A small decrease in the office waste		
3= A moderate decrease in the office waste		
4= A significant decrease in the office waste		
5= A minimization of the office waste		
People | Diversity & Inclusion	2	
0= Unknown changes in (gender) diversity or inclusion (within IT)		
1= No change in (gender) diversity or inclusion (within IT)		
2= A small increase in (gender) diversity or inclusion (within IT)		
3= A moderate increase in (gender) diversity or inclusion (within IT)		
4= A significant increase in (gender) diversity or inclusion (within IT)		
5= Optimal (gender) diversity or inclusiony (within IT)		
People | Employee engagement	4	
0= Unknown changes in Employee Promotion Score (EPS) (of IT employees)		
1= No change in EPS (of IT employees)		
2= A small increase in EPS (of IT employees)		
3= A moderate increase in EPS (of IT employees)		
4= A significant increase in EPS (of IT employees)		
5= Optimal EPS (of IT employees)		

In terms of the reduction of CO2 equivalent, scoring is more rational. A calculator provides an estimation of the CO2 eq emissions for each project. Project managers must fill in 4 categories:

- IT equipment: laptop, desktop, screen;
- Services: IT equipment, telecommunications, consulting, R&D, air freight, land transport, etc.
- Travelling required to complete the project;
- Consumption: energy consumption data for the entire project.

Project managers are then asked to state whether the project results in a positive or negative change in terms of CO2 eq emissions. For each of the emission factors (excluding consumption), we are in a French environment, namely ADEME's "GHG Reports" data. For some items of IT equipment, we also indicate usage data using an ADEME white paper. The result is broken down into **induced emissions and avoided emissions** (like renewable energy guarantees of origin) **in kg of CO2 equivalent** per year. The table below gives an example of the results for the IT Equipment section (note: these results are fictitious; they do not correspond to actual Air France data):

- **Équipements IT.**

Category	Do the deliverables of the project lead to a change in this category ?	Emission factor [kgCO2e/unit]	Uncertainty [%]	Estimated lifespan	Result [kgCO2e/years]
IT equipment.	*Number of equipment (in unit):*				
Laptop	0	156	50%	3	0,00
In France	0	2,875	10%		0,00
In The Netherlands	0	19,92	10%		0,00
In The Netherlands (REGO)		0,677	50%		0,00
Desktop	0	169	50%	3	0,00
In France	0	9,045	10%		0,00
In The Netherlands	0	62,665	10%		0,00
In The Netherlands (REGO)		2,129	50%		0,00
Screen (21.5 inches)	0	222	50%	4	0,00
In France	0	3,894	10%		0,00
In The Netherlands	0	26,975	10%		0,00
In The Netherlands (REGO)		0,917	50%		0,00

Air France KLM experience feedback from the Cigref "Digital sobriety" working group on March 3, 2021

In more practical terms, comparisons are made with the corresponding quantity of petrol or the number of hectares of forests required to absorb the induced emissions (although this last point should obviously not be considered as a full solution.)

If, for example, **in the future Air France were to halve its pool of photocopiers**, the group would have an **induced emission of -627 tCO2eq**/year and an **avoided emission of -54 tCO2e** through its resulting energy avoidance.

In addition to enlisting the support of project managers for this tool, the Group has two areas of work:

- One in terms of content: by monitoring the **publication of other impact factors** (such as those developed by the **NégaOctet** project, **hoping that they will be shared as "open data"**), in order to increase the materiality of digital technology and communicate in terms other than just CO2 equivalent emissions.
- In terms of form: by offering a **more intuitive and fun interface** than an Excel spreadsheet.

Thibault Juguin, IT environment representative, **Air France**

2.2.4. Develop environmental KPIs

Environmental KPIs can relate to the maturity or the efficiency of a project or a service. Efficiency necessarily assumes that some **measuring method** is available, with **high-quality data**, enabling the calculation of a **KPI** and a **comparison to a reference state**. Armed with this information, it is possible to engage in an economic estimate and to verify it.

