

The digital, ally or enemy of the ecological transition?



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CHAIRMAN'S MESSAGE

Until recently, many players saw the digital transition and the energy transition as two parallel and largely independent societal developments, with the latter gradually taking over from the former.

This view has now changed. The digital transition continues its onward march in its usual rapid and spontaneous manner, driven by the market and the growth in equipment related to new digital services such as the Internet of Things (IoT) and artificial intelligence. The ecological transition, on the other hand, is dogged by inertia and difficulties in financing the necessary investments. Its momentum mainly comes from public policies essential for creating decarbonisation markets. In Europe, in particular, all major emitting sectors have started to stabilise and reduce their emissions, as we realise that everyone needs to be on board to achieve the goals of the Paris Agreement.

The issue of climate change has also encroached on the growth of digital activities. Their emissions are growing by nearly 10% a year, and while they seemed negligible a few years ago, they now account for 4-5% of global emissions, including emissions from value chains and digital equipment.

The sector is therefore under renewed pressure, since all companies have become partially digital and are working to control emissions from this field of their operations as from others. Green IT is spreading rapidly, largely on the back of improvements in technical efficiency of both equipment and services.

Furthermore, digital players are increasingly asked to demonstrate their utility in supporting the ecological transition, whose cause they can indeed usefully serve. Equipment pooling, optimum energy consumption management, and travel savings are facilitated by digital technology, illustrating the role of 'IT for green' in the growth of certain uses.

It is difficult at this stage to determine whether the widespread use of digital technology contributes to the overall ecological transition, as the methods for measuring environmental footprints are still somewhat inaccurate. The pressure on the sector is leading to improved knowledge, and EpE members are working with their partners to better manage the impacts of their decisions.

We hope this report - which is the result of a more intense dialogue between experts on the two transitions in each member company, and thus based on their experiences - will be useful to all those who, with the objective of the ecological transition in mind, ponder the question of what contribution digital can make to each of them.

Patrick Pouyanné

CEO of TotalEnergies

Chairman of Entreprises pour l'Environnement (EpE)

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INTRODUCTION

In just a few years, digital transformations have profoundly changed our lifestyles and the way our societies function. Due to the rapid pace of innovation, digital technologies continually redefine our notions of time and space and profoundly change our ways of acquiring knowledge and information as well as our consumption patterns. Not only do they transform our lifestyles, they also shape the way our societies and market participants operate.

In France and around the world, the number of digital devices and their uses keep increasing: the value created by the digital economy could have accounted for 15.5% of global GDP in 2019 and the number of connected objects worldwide could soar more than 200% by 2030.

Digital technologies offer great opportunities to businesses and, if properly used, can contribute to environmental conservation and the well-being of people, but they are rather a significant source of environmental impacts. In France alone, annual consumption of digital goods and services accounts for 2.5% of the country's overall carbon footprint, 10% of power consumption and 62.5 million tonnes of resources consumed.

The trend towards ever greater numbers of users and equipment and ever more intense digital uses will cause a sharp increase in digital-related impacts on the environment, for example, France's carbon footprint from digitalisation could jump 60% by 2040 if nothing is done to limit it, although shortages in mineral and metal supplies are already threatening growth in the sector.

The new challenge for companies, therefore, is to pursue their digital transformation while reducing their environmental footprint. Since 2020, large corporate members of Entreprises pour l'Environnement (EpE) have been looking into the links between digitalisation and the environment in consultation with their stakeholders, under the aegis of EpE's Digital and Environment Commission, chaired by Gilles Vermot Desroches, Director of Citizenship at Schneider Electric. Directors and experts from those companies' sustainable development and information systems departments have shared their corporate best practices and analysed the conditions for reducing the environmental footprint of digital technology («Green IT» section) and leveraging that technology to accelerate their ecological transition as well as that of society as a whole («IT for Green» section). This report summarises the work done and examines the strategies and practices designed to reduce the impact of digital technologies, measure their environmental footprint and monitor their uses by companies in order to accelerate the ecological transition.



Digitalisation and the environment: issues at stake

1 Digitalisation: a global phenomenon

1.1 The digital revolution is transforming our lifestyles

«The current digital revolution will have effects that are at least as important as those produced by the invention of writing and later printing in their time» (Michel Serres, 2015)¹. The digital revolution, or digitalisation, denotes the transition to an economy based mainly on information technology.

This revolution is characterised by the extraordinarily rapid pace of innovation. The invention of the microprocessor in 1971, which increased the power and speed of computers, led to the widespread use of personal computers and the Internet during the 1990s. The first 24-hour all-news television channel in 1980 soon followed by the laptop in 1981, CDs in 1982, bank cards with microprocessors in 1985, GPS in 1987, websites and mobile phones in 1991 are the milestones of an age marked by digital applications whose countless opportunities reshape our daily lives.

The pace of digital innovations has continued to accelerate since the emergence of the smartphones and tablets that underpin social media, the profuse development of new technologies such as artificial intelligence, blockchain and its applications (cryptocurrencies, NFT, traceability systems, etc.), and the recent advent of metaverse and quantum computing.

Due to the rapid pace of innovation, these technologies continually redefine our notions of time and space and profoundly alter our ways of acquiring knowledge and information as well as our consumption patterns. They now define our lifestyles, shaping and disrupting the way our societies and market participants operate. The High-Level

Panel on Digital Cooperation created by the UN Secretary General recognises that «digital technologies are simultaneously allowing unprecedented advances in the human condition and giving rise to profound new challenges²». Indeed, while offering new opportunities in many areas (health, education, environment, etc.), digital technologies multiply and amplify existing disparities, exacerbate inequalities and, encourage fast-moving mass consumption societies. Internet product sales in France grew by 42% between 2019 and 2021³. However, global data breaches could cost more than \$5,000 billion by 2024, not to mention the growing concern about online harassment and the prevalence of child sex abuse.

Although the value created by the digital economy is difficult to measure owing to the lack of a consensus definition, the UN Conference on Trade and Development⁴ estimates that it stood between 4% and 15.5% of global GDP in 2019. Companies are the main players in this profound transformation because they must adapt in order not to lose competitiveness, and benefit from its opportunities. Information technologies facilitate access to new markets and the deployment of new marketing methods. The tremendous success of PayPal, Amazon and Netflix illustrates the sheer size of these new markets.

Digital technologies also serve to automate and facilitate some processes (communication, traceability, logistics, production, etc.), as well as strengthen security. They offer new information collection, storage and processing capabilities that can contribute to better informed or automated decision-making.

1.2 French society is moving to a digital future

In France, the health crisis significantly increased the use of digital technology. The results of a survey on the spread of information and communication technologies in French society⁵ show that **the number of people with digital equipment continued to grow** in 2020 led by the sharp rise in smartphones (84% of people have one, up 7% on 2019) despite an estimated lifespan of only 23 months⁶. Home computer usage fell by 15% to 61%, while tablets rose by 17% to 56% and the proportion of people with at least one TV stagnated at 95%. 73% of French people have

more than two Internet access terminals⁷ and connected objects continue to expand into their daily lives (the number of French people having at least one IoT device rose by 21% in 2020). Another study reveals that an estimated 631 million digital devices were used by 58 million French people in 2020, amounting to 11-15 devices on average per user⁸. According to the French Agency for Ecological Transition (ADEME), the number of connected objects worldwide, estimated at 18 billion in 2018, will reach 46 billion by 2030 (up 206%)⁹.

1 [L'innovation et le numérique par Michel Serres. France Culture, 18 May 2015.](#)

2 [The age of digital interdependence. Report of the High Level Panel on Digital Cooperation convened by the UN Secretary-General. June 2019.](#)

3 [Bilan du e-commerce en France en 2021 : les Français ont dépensé 129 milliards d'euros sur internet. Fevad, 2022.](#)

4 [Digital Economy Report 2019. Value creation and capture: Implications for developing countries. United Nations, 2019.](#)

5 [CREDOC, Baromètre du numérique, édition 2021.](#)

6 [French Senate, information report prepared on behalf of the town and country planning and sustainable development commission by the information mission on digitalisation's environmental footprint and authored by Hervé Maurey, president of the commission, Patrick Chaize, president of the information mission, and Guillaume Chevrollier and Jean Michel Houllégatte, rapporteurs. Recorded with the Speaker of the Senate on 24 June 2020.](#)

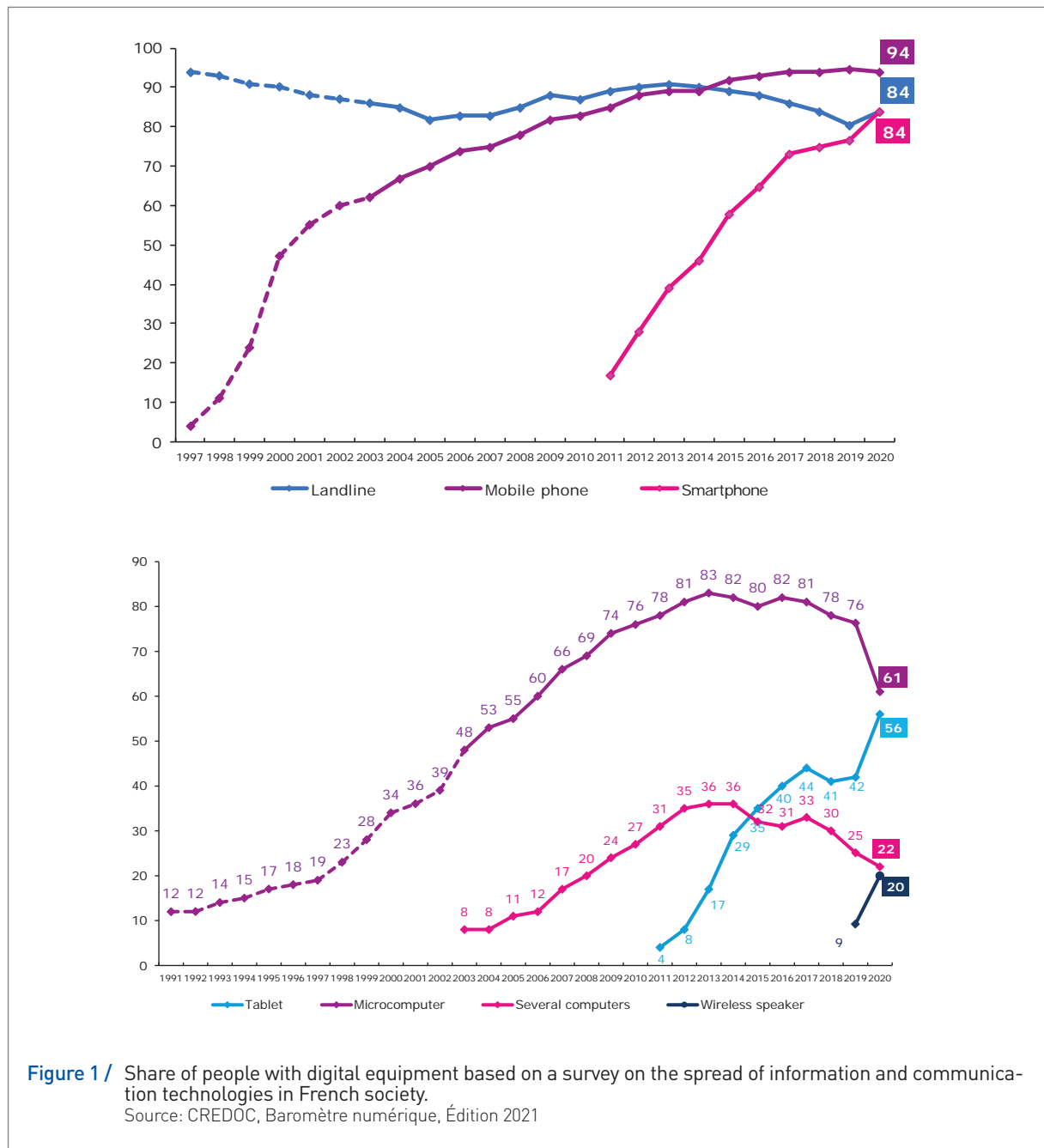
7 [Computer, tablet and smartphone.](#)

8 [Impacts environnementaux du numérique en France. GreenIT.fr, 2020.](#)

9 [ADEME, La face cachée du numérique, 2019.](#)

The use of digital equipment is also rising, as the number of Internet users grows (92%, up 4 points) and households with Internet access switch to ultra-high-speed broadband (cable or fibre). The number of people using social media (67%) and buying online (76%) also jumped by 7% and by

14% respectively in 2020. In France, the volume of mobile data consumed increased by 36% in 2020 and by 21.5% in 2021¹⁰. This increase is mainly due to online video viewing, which accounts for some 60% of internet traffic in both France¹¹ and worldwide¹².