Once a company has set up an **environmental management** system, it must engage in a **continuous improvement process** (whether ISO 14001 certified or not), involving the following steps:

- Identify the scope and the criteria on which the environmental footprint is defined, and specify how the measurements will be carried out,
- Specify the priorities from the inventory that are to be addressed,
- Specify an action plan with quantified objectives,
- Run the projects,
- Provide feedback including "failures" that make improvement possible, in order to avoid repeating mistakes,
- Compare yourself to other organisations,
- Communicate and commit to new action plans; anticipate changes over time.

Creating environmental KPIs is an excellent way to engage in this continuous improvement process: they provide a means of assessing progress and whether or not objectives are being achieved.

Experience feedback from Airbus: Responsible digital maturity KPI

The internal KPI for responsible digital technology is an average of 4 criteria (the values presented are fictitious):

- ***Data centres***: if the energy consumption of each data centre is known every month, the energy performance is measured through the PUE (Power usage effectiveness) and it is possible to compare its measured value with its theoretical value (function of the IT load) for the most strategic data centres, the maturity index will be high.
- **Services and equipment purchased**: if all calls for tenders include environmental criteria (eco-labels, training courses, etc.), the maturity will be 100%.
- ***Cloud Computing***: if we know how to obtain the CO2 footprint for the services used (Scope 3 reporting at least, because there is still little possibility of having a real LCA), then maturity can be defined by calculating the **ratio of the number of suppliers that produce reporting divided by the total number of cloud service providers** (for example, 2 / 6 = 33% maturity).
- **Waste management**: are we able to specify how electronic waste is managed at the 12 Airbus sites in Europe? Is the recovery and destination of this waste known and in accordance with regulations? If the answer is yes, it means that the legal framework is under control, and that maturity is therefore good. In general, much more advanced upstream and downstream traceability is now required (which service generates the WEEE? How is it collected? Who handles its recycling? Where, and what is the effective recycling rate?).

The definition of this maturity KPI is constantly evolving, and is not universal: it would be possible to define many others. The essential idea is to compare the data we actually have with the data we should have, in order to measure the overall impacts and the efficiency (impacts related to the services provided) of our digital services.

Other criteria could also be taken into account, such as paper; upstream traceability of electronic waste (who produces it?); training of employees (or service providers / suppliers) in responsible digital technology; the adoption of best practices in eco-design, etc.

A maturity KPI tells us nothing about the efficiency actually achieved, for which other KPIs must be defined: having environmental requirements in a specification does not mean that they are all satisfied and verified, in the same way that merely having information available is not sufficient to ensure that it is used, and used by people with the right skills. Maturity is a necessary first step, but it is not sufficient.

Emmanuel Laroche, in charge of responsible digital technology at European level for **Airbus**

2.2.5. Demonstrate the ROI of a responsible digital strategy

If we are to convince decision-makers of the need for a responsible digital strategy, we need to be able to **also quantify the gains, or the costs avoided**, as a result of digital sobriety measures. There may still be a lack of tools and methodology to calculate this specific ROI, which is not only financial but also social and environmental; yet we can already advance three major arguments:

- Firstly, responsible digital technology is a **driver of employee and customer engagement**, and in fact forms part of **the organisation's outreach in terms of image.** It feeds into **CSR approaches** to corporate organisation and ethics. In this sense, it contributes to employee loyalty by lending meaning to their commitment. With regard to external parties and customers, responsible digital technology acts as a differentiating factor. In this respect, it may be worthwhile to consider **signing a charter which provides a firm foundation for commitment** in a department, but it is necessary to see that this is followed up, and to ensure that this is a good fit for the organisation's strategy in terms of **resources and budget**. We must raise awareness at the highest level to ensure the implementation of this commitment in a practical and operational way. Sharing benchmarks between organisations enables the development of a fertile network and accelerate collective awareness.
- Secondly, responsible digital technology **generates financial ROI**, by reducing costs associated **energy consumption** in usage, code and applications thanks to ecodesign, by means of reusing the waste heat generated by data centres where possible, but also by reducing the budget for the renewal of equipment (when possible, and with a view to also fighting against cultural obsolescence, which is linked to the attraction of novelty). In addition, digital sobriety can be a source of opportunity **in an application or infrastructure project**, since it plays a part in optimising the company's IT, by: pooling information systems; seeking to reduce the number of architectures and eliminating redundancies; updating inventories of equipment or applications; and even contributing to open-source communities and improving knowledge. Lastly, the act of opening up to **certain refurbished or circular economy markets** helps maintain a **virtuous circle that generates social and environmental value.**
- Finally, ROI assumes a benefit, but it can also illustrate the **existing risk** of not introducing digital sobriety approaches, and **the costs** that this would represent, e.g. in terms of non-compliance with regulations.

2.2.6. Provide training and formulate skills requirements

Training plans are sometimes introduced in organisations in order to develop future job roles and skills specialising in responsible digital technology. The need to **define new skills** is being felt. These could take several forms:

SKILLS	Ecodesign skills	Scientific and critical skills	Impact measurement and LCA skills	Responsible digital ambassador or representative
TASKS	Universally adopt ecodesign in the work of developers and project managers for general contractors. Ecodesign can also cut across accessibility and inclusion aspects	Monitor and critically review the literature on accumulated knowledge, work on building the data quality and consistency required for the measurement	Have the ability to measure gains or losses in terms of environmental costs according to individual projects, BUs, etc. Establish environmental KPIs and ROIs	Works at cross-functional level to coordinate initiatives. A community of environmental representatives can be created in various departments
JOB PROFILES	Job profiles: computer engineer, web designer, UX, developer, architects, PMO, etc.	Job profiles from the sectors of research, environmental sciences or engineering	Technical profiles from scientific or engineering backgrounds	Diverse profiles, from management, legal, CSR, IT, etc.

Required skills — Career development

"Responsible digital technology" skills requirements - Cigref working group, 2021

2.3. Main obstacles encountered

2.3.1. The impact of SaaS

Cloud hosting impact data, particularly SaaS data, currently **lacks a systemic vision** and **does not have a sufficient level of granularity**. Public cloud computing calculators often return a neutral result in terms of carbon emissions, because they take the suppliers' energy compensation policies into account. Consider a supplier that uses carbon-free energy: it will return a result of zero CO_2 emissions from its activities, and yet the transfer of data does indeed have an impact. The major issue is based on Scope 3, which is not sufficiently taken into account today. In any case, the **compensation principles** advanced in many CSR reports are **insufficient** in relation to the problem and do not respond to the issues faced by organisations. This generates a real difficulty for decision-makers in selecting the appropriate methods of transformation. In addition, it does not provide accurate **measurement of the impact** of employees' **"full cloud" working environments**. But rising expectations with regard to suppliers offer the hope of progress.

In any case, organisations agree on the fact that it will be necessary always to ask suppliers about **their footprint for the services they deliver**, the **means they use** to reduce it, and **their goals** for annual reduction, excluding compensation. They also expect not only cloud providers but also manufacturers to comply with the **Greenhouse Gas Protocol**[21] and consistently provide information on the geographical location of their emissions (**Location-Based Emissions**) and on their use of the low carbon or renewable energy market (**Market-Based Emissions**).

2.3.2. Availability of impact data

Carbon footprint assessment is still overly focused on **IT assets and on-premises infrastructure**. There is a lack of data on **networks'** emission factors (e.g. how to allocate a flow by application), on **IaaS** (Infrastructure as a service) and **PaaS** (Platform as a service), and also on **use cases** (videoconferencing, streaming, email, etc.). There is also insufficient capacity to analyse data under real-world usage conditions: for example, with regard to ***data centres***, precise inventories exist, but using power rates based on the overall power of the data centres, thus assuming that each customer's load rate is the same. It remains difficult to establish **LCA for servers**, and there is little **public data on LANs** (local area networks).