10 [Enquêtes annuelles 1998 à 2020 ; enquêtes trimestrielles 2021. Arcep. Accessed 02/08/2022.](#)

11 [Pour une transition numérique écologique. Information report n° 555 \(2019-2020\) by Guillaume Chevrollier and Jean-Michel Houllégatte, prepared on behalf of the town and country planning and sustainable development commission, submitted on 24 June 2020.](#)

12 ADEME, La face cachée du numérique, 2019.

French companies cannot escape this development. Those whose core business is not digital are speeding up the digitalisation of their processes, which is gradually becoming a precondition for maintaining their competitiveness. In 2019, digital spending amounted to €150 billion representing 6% of French GDP¹³. The digital transformation of businesses is characterised by investments focused mainly on social technologies (networks, marketing, collaborative tools), mobile applications, data analysis and processing technologies (big data, artificial intelligence, predictive analytics, etc.), security (confidentiality, data protection, cybersecurity) and, more importantly, migrations to the cloud. While the volume of data consumed on mobile networks by French companies grew by 33.5% between 2019 and 2020, their investment in SMACS technologies¹⁴ rose to €14.9 billion in 2020. The expansion of teleworking, the modernisation of working methods, and the digitalisation of customer relations were the main driving factors. The results of a survey of 100 information systems directors in 2021 show that this trend is likely to continue, with 48% of companies planning an increase in their budget for 2022¹⁵.

Accordingly, companies whose core business is digital are enjoying strong growth in France. French digital sales¹⁶ increased by 20%¹⁷ between 2009 and 2020, climbing to €56.3 billion in 2021 and projected to grow by 7.1% in 2022. ESNs (digital services companies) account for the bulk of this market (53%), followed by software vendors as well as cloud platforms (35%), and engineering and technology consulting (15%)¹⁸. Five major trends are driving the sector: digital transformation support, consulting and systems integration services (cloud), big data (data collection and analysis), IoT (connected objects) and security. The sector is a net job creator for the eleventh consecutive year (4,600 jobs were created in 2020 despite the health crisis) and continues to enjoy a steady increase in investment. For example, in 2021, investments by telecom operators providing electronic communications services amounted to €14,874 million (excluding mobile frequency purchases), an increase of 10.9% over the previous year, and investments in very high-speed local loops increased by 12% compared to 2020¹⁹.

2 Digitalisation: serious environmental impacts are increasing

2.1 Digitalisation's environmental impacts are multiple

The rapid intensification of digital activities and their global nature generate and worsen environmental impacts. The increasing use of digital technology is matched by direct and indirect environmental impacts and a host of studies designed to monitor them.

In a report submitted to the French Ministry of Ecological Transition and Ministry of Economy, Finance and Recovery, ADEME and Arcep published the findings of their study of the environmental impact of digitalisation in France in 2020 based on twelve environmental indicators.

The consumption of digital goods and services represented an annual carbon footprint of 16.9 Mt CO₂eq, i.e. **2.5% of France's total annual carbon footprint**, with other studies estimating it at 3.2% (24 Mt CO₂eq)²⁰. Annual electricity consumption driven by digital uses amounted to 48.7 TWh or about **10% of France's annual power consumption**.

In addition to greenhouse gas emissions, the study identified three other environmental indicators that are most impacted by the country's digitalisation: **natural abiotic resource depletion** (948 tonnes of antimony equivalent²¹ of mineral and metal resources), **ionizing radiation emission** (indirectly through energy consumed), and **abiotic fossil resource depletion**²².

In all, **62.5 million tonnes of resources**²³ are used every year to produce and use digital equipment in France. This equipment produces **20 million tonnes of waste** annually over its entire life cycle, or nearly 300 kg per capita.

At end of the life cycle, a French citizen would generate an average of **11.5²⁴ to 21²⁵ kg of WEEE**²⁶ per year and, while household and professional WEEE is rather well recycled (75.2%), at 44.3% the overall collection rate is still well below the national target of 65%. The actual share of WEEE recycled in France can therefore be estimated at 33.3%.

13 Étude Markess, <https://comarketing-news.fr/infographie-le-poids-du-numerique-enfrance/>

14 The acronym SMACS denotes the five sectors of digital transformation: Social, Mobile, Analytics, Cloud and Security.

15 [Bilan 2021 et perspectives 2022 du secteur numérique. Numeum, 2021.](#)

16 The digital sector includes digital service companies, software publishers, and technology consulting companies.

17 [Numeum, Chiffres et datas du secteur numérique. Tendances, analyses et zooms du secteur. June 2021.](#)

18 Numeum, Bilan 2021 et perspectives 2022 du secteur numérique, 2021.

19 [Enquêtes annuelles 1998 à 2020 ; enquêtes trimestrielles 2021. Arcep. Accessed 02/08/2022.](#)

20 [Impacts environnementaux du numérique en France, GreenIT.fr, 2020.](#)

21 This indicator assesses the amount of mineral and metal resources extracted from nature as if it were antimony.

22 Primary energy consumption from non-renewable sources (oil, natural gas, etc.).

23 Includes abiotic resources (materials, fossil energy, etc.), biomass, mechanical or erosion-related earth movements, water, and air.

24 Equipements électriques et électroniques : données 2020. Rapport annuel de la filière. ADEME.

25 [Forti V., Baldé C.P., Kuehr R., Bel G. the Global E-waste Monitor 2020:](#) Quantities, flows and the circular economy potential. United Nations University (UNU)/United Nations Institute for Training and Research (UNITAR) – co-hosted SCYCLE Program, International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Rotterdam.

26 WEEE: Waste Electrical and Electronic Equipment.

In addition to its impact on the environment, **digitalisation causes significant social impacts**. Working conditions in mining companies, often located in developing countries, are deemed a major challenge. There is also the issue of greater inequality caused by the digital divide. For example, 37%²⁷ of the world's population has never used the Internet before, and the pace of technological innovation is such

that more and more people are having difficulty using new technologies (digital exclusion). Cybersecurity and data protection present real economic, strategic and political challenges, but the misuse of digital technologies can also have multiple consequences (addiction, deteriorating social relations, etc.).

2.2 Terminal manufacturing accounts for most of the impacts

According to a segment analysis of digital services, the results of which are presented in Figure 2, **terminals are responsible for the lion's share of digitalisation's**

environmental impacts in France (64%-92% depending on the indicator), followed by data centres²⁸ (4%-22%) and then networks (2-14%).

| | Depletion of natural abiotic resources – elements | Depletion of natural abiotic resources – Fossils | Acidification | Ecotoxicity | Climate Change | Ionizing radiations | Fine particles emission | Photochemical ozone creation | Material Input per Unit of Service (MIPS) | Waste production | Primary energy consumption | Final energy consumption (use phase) |
|-----------------------------|---|--|---------------|-------------|----------------|---------------------|-------------------------|------------------------------|---|------------------|----------------------------|--------------------------------------|
| TIER 1 - End-user terminals | 91,8% | 68,4% | 79,9% | 83,0% | 78,7% | 67,7% | 71,5% | 80,0% | 78,0% | 86,7% | 66,3% | 63,6% |
| TIER 2 - Networks | 4,1% | 11,6% | 4,9% | 1,9% | 5,5% | 13,0% | 9,8% | 5,2% | 6,8% | 5,5% | 12,4% | 14,1% |
| TIER 3 - Data centres | 4,1% | 20,0% | 15,2% | 15,0% | 15,9% | 19,3% | 18,7% | 14,7% | 15,2% | 7,9% | 21,2% | 22,3% |

Figure 2 / Breakdown of environmental impacts by digital equipment and infrastructure.

Source : Évaluation de l'impact environnemental du numérique en France et analyse prospective, Arcep, ADEME, 2022.

²⁷ [Press Release. 2.9 billion people still offline. International Telecommunication Union \(ITU\), 2021.](#)

²⁸ Data centres include servers, network equipment and storage arrays.

| | Depletion of natural abiotic resources – elements | Depletion of natural abiotic resources – Fossils | Acidification | Ecotoxicity | Climate Change | Ionizing radiations | Fine particles emission | Photochemical ozone creation | Material Input per Unit of Service (MIPS) | Waste production | Primary energy consumption | Final energy consumption (use phase) |
|-----------------------|---|--|---------------|-------------|----------------|---------------------|-------------------------|------------------------------|---|------------------|----------------------------|--------------------------------------|
| Manufacturing - Total | 121,5% | 25,1% | 84,3% | 81,2% | 78,0% | 19,6% | 41,3% | 80,7% | 96,7% | 98,0% | 19,6% | 0,0% |
| Distribution - Total | 0,3% | 0,3% | 2,6% | 0,7% | 1,1% | 0,0% | 0,6% | 4,6% | 0,3% | 0,3% | 0,3% | 0,0% |
| Use - Total | 0,2% | 74,6% | 17,6% | 7,6% | 21,0% | 80,4% | 59,4% | 17,6% | 12,8% | 1,8% | 80,3% | 100,0% |
| End of life - Total | -22,0% | 0,0% | -4,4% | 10,5% | -0,1% | -0,1% | -1,4% | -2,9% | 9,7% | 0,0% | -0,1% | 0,0% |

Figure 3 / Breakdown of environmental impacts by life cycle stage.

Source : Évaluation de l’impact environnemental du numérique en France et analyse prospective, Arcep, ADEME, 2022.

The vast majority of impacts caused by **the manufacture** of all the equipment used by the French digital sector (terminals, networks and data centres) consist of greenhouse gas emissions, which at 78% are well above the estimated 2019 global average of 40%²⁹. This very energy-intensive stage often occurs in countries with an extremely high-carbon energy mix (Asia and the United States). It also uses a large amount of strategic metals, still recycled to a very limited extent, the extraction and refining of which have very significant environmental impacts (resource and energy consumption, waste production, damage to water, air, and soil quality, and impacts on animals and plants)³⁰.