Data concerning **metal extraction** and equipment **production and manufacturing** phases **up until final assembly** are still incomplete: without open and shared data, which generates consensus, everyone's assessment of their own footprint is based on hypothesis. Carbon indicators have been very vague for many years, but today they are increasingly scientifically qualified. This is why most organisations only use the carbon indicator, for the time being, while waiting for developments in research and knowledge regarding other indicators.

2.3.3. Internal organisation

The occasional difficulty experienced in enlisting management support in IT departments and business units still demonstrates a need to find the right means of convincing and raising awareness. The issue also has its roots in the commitment of management committees and IT departments. One possible method is to offer **ROI** on digital sobriety initiatives. The indicators must therefore provide a means of **evaluating the benefits** accruing from reduced environmental impact in projects.

Organisations need to develop **environmental, strategic and operational KPIs.** Tools exist for producing "Green IT" indexes for maturity (compliance with good practices) but they do not yet exist for **performance of a digital service** (objective quantification of impacts) – yet this should be a basic prerequisite to reducing the default carbon footprint for digital technology.

[21] https://ghgprotocol.org/sites/default/files/Scope2_ExecSum_Final.pdf

3. CARBON ACCOUNTING FOR IT DEPARTMENTS OF FRENCH ORGANISATIONS: EXAMPLE OF THE W eNR TOOL

*With the contribution of **Vincent Courboulay**, Scientific Director of the INR,*
*with **Guillaume Bourgeois, Benjamin Duthil** and **Louise Vialard***

Organisations, as central users of digital technologies, have a key role to play in the convergence between climate and social emergencies and digital transition. The phase of raising awareness of the environmental and social impacts of digital may now be a reality, yet we must ensure the widespread introduction of the next step: the **measurement phase**. After all, if we continue to fail to place measurement at the heart of management, we will lead blindly and be unable to act on the main drivers. In 2021, in order to resolve this problem – and as a direct legacy of the WeGreenIT operation supported in 2018 by the WWF – the *Instituts du Numérique Responsable* responsible digital technology institutes of France, Switzerland and Belgium carried out the **only free study into quantitative and qualitative measurement of IT footprint, "WeNR 2021 "**, which the Cigref working group has chosen to support and monitor as an essential reference as it fulfils the expectations of many organisations in terms of openness, relevance, and scalability over time. Some preliminary results from the "large organisations" category are presented below.

Carried out in direct relation with two universities and an engineering school (La Rochelle University, UC Louvain and EIGSI) and with public funding from the urban community of La Rochelle, WeNR 2021 is open to everyone. Teams of volunteers have worked for many months to provide an ambitious new tool intended to reach as many organisations as possible. It was officially launched on 31 March 2021.

WeNR is more ambitious than WeGreenIT and contains more indicators, both qualitative and quantitative; it relies – for now, voluntarily – on open and free data. The questionnaire is accessible online, but the data obviously remains confidential. **The tool enables any organisation to understand the impact of the "People-Planet-Prosperity" triangle**, and measure its level of responsible digital maturity, before making the most far-reaching decisions in terms of carbon footprint reduction. It relies on a quantitative and qualitative questionnaire:

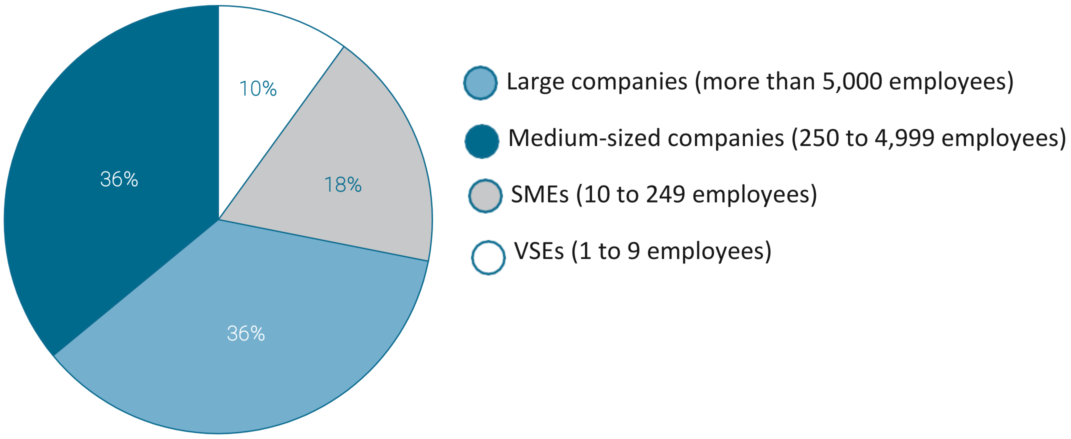
- The first part (quantitative) assesses the information system's environmental footprint. It is based on a precise inventory of 150 indicators covering 3 areas: the entity (organisational structure, employee equipment); data centres; the cloud and cloud computing operators.
- The second part (qualitative) assesses the maturity of the company in terms of responsible digital technology.

In addition to the previous WeGreenIT study, the objective of the WeNR2021 study is to cover most countries, and an English version is directly accessible[22]. This WeNR 2021 is the first in a long series of **WeNR measurement campaigns** to enable everyone to understand, measure and manage their activity.

3.1. CONTEXTUAL DATA

The number of companies participating in the study is **75**, representing a total of 1,309,604 employees. The distribution of respondents as a % is as follows:

[22] https://wenr.isit-europe.org/



The distribution of respondents by country corresponds to:

- Switzerland: 7%
- Belgium: 11%
- France: 82%

Among the responding organisations, 82.9% of them **have a Responsible Digital representative**, and the average estimated duration for the deployment of "responsible digital" approaches is around 3 years.

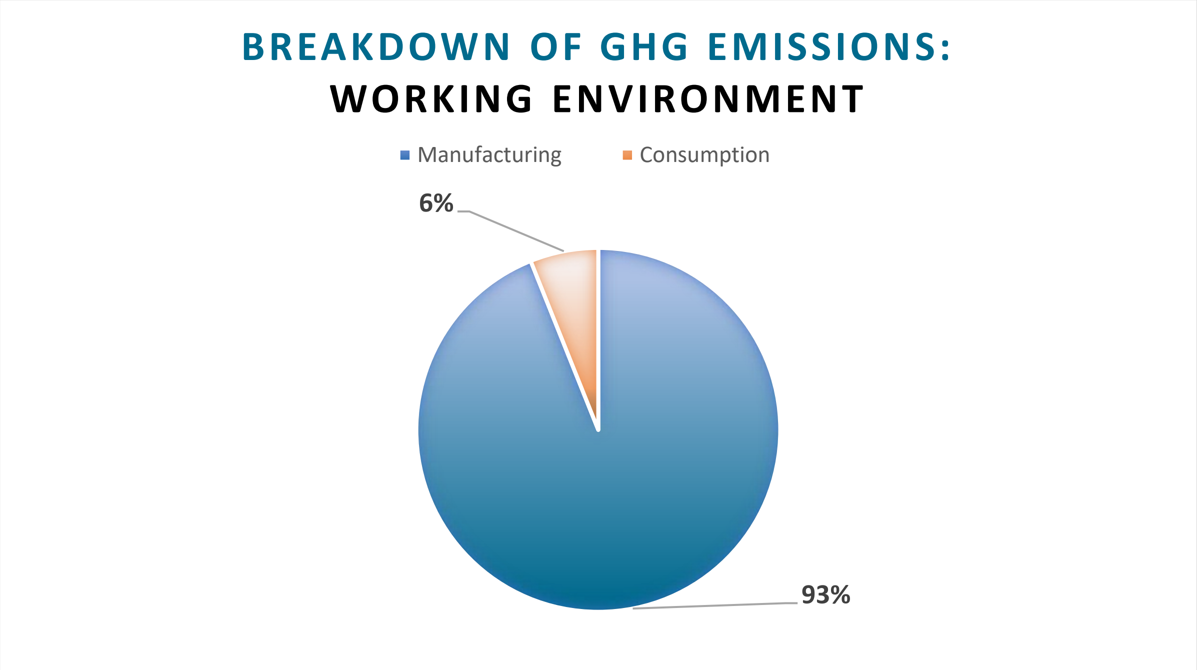
KEY FIGURES	
75 PARTICIPATING ORGANISATIONS	1,309,604 EMPLOYEES INVOLVED
31% PUBLIC ORGANISATIONS	69% PRIVATE ORGANISATIONS
82.9% HAVE A "RESPONSIBLE DIGITAL" REPRESENTATIVE	3.34 years LENGTH OF IMPLEMENTATION OF RESPONSIBLE DIGITAL INITIATIVES