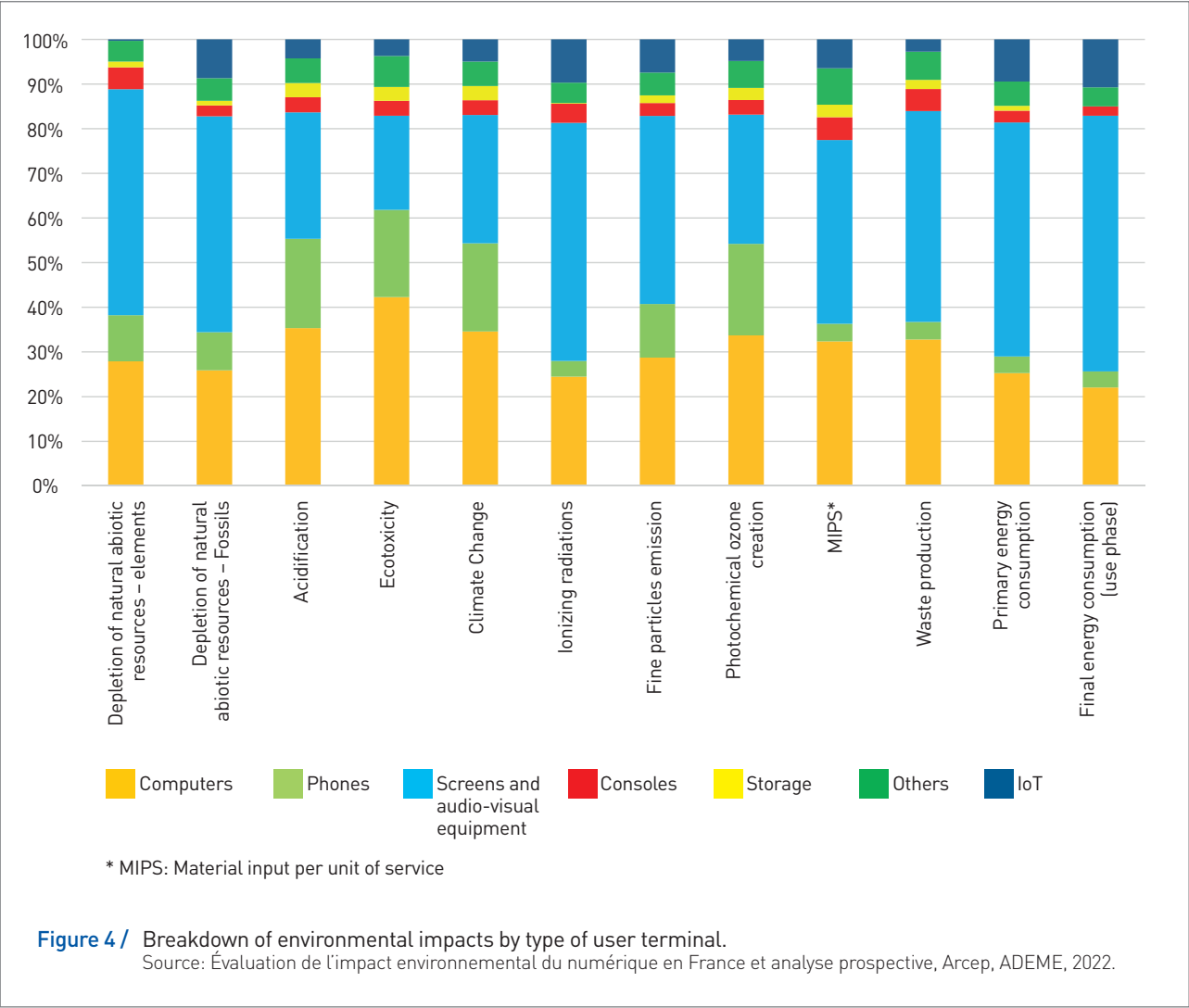
Equipment use is the second stage and one which contributes the most to France’s digital environmental footprint, particularly through energy consumption. It accounts for 21% of greenhouse gas emissions across the entire value chain, well below global average because of France’s low-carbon energy mix. The lower impact of electricity consumption also explains the higher impact from the manufacture of equipment used in France. Figure 3 shows

the breakdown of environmental impacts by lifecycle stages of all equipment (terminals, servers, and data centres). It highlights **the negligible impact of the distribution stage** and identifies the potential for reducing the environmental footprint from the treatment of end-of-life equipment through virgin material or primary energy substitution.

Screens and audiovisual equipment account for most of the overall environmental impact of terminals in France at between 18% and 37%, depending on the environmental indicator. Among them, **televisions** have the heaviest environmental impact due to their number (more than 65 million), their manufacture, and their high energy consumption (179 kWh/year on average). **Laptops** are the second most impactful equipment category (13.5-35%), followed by tablets, smartphones, desktops, TV boxes, video game consoles, printers and connected objects (each representing between 5% and 15% of the total terminal footprint). The breakdown of environmental impacts by indicator and by type of user terminal is shown in Figure 4.

²⁹ [Environmental impact of digitalisation: 5-year trends and 5G governance](#). Updated prospective scenarios of global digitalisation impacts and proposals for the deployment of sustainable 5G. Analysis note. March 2021.

³⁰ [La consommation de métaux du numérique : un secteur loin d’être dématérialisé](#). Document de travail. France Stratégie.



Data centres (divided into five broad categories: local public, national public, corporate, colocation and HPC³¹) have the second biggest environmental impacts due to their high energy consumption and the footprint of some of their components (particularly servers and storage equipment). Depending on the indicator used, corporate data centres account for 34-51% of the total environmental impacts of this category.

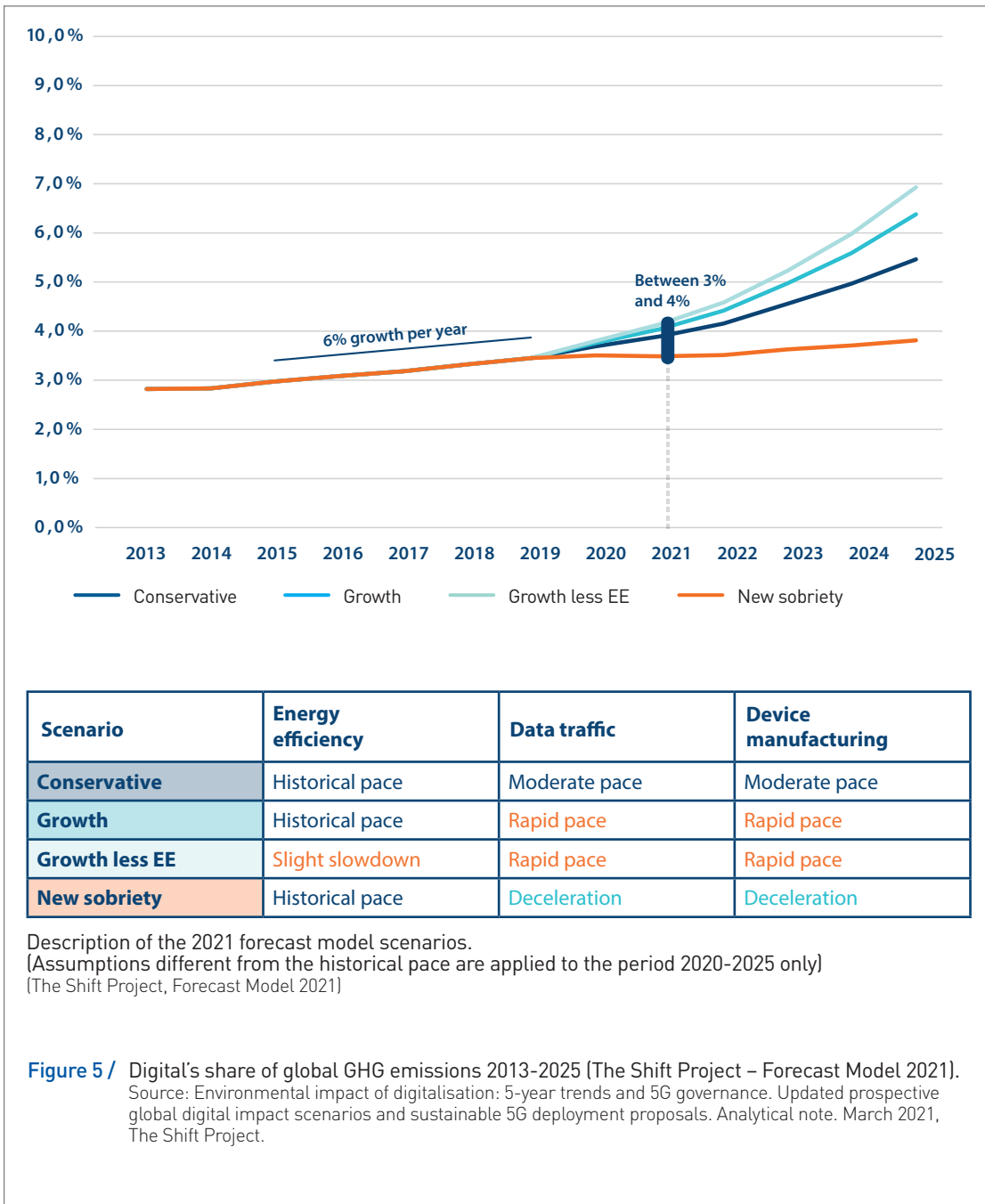
Networks have the smallest environmental impact of digital service segments. Although fixed networks have a greater impact over their entire life cycle (76-90% of all networks depending on the indicator) than mobile networks because of their higher use-phase electricity consumption and equipment deployment levels (in particular, devices installed in users' homes), **an analysis per gigabyte of data transferred reveals the vastly superior environmental efficiency of fixed networks** over mobile networks.

31 High performance computing.

2.3 Such trends are not sustainable

The growing number of users, the higher take-up of equipment (especially smartphones and connected objects), more intensive use (especially more video viewing driven by better resolution quality), the emergence of new digital technologies (cryptocurrencies, artificial intelligence, etc.), the growth in data processing and transport as well as related energy consumption increases have aggravated digitalisation's global environmental footprint over the last few years.

According to The Shift Project, the global digital carbon footprint grew by 6% every year between 2015 and 2019. The annual growth rate could reach 9%³² in the short term. If so, the sector would account for nearly 7% of global GHG emissions by 2025.



32 [Environmental impact of digitalisation: 5-year trends and 5G governance](#). Updated prospective scenarios of global digital impacts and proposals for the deployment of sustainable 5G. Analytical note. March 2021, The Shift Project.

France's **digital carbon footprint could increase 60% by 2040** if nothing is done to control it. In that case, it would account for 6.7% of the national carbon footprint³³ and directly undermine the country's ability to meet the commitments of the Paris Agreements.

Apart from the risks associated with the increase in greenhouse gas emissions, the digital sector, far from the image of non-materiality often attributed to it, consumes a growing quantity and diversity of metals. **Tensions over the supply of minerals and metals** on which digital equipment very heavily depends are beginning to affect the sector.

In addition to major metals, such as copper, iron and tin, **an increasing diversity of minor and precious metals have become essential to the digital sector** because of their performance boosting properties for equipment. Figure 6 shows the main raw materials used by digital technologies, most of which **are already considered critical raw materials by the European Commission**. Indium, for example, is used in flat screens, neodymium (light rare earth) in almost all hard disks, tantalum in electronic capacitors, and gallium and germanium are necessary for manufacturing semiconductors³⁴.

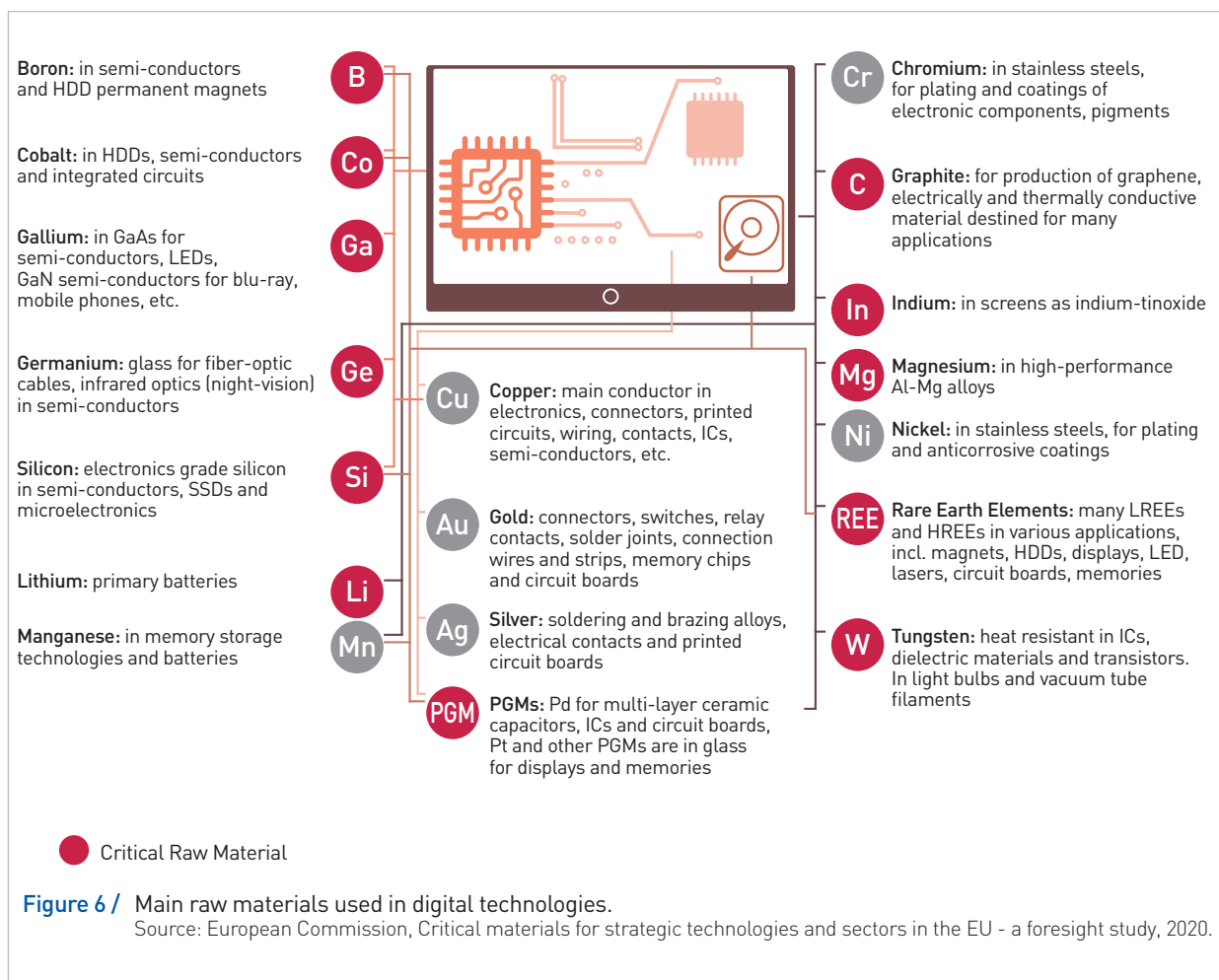


Figure 6 / Main raw materials used in digital technologies.

Source: European Commission, Critical materials for strategic technologies and sectors in the EU - a foresight study, 2020.

33 [French Senate, information report prepared on behalf of the town and country planning and sustainable development commission by the information mission on digitalisation's environmental footprint and authored by Hervé Maurey, president of the commission, Patrick Chaize, president of the information mission, and Guillaume Chevrollier and Jean Michel Houllégatte, rapporteurs. Recorded with the Speaker of the Senate on 24 June 2020.](#)
 34 [La consommation de métaux du numérique : un secteur loin d'être dématérialisé.](#) Working document. France Stratégie.

Every year, therefore, the electronics industry consumes 320 tonnes of gold and 7,500 tonnes of silver, and accounts for 22% of global mercury consumption (514 tonnes) and up to 2.5% of lead consumption. In the field of rare earths, computer and mobile phone manufacture alone accounts for 19% of global palladium and 23% of cobalt production³⁵. In 2018, 34% of the world's annual tantalum production (2,000 tonnes) was used to manufacture electronic capacitors. In 2020, 63% of global copper consumption was used for electrical conductivity and 8 million tonnes for electrical and electronic equipment. 1.8 million tonnes were used for domestic household appliances in 2021, an amount that is expected to increase by 3% in 2022³⁶.

In a foresight study, the European Commission assesses the consequences of the development of nine technologies and three strategic sectors (renewable energy, mobility, defence and aerospace) on the demand for raw materials³⁷. In its view the use of lithium-ion batteries in portable electronic devices, stationary energy storage technologies and electric vehicles will increase by more than 30% in the next ten years, while several of their components, of which only 1% are produced in Europe, are already classified as critical raw materials (graphite, silicone, titanium, niobium, cobalt and lithium).

The growth in data production (from 33 zettabytes (ZB) in 2018 to 175 ZB in 2025), and thus in storage infrastructure, will most certainly lead to **an increased need for materials**, estimated at 80,000 tonnes globally for neodymium, or 120 times higher than current annual European consumption.

Although the risk of depletion of metal raw material reserves seems to be limited, supply tensions are arising as a result of increased competition between regions and between the sectors using them (renewable energy, e-mobility, defence, aerospace, pharmaceuticals, chemicals and petrochemicals), and the economic interconnectedness between the value chains of metals on which the digital sector is particularly dependent. This situation reflects the dependence between the production of several metals often co-produced by a mine and those produced as a by-product from the extraction of a main metal. For example, the production of tantalum, germanium and gallium, co-produced from the production of major metals, would not be economically viable if undertaken alone. As a result, there are already noticeable gaps between supply and demand and shortages of some minor metals.

Geopolitical factors related to the concentration of minor metal production in some countries and the **very limited potential (impossible in the short term) for recycling critical raw materials** would further exacerbate supply risks for the digital sector.

Figure 7 shows that 34 of the 60 metals examined in a UNEP study³⁸ have a recycling rate of less than 1%. Many of these (indium, neodymium, tantalum, gallium and germanium) are pervasive in digital equipment. ADEME estimates that, in France, less than 1% of rare earths are currently recycled from waste and that most of the recovery concerns manufacturing waste³⁹.

³⁵ [Guillaume Pitron, La Guerre des métaux rares. La face cachée de la transition énergétique et numérique. Les Liens qui Libèrent, 2018.](#)

³⁶ [Copper is Material of choice for Appliances. Competitive Analysis of the Appliances Market. The Martec Group for the International Copper Association, 2018.](#)

³⁷ [European Commission, Critical materials for strategic technologies and sectors in the EU - a foresight study, 2020.](#)

³⁸ [Recycling rates of metals. A status report. UNEP, 2011.](#)

³⁹ [Fiche technique. Terres rares, énergies renouvelables et stockage d'énergies. ADEME, 2020.](#)

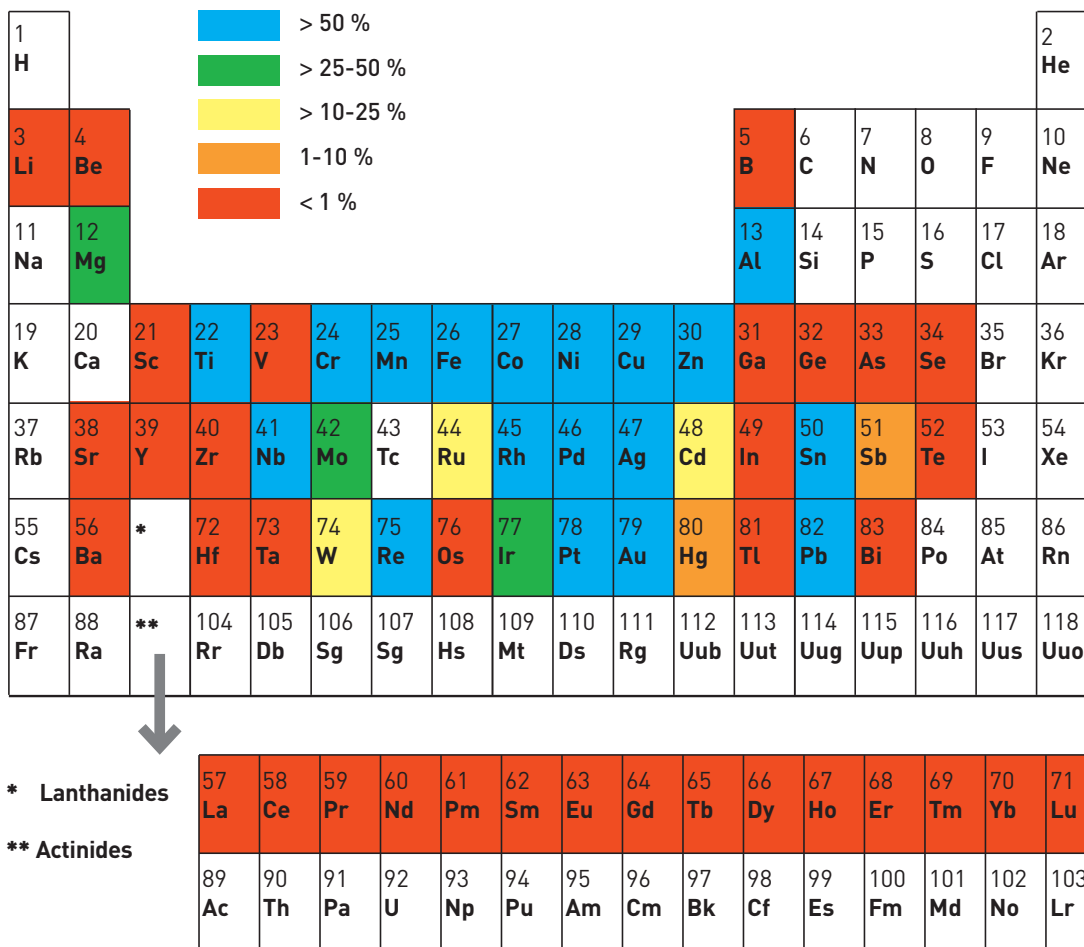


Figure 7 / Recycling rates of sixty metals derived from end-of-life products. The white boxes indicate that no assessment was made due to lack of available data.
 Source: Recycling rates of metals. A status report. IUCN, 2011.