3.2. Key figures for large companies

With regard to the "**Large companies**" category alone, some figures have been extrapolated from the study. They provide a benchmark for the coming years for use by large organisations. They are presented here in the form of an infographic. Remember that this is an average of the 36% of respondents from the "large companies" category:

TOTAL IT GHG EMISSIONS PER USER / YEAR *(excluding services and cloud computing)*	
250 kg CO2eq	OF WHICH, FOR DATA CENTRES: 45 kg CO2eq

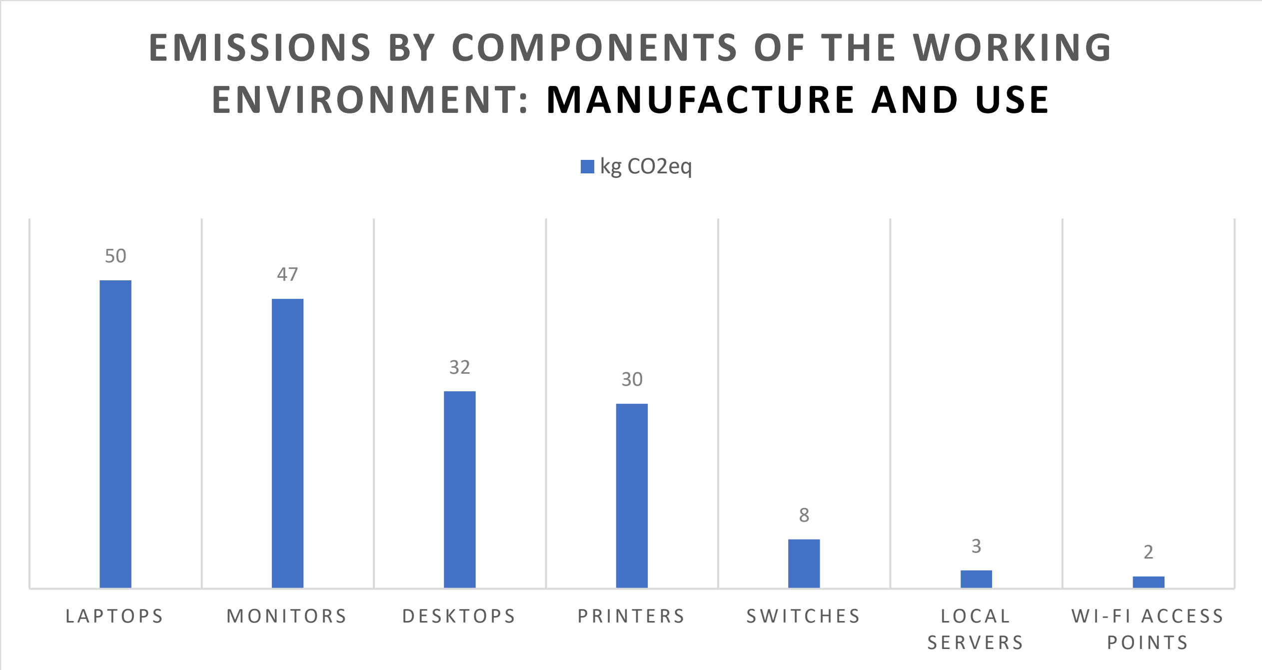
Regarding the employee working environment, the breakdown of GHG emissions between manufacture and use is as follows:



WeNR - Breakdown of GHG emissions: Working environment

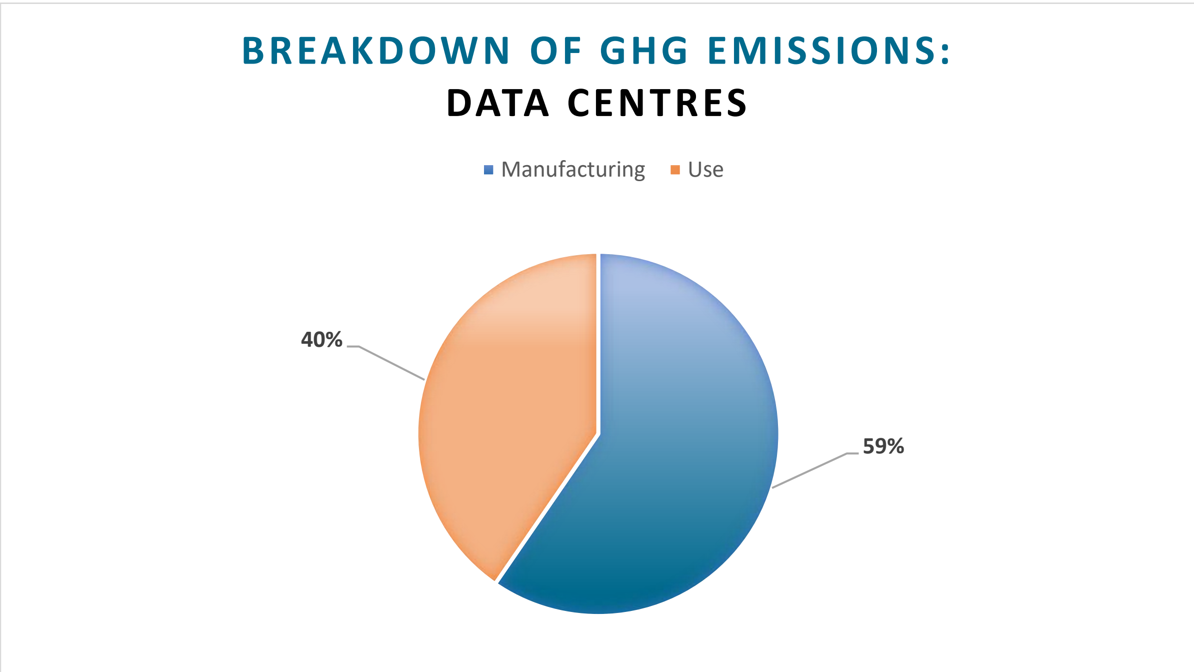
This result may seem surprising in relation to other studies, which claim rates of around 70% linked to digital manufacturing. But these figures need to be placed in context. This often-quoted figure of 70% relates to the share of manufacturing in the total digital footprint, including consumption from networks, data centres and equipment, whereas in this case the percentage is based on a ratio between manufacturing and consumption of equipment only, and within the context of an organisation. Furthermore, this result is also due to (a) the extensive use of green energy by respondents, or (b) the use of electricity from nuclear energies specific to France, hence the low share of emissions linked to consumption.

In the employee work environment, the main sources of emissions come from the following equipment:



WeNR - Emissions by components of the working environment: construction and use

With regard to data centres, the manufacturing phase still constitutes a significant portion of emissions, but with a very significant portion also due to use:



WeNR - Breakdown of GHG emissions: Data centres

Across IT as a whole, the components with the greatest impact in terms of emissions are **the user environment** and **printing**.