2.4 The positive externalities of digitalisation

Although digital technologies pose real social risks (dissemination of misinformation, cyberattacks, child pornography, increased inequalities, etc.) and have a significant impact on the environment, **they have enormous potential for positive transformation.**

Adopted at the United Nations Summit on Sustainable Development on 25 September 2015, the 2030 Agenda for Sustainable Development acknowledges that «the spread of information and communications technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies, as does scientific and technological innovation across areas as diverse as medicine and energy⁴⁰».

Used wisely, they can also **contribute to the conservation of the environment and the well-being of people.** Digital innovations can, for example, be used to mitigate and adapt

to the effects of climate change, in particular by optimising the generation and distribution of renewable energy, and enabling the development of smart transport systems, more sustainable production and consumption patterns, better land use management systems and the expansion of smart cities⁴¹.

Recently, digital technologies have also proven their ability to help us adapt to major hazards. During the COVID-19 pandemic, they helped maintain the social link during periods of lockdown, with supercomputers identifying candidates for treatments and vaccines, e-commerce platforms prioritising basic necessities and medical supplies, and video conferencing platforms allowing the pursuit of educational and economic activities⁴².



Digital technologies can facilitate satellite earth observation and monitoring of various environmental parameters.
International Space Station (ISS) orbit in space over the Amazon River - SpaceX - NASA Search - 3D render.
©iStock

⁴⁰ A/RES/70/1 – Transforming our world: The 2030 Agenda for Sustainable Development. Resolution adopted by the General Assembly on 25 September 2015, United Nations.

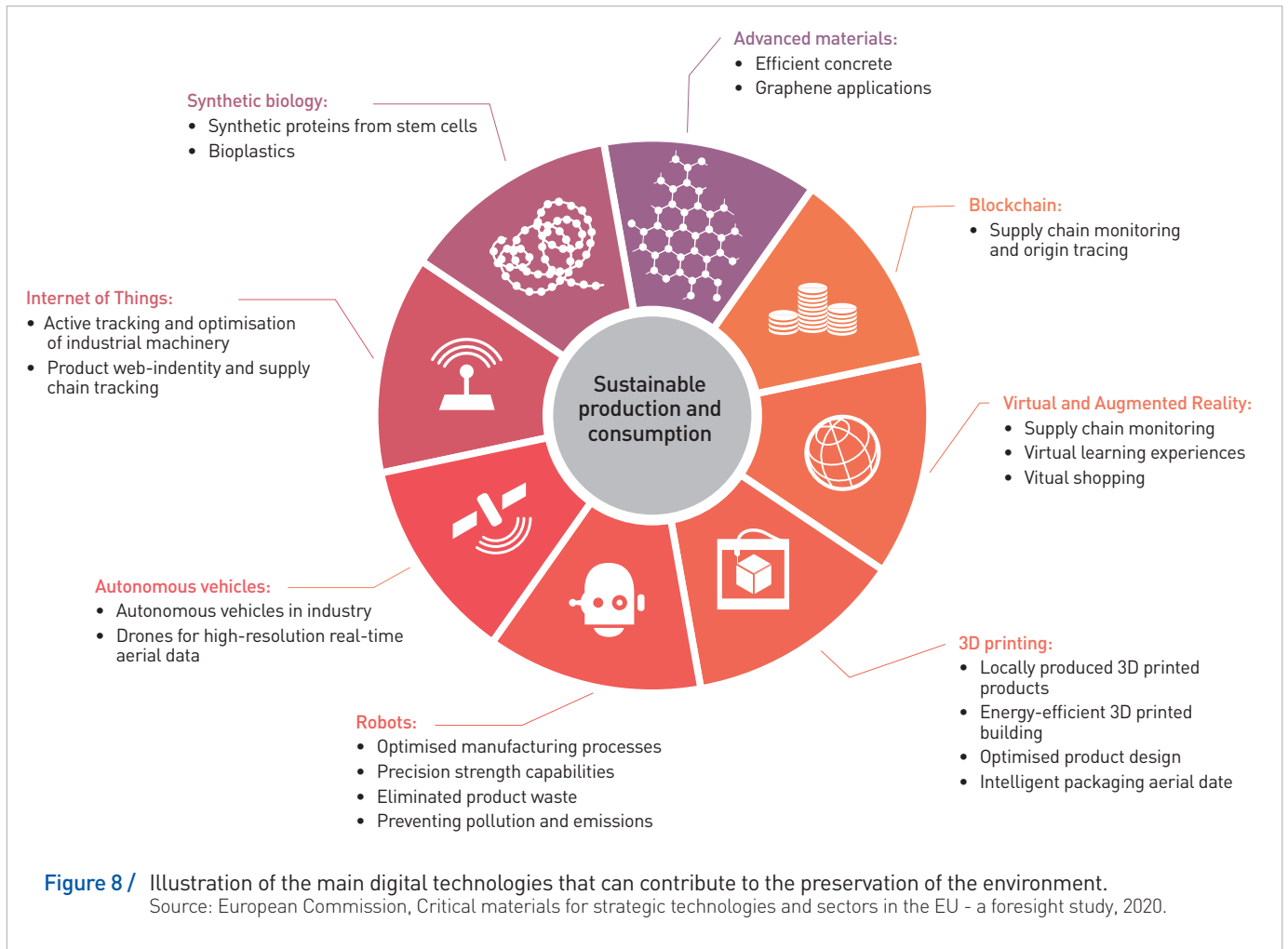
⁴¹ [Innovation for the Earth. Harnessing technological breakthroughs for people and the planet, PwC, 2017.](#)

⁴² [Digital Cooperation Action Plan: Implementation of the recommendations of the High Level Group on Digital Cooperation. Report of the Secretary General of the United Nations. 29 May 2020.](#)

Various innovations and technologies will further expand the boundaries of what is possible in the coming years.

Figure 8 presents the main digital technologies likely to be widely adopted by the business community over the next ten years with the potential to support the transition towards more sustainable production and consumption practices. Cutting edge materials will optimise the performance of digital equipment and further diversify its uses. Connected objects and sensors will improve quality and information access. Connected robots, driverless vehicles and drones

will support or replace some human activities. Blockchain is already opening up new applications thanks to an infallible and decentralised traceability system. 3D printing has numerous applications in industry, construction and medicine. Cloud and big data technologies will help reduce data storage and energy consumption. Other digital innovations in the fields of synthetic biology (biotechnology), virtual and augmented reality and artificial intelligence are likely to further transform our societies and the activities of market participants⁴³.



Aware of these opportunities, many businesses are looking to make the digital transition a driver for the ecological transition. Section 4 of this report «The emergence of IT for

Green» presents in greater detail standard digital practices to accelerate the ecological transition of companies.

⁴³ [Innovation for the Earth. Harnessing technological breakthroughs for people and the planet, PwC, 2017.](#)

2.5 Better management through regulation and voluntary approaches

The growing acknowledgement of these issues has resulted in a plethora of studies seeking to monitor them better, as well as a series of initiatives aimed at raising awareness, promoting training and fostering broad-based commitments. Moreover, **the regulatory framework is being beefed up in France and at EU level.**

Since 2019, under the Eco Energie Tertiaire (energy saving) scheme, data centres with a surface area greater than or equal to 1,000 m² have been required to reduce their electricity consumption. Although several other regulations existed before, the Prime Minister's circular of 25 February 2020⁴⁴ marked the beginning of a cycle of **strengthening political commitment to greater digital responsibility.** It outlined the State's commitments to eco-responsible public services and laid the groundwork for the creation of the ministerial mission for eco-digital responsibility (MiNumEco) whose aim is to assess and improve the public administration's digital environmental impact.

In the months that followed, the Citizen Climate Convention proposed «to support the development of digital technology with a view to reducing its environmental impacts⁴⁵», and then on 23 February 2021, Barbara Pompili, Minister for the Ecological Transition, Bruno Le Maire, Minister of Economy, Finance and Recovery, and Cédric O, Secretary of State for Digital Transition and Electronic Communications announced the release of **an interministerial digital and environment roadmap.**

Since the AGEC law (The French anti-waste law for a circular economy) came into force, electrical and electronic products must display a reparability index at the time of purchase. The index aims to encourage consumers to buy eco-designed objects, and repair them if necessary, in order to limit WEEE as much as possible⁴⁶. From 2022, the index must make more information available to consumers (rate of incorporation of recycled materials, recyclability, presence of precious metals or rare earths, and hazardous substances). In addition, manufacturers are required to make spare parts available for at least five years for some equipment. The law also requires internet and telecom operators to inform customers of their monthly data consumption and carbon footprint⁴⁷.

Enacted in November 2021, the **REEN law** (to reduce the environmental footprint of digital technology) provides for measures to improve user awareness of the impact of digital technology, limit the renewal of terminals, support ecologically virtuous uses of digital technology, promote less energy-consuming data centres and networks, and implement a digital responsibility strategy across the country.

European regulations are also forcing information and telecommunications companies to become more transparent. These companies are, for example, subject to the obligation of disclosing the eligibility of activities and their alignment with the European taxonomy for sustainable activities.

Simultaneously, a French network of digitally responsible players is expanding, comprising researchers, associations, working groups, public bodies and businesses. Figure 9 presents an exhaustive map of digitally responsible players in France.

Several specialist players are emerging, including GreenIT.fr and Alliance Green IT. Others, like The Shift Project, are becoming increasingly active. Meanwhile, expert networks and voluntary commitment schemes are springing up in favour of more digitally responsible practices. The manifesto presented by Planet Tech'Care has been signed by 631 companies and transformation players in France, and the digital responsibility charter designed by Institut du Numérique Responsable now brings together more than 300 French, Belgian and Swiss organisations.

This ecosystem contributes to improving the skills of all stakeholders, in particular through the publication of multiple studies that analyse the environmental and social impacts of digital services and products, identify best practices and make recommendations. Among other notable publications, the «Digital and Environment White Paper⁴⁸» was published in 2018 by the French Institute for Sustainable Development and International Relations (IDDRI), the New Generation Internet Foundation (Fing), GreenIT.fr and WWF France. ADEME has published many papers as well, and the CSR platform (France Stratégie) has hosted a working group whose conclusions are contained in two opinions⁴⁹ on corporate digital responsibility.

⁴⁴ Prime minister's circular of 25 February 2020. Engagements de l'État pour des services publics écoresponsables.

⁴⁵ Produire et travailler - Objectif 12 (fusion C4). Accompagner l'évolution du numérique pour réduire ses impacts environnementaux. Citizen Climate Convention, June 2020.

⁴⁶ Reparability Index, <https://www.indicereparabilite.fr/>

⁴⁷ AGEC law, 2020, <https://www.ecologie.gouv.fr/loi-anti-gaspillage-economie-circulaire>

⁴⁸ IDDRI, FING, WWF France, GreenIT.fr (2018). Digital and Environment White Paper.

⁴⁹ France Stratégie. Corporate Digital responsibility – Summary.

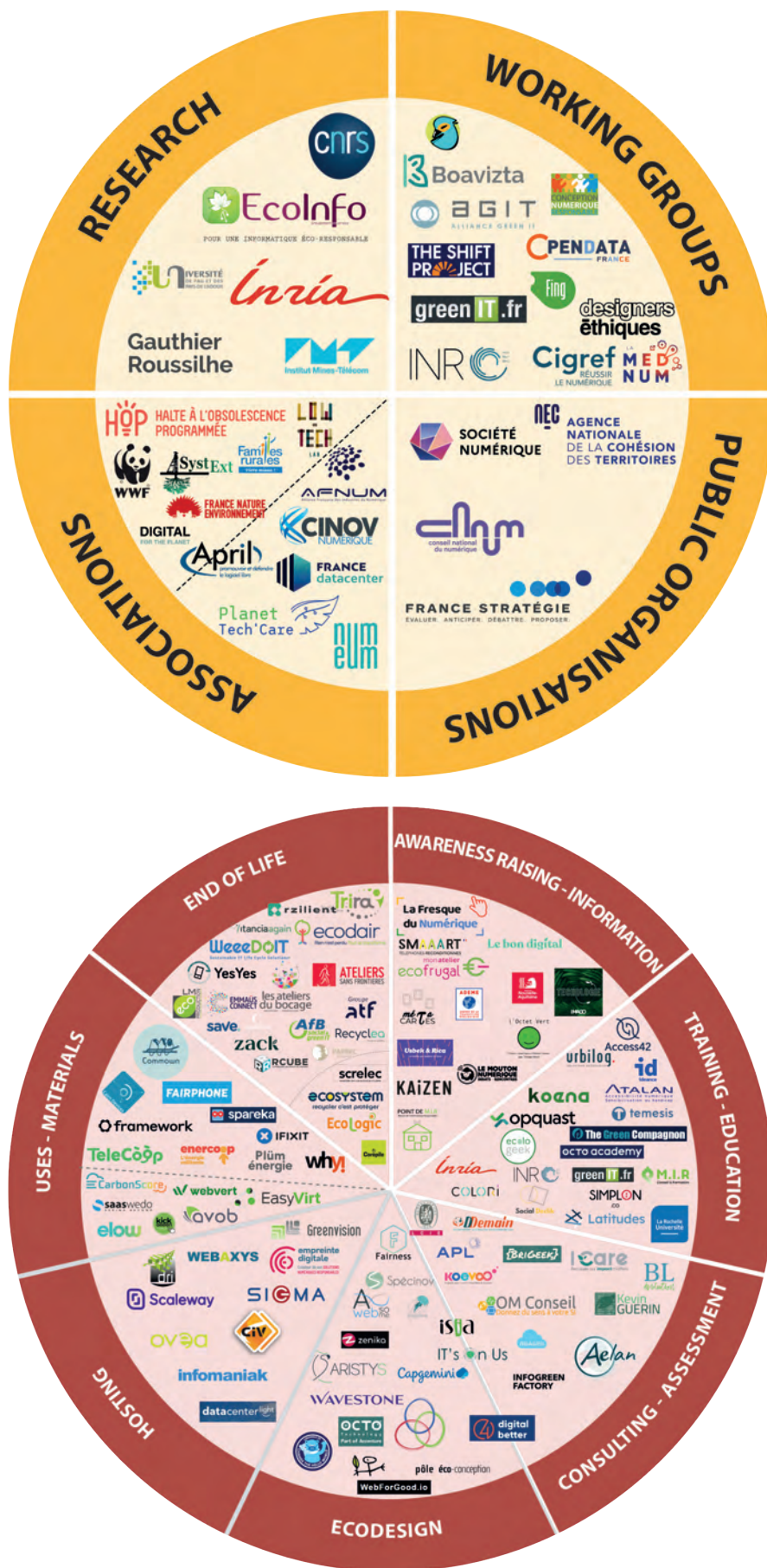


Figure 9 / Mapping of the main digital players in France. Modified from « Panorama des acteurs du Numérique Responsable – 1st edition » Aelan, January 2022.

3 Digital responsibility: a strategic challenge for business

French companies are actively involved in digital responsibility studies and play an important role in driving them. The digital transition is transforming their activities and forcing many to adapt to the new circumstances, and even switch to new markets. The solutions help to simplify, support and optimise certain processes (communication, traceability, logistics, production, etc.) as well as increase security. Moreover, the transition presents real opportunities for many of them. Just as e-commerce has helped companies to develop new business strategies and access new markets, so digital technologies, including those used for environmental conservation, are expected to be widely adopted by the business community over the next decade.

The benefits delivered by the responsible use of digital products and services are not limited to the preservation of the environment. The definition and implementation of a digital responsibility strategy is often an opportunity for companies to examine their information systems and

identify levers for optimising and significantly reducing consumption and costs. By embracing responsibility principles at an early stage, businesses can anticipate French and international regulatory developments, thus reducing their exposure to transition risk and building a brand image that attracts and retains talent. Lastly, the appointment of dedicated digital responsibility teams allows companies to boost their innovation dynamic both internally and across their value chain, and accelerate their ecological transition (IT for Green).

Accordingly, digital responsibility offers various co-benefits, including economic ones. In this sense, the Accenture study «Uniting technology and sustainability: how much progress has big business made?» reveals the scale of the transformations companies are carrying out, and identifies a clear link between implementation of digitally responsible practices and improvements in corporate financial and non-financial performance.



Information technology helps optimise inventory management and supply chain traceability.
©iStock

Combining Technology and Sustainability: where do large companies stand?

As companies set ever more ambitious environmental, social and governance (ESG) goals, their sustainability and technology strategies must be more closely aligned. New positions are emerging to meet this challenge, such as Green IT managers or Digital Responsibility Officers, who will play a key role alongside CIOs in supporting the transformation of their business into a sustainable organisation.

An effective sustainable technology strategy contributes to business growth and improved ESG performance. It addresses three imperatives:

1. To make the technology itself progressively more sustainable (Green IT component);
2. To use the potential of technology to enable and accelerate sustainability efforts throughout the organisation (IT for Green);
3. To pursue innovation with ecosystem partners and embed practices conceptually across all businesses to develop tomorrow's sustainable business models.

Accenture conducted a survey of 560 large companies around the world in 2022 to explore the adoption of sustainable technology strategies, levers and barriers. It revealed that companies with the most comprehensive sustainable technology strategies perform better in all areas, including financial ones.

Some key findings include:

- 100% of executives interviewed agree that technology is critical to sustainability.
- only 7% have fully integrated their technology and sustainability strategies.
- currently, only 49% of CIOs are part of the executive team that sets sustainability goals. Furthermore, only 45% are evaluated on the achievement of these goals.

■ **For more information:**

<https://www.accenture.com/us-en/insights/technology/unitingtechnology-sustainability>



Technology for business sustainability.

The scale and variety of benefits derived from the implementation of these practices have led EpE's Digital and Environment Commission to study in greater detail corpo-

rate practices for reducing the environmental footprint of their digital activities.



Business practices to reduce the impact of digital activities (Green IT)

Aware of the issues and faced with a growing number of challenges, businesses are reengineering their sustainable development strategies to incorporate environmental impact reduction targets for their digital activities. For most companies, digitalisation accounts for a small part of their total environmental footprint and developing a dedicated strategy and action plan for it reflects an awareness of the environmental emergency and a desire to seize forthwith all impact reduction opportunities, down to the smallest ones. While everyone recognises the need for action, the transition is handled differently by each company.

Some businesses develop their digital responsibility strategy in a top-down manner at the initiative of senior management or the sustainable development, research and innovation, and information system departments; others adopt a bottom-up approach driven by committed employees who spontaneously generate an in-house digital responsibility dynamic and subsequently raise awareness amongst the company's management and colleagues; yet others tap the energy of their ecosystem to work together and garner broader support for digital responsibility issues.

This section provides an overview of impact reduction practices implemented by large French and international companies.

1 Top-down approaches

To achieve their greenhouse gas emissions reduction targets, many companies have developed digital responsibility strategies and associated them with a commitment to contribute to carbon neutrality. While these strategies are

for the most part fairly recent, they set ambitious targets for carbon footprint reduction, sustainable procurement policy, and employee awareness.

For example, Société Générale has introduced a seven-point programme spearheaded by the information systems department aimed at halving the group's digital carbon

footprint by 2025. The strategy is applied across all Société Générale IT departments.



Presentation of sustainable IT actions and strategy

Société Générale has signed the charter of the Responsible Digital Institute and in 2019 launched a «CSR by IT» program to limit the negative impacts of digital technology on the environment and society. The objective of reducing the group's digital carbon footprint by 2025 is 50%.

This program, led by the Cross-functional Information Systems Department, brings together 300 experts from the digital sector who worked in 18 working groups, with the aim of distributing operational deliverables to all the group's IT departments. It is based on federated governance with the various CSR managers of the IT departments. The work of the CSR by IT program has been grouped into 7 communities:

- **Norms and standards:** definition and application of CSR criteria to existing processes: digital project, IS architecture, and IT purchases;
- **Development of CO₂ calculators:** definition of hypotheses, benchmarks and calculation methods for the development of CO₂ measurement tools;
- **Social responsibilities:** diversity and inclusiveness goals for developers and digital users;
- **IT foundation:** actions to reduce the energy consumption of IT infrastructure and equipment;

- **Data and AI:** assessment and reduction of the environmental impact of data storage, transfer and processing;
- **Ecodesign and e-accessibility:** design and develop an information system that consumes less energy and is more accessible;
- **CSR by design transformation** to distribute CSR by IT methods, standards and tools as quickly as possible within the entities.

This work has made it possible to implement initial reduction actions: migration of historic datacentres to more energy-efficient sites, optimization of infrastructure energy consumption, use of green energy in France and abroad, recycling and reuse of end-of-life IT equipment. In addition, Société Générale deploys standards, training and tools to support its 25,000 IT experts in eco-design, green coding, responsible data management and e-accessibility practices. Finally, the group measures the impact of its actions using eqCO₂ calculators and dashboards developed internally.

For corporates whose core business is digital, commitments to reduce the impact of digital technologies are essential. A case in point is the Iliad Group, which aims to

undertake a series of actions to make its scope 1 and 2 emissions carbon neutral by 2035.



For a sustainable IT deployment: the group's climate commitments

Iliad group, Free's parent company, has 16,500 employees working for 45 million subscribers in Europe. Initially present in France, the group has extended its fixed and mobile operator activities to Italy and Poland in recent years.

Iliad has been working for 10 years to reduce the footprint of its activities and is proud that in France, a Free subscriber emits on average only 1.8 kg of CO₂ (scopes 1 and 2) per year, which is less than 0.02% of the carbon footprint of a French citizen.

The growing importance of digital technology and the growth of Iliad are associated with an increase in its CO₂ emissions. This is why the group adopted a more ambitious climate strategy last year.

The company is aiming for zero net carbon emissions by 2035 on its scopes 1 and 2, and zero net carbon emissions on the significant emissions of its scope 3 by 2050. The group has committed to investing one billion euros to achieve its environmental transformation and has defined 10 key commitments.

Iliad's first priority is to limit the evolution of its energy consumption in a context of explosion of uses on its networks. To do so, the company is relying on the optimisation of its networks to make them less energy consuming and on a strategy of supply in renewable energies. Investments in the deployment of fiber optics and 5G, two eco-efficient technologies, are essential to achieve these goals.