Areas where companies are **most mature** are:

- Equipment lifespan and end of life

- Computer centres
- Printing

Areas where companies are **least mature**, however, are:

- Digital services
- Business applications
- Governance
- Telephony

3.3. Future prospects

WeNR tools will be developed in different ways. **The data sources used will be expanded and optimised**. But this is merely the first stage. In the future, WeNR will include an **ability to monitor continuously over time**. Monitoring is necessary to highlight changes that can be made to reduce carbon footprint.

To this end, two future projects – WeNR Light and WeNR Plus – are planned. Users of the WeNR Light solution will be able to obtain a quick and fairly precise initial idea of the environmental impact of their IT assets, and also their Responsible Digital maturity, directly online. **WeNR Plus, which will use the WeNR model and calculator**, will provide a more complete and detailed report in terms of quantity, quality and comparison with **organisations in the same sector; but most importantly, an analysis of the impact of strategic decisions**. The analysis tools provided will therefore provide a means of identifying courses of action for establishing a responsible digital strategy.

Finally, following the liberalisation of the carbon impacts of various cloud providers, the next edition of WeNR will contain a **component for quantifying greenhouse gas emissions from Cloud Computing systems via the use of APIs**.

CONCLUSION

The contribution of digital technology to global GHG emissions, and therefore the efforts required in this area to meet the objectives of the Paris Agreement, are no longer in dispute. Large organisations include this contribution in their carbon footprint, but still lack common data and benchmarks that would enable them to understand and act in a realistic manner, with quantitative and qualitative objectives. Free software tools such as “WeNR” enable the creation of a dynamic with the ecosystem and between organisations of all kinds, making it possible to improve and accelerate the sharing of knowledge and precise data on all IT for an organisation.

Organisations are now seeking to establish a system of governance based on the identification of the main emission sources, with the help of public benchmarks such as ADEME’s Base IMPACTS® database.

The results of their measurements should enable them to implement ambitious policies to reduce their footprint across the board, relating primarily to the footprint of the user’s work environment with a responsible purchasing policy, including clauses concerning CO2 reporting or location and market based emissions, and also to the use of infrastructure (data centres and networks) and cloud computing services. Lastly, with regard to uses, the establishment of digital eco-measures, through awareness-raising and training, are some initiatives that are gaining momentum, particularly through the use of mass-market measurement tools, some of which are fun and educational, facilitating empowerment and awareness of the environmental impacts of digital technology. Organisations are also starting to formulate their requirements for dedicated skillsets for measuring the environmental footprint of digital technology, across multiple criteria if possible. There is a lack of time and resources for carrying out such missions of conducting inventories of assets and services, and for implementing calculation methodologies to carry out a comprehensive assessment.

The work of pooling knowledge and influence must now continue in line with a philosophy of transparency and mutual assistance between the different stakeholders – professionals, organisations and suppliers, researchers, and politicians – in order to ensure shared progress in terms of digital technology’s multi-criteria environmental footprint.

Achieving digital success to help promote the economic growth and competitiveness of its members, who are major French corporations and public administrations, and users of digital solutions and services

Cigref is a network of major French corporations and public administrations set up with a view to developing its members' capability to acquire and master digital technology. It is a unifying player in the digital society, thanks to its high-quality thinking and the extent to which it represents its members. Cigref is a not-for-profit body in accordance with the French law of 1901, created in 1970.

To achieve its mission, Cigref counts on three business units, which make it unique.

Belonging

Cigref speaks with one voice on behalf of major French corporations and public administrations on the subject of digital technology. Its members share their experiences of the use of technology in working groups in order to elicit best practices.

Intelligence

Cigref takes part in group discussions of the economic and societal issues raised by information technologies. Founded nearly 50 years ago, making it one of the oldest digital associations in France, it draws its legitimacy from both its history and its understanding of technical topics, giving it a solid platform of skills and know-how, the foundation stones of digital technology.

Influence

Cigref ensures that its member companies' legitimate interests are known and respected. As an independent forum in which practitioners and actors can discuss and create, it is a benchmark recognised by its whole ecosystem.

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