Various technological innovations have been deployed, notably to ensure the highest environmental performance of data centers. The most recent one incorporates an adiabatic cooling process that avoids the need for air conditioning and refrigeration gas. This results in significant savings in electricity consumption and avoids wasting millions of cubic meters of water.

At the same time, the entire logistics chain has been redesigned to eliminate the use of air freight, optimize vehicle loading, increase the filling rate of trucks and containers and even use reusable plastic transport pallets.

Various measures have been implemented to improve the environmental performance of the Freebox and guarantee them a lifespan of at least 10 years; they are now ecodesigned, fully recyclable and consume less energy: the latest Freebox consumes 40% less energy than previous generations.

Finally, the group is committed to a responsible sales policy that does not encourage the early renewal of terminals, the main source of carbon impact in the digital sector. Subscribers are supported in extending the lifespan of their products, but also in adopting eco-actions that will enable them to make greater energy savings.

Some companies in sectors that have undergone widespread digitalisation in the last few decades have incorporated the reduction of their digital footprint into the early stages of their digital transformation. SNCF, for example,

regularly updates its digital responsibility strategy. The scope of the carbon footprint of its digital activities is widened every year. The inclusion in 2022 of up-to-date data retrieval from suppliers is a ground-breaking development.



2022 update of the sustainable digital strategy

Integrating sustainable IT into the company's strategy

The transition to sustainable digital is cross-functional: the first challenge was to get decision-makers and employees on board. The «All SNCF» («Tous SNCF») project and the leadership of both the group's Deputy CTO and CIO have made it possible to position this commitment at the heart of the group's strategy.

Measuring the carbon footprint and defining a global strategy

The SNCF IT Carbon Footprint's scope was expanded in 2022 with the integration of more than 25 suppliers' scope 3 emissions and the addition of telecom operators; the final results confirmed several strategic orientations:

1. Terminals still account for the majority of the carbon footprint and a large action plan is underway: BYOD⁵⁰ for service providers; Fairphone experimentation; detailed analysis of the multiple allocations of terminals to employees; continuation of «The big pick up» («La Grande collecte») program to give a second life to 80% of our collected equipment (more than 30,000 by 2021).
2. Historical data centres have started to decrease in size as a result of the gradual migration of a certain number of applications to cloud, by systematically deploying FINOPS⁵¹ to cap the rebound effect.
3. Partners and suppliers have a key role to play. CSR requirements represent up to 20% of the purchasing criteria.

Cloud service providers do not communicate the carbon footprint per service. It is therefore impossible to deploy targeted eco-actions on the «digital workplace» part, while the associated uses continue to explode: the individual storage has increased of 30% in 2021, for example.

Raising awareness

Each business has its own sustainable digital approach:

- for all employees: e-learning to understand the environmental impact of digital and to better manage emails;
- for team building: The Digital Fresco ("Fresque du Numérique") is permanently established thanks to a collaboration with the association;
- for digital players: more specialized support and a network of referents that is growing in skills.

Accelerate the company's transformation in 2023

- Training our entire digital ecosystem on all environmental issues: for example, an eco-design matrix is being deployed in 50 projects;



Second level of internal GREEN application certification ©SNCF

- Assessing the environmental impact of adding new digital services to business remains complex: the addition of these services for employees and customers leads to an increase in CO₂eq emissions. But this must be put into perspective: does this new digital experience replace another service with a higher environmental impact?

⁵⁰ Bring Your Own Device.

⁵¹ FINancial OPerationS.

The definition of a digital responsibility strategy can be hampered by the lack of benchmarks. The interest shown by French stakeholders in the link between digitalisation and the environment is a relatively recent development, and knowledge, methods and tools are still evolving. Some

companies have introduced a labelling system to create an internal dynamic. Such is the case of EDF, which signed the digital responsibility charter⁵² in October 2020. The group has subsequently adopted a three-year action plan based on its labelling blueprint.



The INR label helps structure the sustainable digital strategy

The implementation of EDF's raison d'être of «building a net zero energy future with electricity and innovative solutions and services, to help save the planet and drive wellbeing and economic development» has reinforced the challenges related to sustainable digital development. This theme is now a dedicated CSR commitment among the 16 that make up the CSR architecture of the EDF Group. It is now included in the roadmaps of the IT businesses until 2025.

In March 2021, EDF strengthened this ambition when it became the first energy company to obtain the French sustainable digital label (label Numérique Responsable) developed by the Institut du Numérique Responsable (INR) (Sustainable Digital Institute) with the support of the French Ministry of Ecological and Solidarity Transition, ADEME and the WWF. Within this framework, EDF has made 20 binding commitments to progress. For example, making new web applications more inclusive and sustainable, integrating sustainable digital technology in the professional training of digital employees, and strengthening the sustainability criteria in IT purchasing. These are set out in a 2021-2024

action plan that structures the group's sustainable digital strategy around three axes to cover the multiple challenges.

The first axis aims to implement «Sustainable Digital by design» through actions to reduce the environmental footprint of equipment and digital infrastructures, by promoting the eco-design of digital services and improving their accessibility. The second part focuses on transforming the user experience by providing tools and training to reduce their impact. Finally, the last axis focuses on innovation and, more specifically, on supporting the development of responsible Artificial Intelligence (AI) or Internet of Things (IoT), for example in the fields of hydraulic dam management, smart building uses or predictive maintenance of industrial components.

Deploying this action plan enables EDF to remain committed to sustainable digital development. Its participation in the INR's WeNR 2021 benchmark alongside 74 other European organisations has highlighted the company's maturity in this area.

2 Bottom-up approaches

Awareness of digitalisation's negative externalities is sometimes driven by a group of employees or committed stakeholders, who join forces, study the issues and avenues of action and raise awareness to reduce digital environmental footprints, before seeking highlevel support on the systematic implementation of those practices across the company.

At Michelin, for example, a committee for the transition to digital responsibility was formed spontaneously and succeeded in incorporating the issue into the group's strategic guidelines.

⁵² <https://charte.institutnr.org/>



Structuring of the group for a sustainable digital approach

The use of digital technology is not without consequences on the environment. In 2019 a group of digital transformation stakeholders examined the impact of Michelin's digital operations. This same questioning was raised by the Stakeholder Committee, bringing together representatives of shareholders, employees, customers and suppliers. This convergence of concerns about the impact of digital technology helped establish the team's legitimacy and structure the approach.

Since then, work has continued within a multi-disciplinary operational committee, with two sponsors, the Director of Digital Transformation and Information Systems and the Director of Sustainable Development and Mobility, with the assignment to fully integrate sustainable digital issues into Michelin's digital transformation.

Two focus areas have been defined: firstly, promoting Green IT, i.e., responsible digital technology seeking to minimise its impact on the planet and people; and

secondly, launching the IT for Green initiative to use digital solutions to reduce Michelin's activities negative impact (scopes 1, 2 and 3).

Reporting to the environment governance, the Committee submits strategic proposals and reports on its progress to the Group's top management. The team in charge of sustainable digital transformation has defined a five-year roadmap with ambitions and actions that impact the entire company, including factories and digital uses. A network of ambassadors to disseminate best practices has also been set up.

The transition to a sustainable digital environment is therefore being made within a coconstruction framework. Michelin's approach to controlling its digital footprint is fully in line with the Group's All-Sustainable approach, which aims to strike a balance between the development of people, economic and financial growth, and respect for the planet and its inhabitants.



At AXA, a targeted digital responsibility initiative was initiated by an expert from the IT department. This attracted

support from general management and a dedicated team headed by that person was set up.



Presentation of the «Digital Sustainability Initiative»

The AXA Group has committed to reducing the carbon footprint of its operations by 20% between 2019 and 2025 as part of its strategic plan «[Driving Progress](#)».

The AXA Group is present in 50 countries, counts around 150,000 employees and 95 million customers. Insurance as a business is becoming increasingly digital: services as well as all stored data. The latest measurements indicate that AXA's digital activities represent 30% of the group's total carbon footprint. In light of this, and as a responsible insurer, AXA has decided to create a «Digital Sustainability» initiative in 2019 led by a team of experts.

The «Digital Sustainability» encompasses three pillars:

Identify: to recognize the growing share of digital in the carbon footprint of operations and raise awareness among our teams.

AXA's goal is to train all group employees in 2023 through the digital sustainability module developed by the AXA Climate Academy, an internal version of the [AXA Climate School](#) that offers training to all audiences.

Measure: to understand, assess and manage this carbon footprint.

AXA first published the digital carbon footprint data for fiscal year 2020 (27,845 tCO₂eq) in the 2020 Annual Report and then in the [2021 Annual Report](#). The measurement methodology is in a continuous process of improvement, notably through the integration of data from IT service providers [e.g., Cloud].

Act: to implement actions to contain this carbon footprint, including relevant stakeholders.

Some of the actions deployed to contain the digital carbon footprint include:

- mobilizing entities through the identification of local Digital Sustainability Leads.
- offering reconditioned phones to employees in some entities and developing the «bring your own phone» offer in other entities.
- raising team awareness of the need to extend the lifespan of equipment.
- moving certain applications to the Cloud, to more efficient infrastructures.
- evaluation of new digital projects with an internal analysis grid as part of a more sustainable business architecture.

Given the cross-cutting nature of digital technology, some companies opt for centralising skills and share digital responsibility best practices through working groups, including employees from all subsidiaries. Skills improve-

ment across the company is achieved by collaborating on various initiatives. The Green IT Club set up by VINCI, which brings together a dozen employees, is one such example.



Responsible digital strategy and overview of the initiatives carried out by the Green IT club

To federate the various initiatives of the Group's entities in the field of sustainable IT, VINCI created a Green IT Club in 2021, bringing together VINCI SA, VINCI Construction, VINCI Concessions, VINCI Energies, VINCI Autoroutes and VINCI Immobilier. The aim of this Club is to share information and best practices, to promote them internally and externally, and to monitor the situation by participating in various initiatives, presentations or workshops.

For example, VINCI Energies' Green IT initiative won a prize at the VINCI Environmental Awards in 2021. Following an audit of its companies, VINCI Energies developed a strategy to reduce the environmental footprint of its digital activities:

1. **Defining objectives and setting up governance:** reduce the carbon impact of IT employees by 40% by 2030 (as compared to 2020) in alignment with the group's objective to reduce its direct GHG emission by 40% by 2030 (as compared to 2018) and extend the lifespan of PCs to 5 years.
2. **Helping group companies to activate the first levers:** estimation of the IT carbon footprint, migration of local servers to the Cloud, implementation of a reconditioned mobile phone fleet, etc.
3. **Raising user awareness of the significant environmental impact of equipment and sustainable IT practices.**

To reach these objectives, VINCI Energies has already implemented several concrete actions:

- employee awareness via the «Green IT» passport and other e-learning content;
- communication with the group's 1,800 companies thanks to a dedicated newsletter (the «Green IT Mag») and a website dedicated to sustainable IT;

- creation of a Green IT tool to assess the environmental footprint of entity;
- the establishment of partnerships for more responsible purchasing (reconditioned equipment, Fairphone) and more sustainable management of the end of life of equipment.

The outlook for 2023 is to have VINCI Energies' approach certified by the Sustainable IT label («Label Numérique Responsable»), and to carry on deploying it notably on issues related to the cloud and responsible purchasing.

At VINCI SA level, the Group IT systems Department partnered with the Environment Department to implement the following actions in 2022:

- organisation of events: Cyber World CleanUp Day, podium for users to best sustainable IT practices);
- creation and dissemination of a toolbox: resources, quizzes, workshop facilitation materials, etc.;
- implementation of a «sustainable IT» passport: e-learning, webinars, quizzes, digital collage workshops («Fresque du Numérique»);
- development of the «Green IT» platform and the «Greet» application, which enable teams to estimate and monitor the carbon footprint of their digital activities, identify levers for reduction, and promote eco-design;
- integration of environmental criteria in the digital tenders (PCs, screens, etc.);

Encouraging and actively identifying projects initiated by employees can be an integral part of a company's digital responsibility action plan. To this end, Société Générale group organises an annual «Environmental Efficiency

Award» for GHG emissions reduction initiatives launched by employees. Its IT category rewards projects contributing to the achievement of the group's environmental objectives.



The environmental efficiency Award

To support the implementation of the commitment to reduce carbon emissions by 50% from its operations by 2030, the Societe Generale group, thanks to its internal carbon tax system set up 9 years ago, rewards annually as part of the Environmental Efficiency Prize (PEE) initiatives to reduce carbon emissions submitted by its employees.

The initiatives are selected for their innovative nature and their environmental and economic efficiency. The winning initiatives are classified into several categories, including the IT category, which rewards all approaches that notably those that aim to reduce or limit the carbon footprint of digital technology.

The IT experts who are members of the selection committee provide candidates with a methodological guide to determine the environmental impact of the actions implemented in this area.

Typical projects are presented there in order to guide the initiators in their calculations of carbon emissions. The methodology is based on the principle that all project components must be taken into account.

For example, the 2021 edition distinguished a set of projects applying the strategy to Société Générale data centres. Their consolidation and optimization are based on the group's digital transformation and hybrid cloud strategy. This makes it possible to reduce the quantity of IT equipment and technical rooms necessary for the operation of IT systems and includes the migration of the IT infrastructure to new data centres with less emissions.

3 Leveraging the ecosystem

The implementation of digital responsibility practices can be accelerated by close collaboration with company stakeholders in a wide variety of fields. While some actions aim to reduce the consumption of digital materials or the

waste produced by them, others seek to leverage their ecosystem in an attempt to innovate and design new business models.

3.1 Acting across one's ecosystem

For companies whose core business is not digital, environmental impacts are mostly indirect and occur during the terminal manufacturing stage upstream in the value chain and the waste treatment phase downstream. These impacts can be reduced through the implementation of circular economy practices, which partnerships and

collaborative ventures facilitate and accelerate⁵³. The use of eco-designed or reconditioned equipment, maintenance and repair, reuse, and equipment or component recycling help to extend the service life of machines, to mitigate the environmental footprint associated with their manufacture, and even to avoid the use of new equipment.

⁵³ [Partnerships: cornerstone of the circular economy, EpE, 2021.](#)

Acting across the entire ecosystem, from upstream to end-of-product-life, is undoubtedly one of the most complex aspects of a digital responsibility strategy because it requires collaboration beyond the company's scope of activity between actors of the different levels of one or several value chains. Some solutions involve making the collection, treatment and recovery of waste from electrical and

electronic equipment a full-fledged business model. For example, Paprec has developed know-how in the collection and treatment of this waste through a specialist business line and now plays an important role in more sustainable management of end-of-life equipment for over 5,000 customers.



The reuse and reutilisation of computer components and hardware: a necessary transition towards a sustainable IT

The extraction of natural resources used to manufacture equipment and the volume of waste they generate represent one of the main pressures on the environment in the digital sector. The development of operational solutions is therefore necessary to reduce the ecological footprint of this sector.

Waste and products from electrical and electronic equipment (WEEE) have a high potential for reuse and reutilisation. Paprec, the French leader in recycling and third player in waste management, uses it as a raw material. Through its sector, created in 2010, specializing in the collection and treatment of WEEE and with 8 ICPE⁵⁴ sites and nearly 200 employees on national territory, Paprec collects nearly 100,000 tonnes of waste from electrical and electronic equipment per year with approximately 5,000 customers. The recovery rate can then reach 80% depending on the categories.

This waste can, after a strict and secure procedure of sorting, dismantling, destruction of data and depollution, find a new life and be used again.

In order to extract the maximum amount of recoverable materials, the WEEE sector is perfecting its production tool through massive investments (€12 million in 5 years). More

and more electrical and electronic equipment is thus reused and/or reutilised, thus saving so-called «first melting» energy and avoiding greenhouse gas (GHG) emissions linked to the use of virgin raw materials.

The use of alternative modes of transport such as river transport, scooters and electric vehicles adapts to waste collection environments and also reduces GHG emissions. Reuse and reutilisation are consistent with a social and solidarity economy approach. The Sarcelles site has thus hired people with disabilities from the neighboring rehabilitation centre for disabled workers (ESAT). More generally, the WEEE sector collaborates with Le Petit Plus, a company integrated into Paprec in 2019 in which at least 55% of employees are disabled.

The solution provided by Paprec WEEE for managing the end of life of equipment thus has a triple benefit: limiting the waste of natural resources, depolluting components and creating jobs. This sustainable IT approach focusing on reuse and/or reutilisation is part of a logic of life cycle improvement and reinforces Paprec's circular economy model as much as it contributes to the development of a responsible economy.



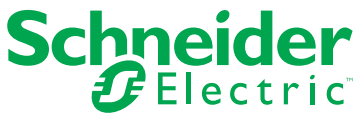
Hard drive data erasing benches.
©Paprec

54 Facilities classified as Environmental Protection

One of the main pillars of the circular economy, ecodesign, is a particularly effective and well-regarded activity in the digital sector, one which is often criticised for planned obsolescence practices and significant waste generation.

Factored as early as possible into the value chain, ecodesign reduces the environmental footprint of equipment over its life cycle. Data centres, the digital services segment

with the largest environmental impact after terminals, are particularly appropriate for new technology-driven ecodesign. By applying this set of practices and offering more sustainable data centres across the ecosystem, Schneider Electric aims to support the digital transformation of the rest of the society in a sustainable way.



Developing sustainable data centers: the first brick of IT for Green

Concrete examples

The energy infrastructure that powers and cools IT servers is the foundation of the digital economy. Therefore, designing them to minimise their environmental impact is key.

When designing a datacenter, the «process» stage requires a particular focus to reduce the product's environmental footprint as much as possible in its design, manufacturing... and use! Some elements of a datacenter will operate for up to 20 years, during which they will consume energy, water and other raw materials. Finally, end-of-life management is also key, with the impact associated with their destruction or reconditioning.

To meet these challenges, Schneider Electric is developing a strategy based on two labels:

- **Green Premium**, which provides all the environmental information on Schneider Electric products, while at the same time conveying a strong and concrete environmental ambition: recyclability of at least 50% of components, elimination of hazardous materials, no programmed obsolescence, very high energy efficiency, etc.
- **Circular Certified**, which identifies Schneider Electric's products from circular economy: recovered from its customers, refurbished in its plants and sold with the same functionality as a new product. This initiative reduces the carbon impact of a new product by 70 to 80% and the tension on raw materials by limiting the extraction of new minerals.

This strategy provides solutions for more sustainable data centers. Two examples:

- **Cooling** can account for more than 50% of a datacenter's energy consumption and the gases used to cool the water loops have, in case of a leak into the atmosphere, a warming power 2,000 times higher than that of CO₂. Many solutions have been devised. The R410a gas (GWP: 1924) has been replaced by 1234ze (GWP: 7). Free cooling uses calories from outside instead of the compressor to cool the water. By optimising the design of the cooling cabinets and units, the infrastructure is cooled with warm water (20°C) rather than chilled water (9°C). By combining free cooling and warm water, energy savings of 60 to 70% are reached compared to a traditional solution.
- **Secured energy** - the **EconversionTM** certificate increases the efficiency of the inverters from 96 to 99% with four times less kilowatt hours consumed per year (for a 1MW machine, the consumption is reduced from 350 MWh to 87MWh). Combined with circularity audits for existing sites, these initiatives help customers operating data centers to achieve carbon neutrality and reduce their impact on biodiversity.

In Marseille, Europe's fifth largest hub for networks, telecoms and the cloud, Schneider Electric has been deploying these technological innovations in its customer Interxion's data centers for over 15 years. The latest infrastructure is 30 times more energy efficient than a traditional facility. Innovation for a more sustainable world continues.

3.2 Innovating for sustainable digital transformation

In addition to equipment design, pooling skills and resources allows to maintain the momentum of network innovation, to achieve ongoing improvements, and to disseminate knowledge and tools useful for the transition to greater digital responsibility among all players.

In line with this, LF Energy Foundation, created by RTE and Linux Foundation, has founded a community of players that collaborate and share resources to develop and deliver open access energy management optimisation software designed to decarbonise electrical systems.



Promoting an open-source collaboration model for the energy transition

Achieving a successful energy and ecological transition requires the development of new, innovative and more horizontal approaches. RTE is playing an active role in this process, supporting the transformation of the French and European energy system through the massive use of renewable energies and the electrification of energy uses. These upheavals call for a new way of thinking about the management of the electricity network, in a more open and collaborative way. This means inventing and developing new technological and digital solutions that will enable a successful transition to carbon neutrality while preserving a secure and economical energy supply.

Faced with the challenge of accelerating the pace of change, yesterday's methods have demonstrated their limits. For this reason, RTE, like the other network operators in France and Europe, has been for several years interested in open and collaborative approaches to digital

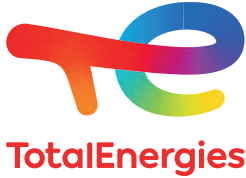
development projects. The challenge is not only to increase efficiency, but also to improve relevance and robustness. Open Source, which is still not very widespread in the energy world, offers a framework for collaboration and governance conducive to meeting this challenge. It stimulates innovation, accelerates development and distribution of solutions through collaboration, and pools costs and skills.

In order to promote an open-source collaboration model within the electricity industry, RTE has joined forces with The Linux Foundation to create the LF Energy Foundation (www.lfenergy.org) in 2019. Today, RTE is a strategic member of LF Energy and is collaborating within this framework to develop six core business software applications essential to its digital transformation. This software will provide the supervision, control and optimisation of networks that are essential for the integration of renewable energies and the intelligent management of consumption.



Pooling efforts and resources can also be achieved through a more compact business partnership involving fewer players. For example, TotalEnergies has partnered with two digital services companies to facilitate the integration of digital

innovations into its information systems. TotalEnergies is committed to supplying renewable energy to its partners in exchange for innovative solutions to digitalise its operations.



Partnership with two major cloud providers to support digital innovation and carbon neutrality goals

TotalEnergies will provide its two cloud partners with renewable electricity for their operations. The Cloud partners will provide the company with the tools to accelerate its digital transformation.

The group has announced a strategic collaboration with two major Cloud providers in 2021 through which it will help its partners achieve their commitments to use 100% renewable energy for their operations, while they will enable TotalEnergies to accelerate its digital transformation. This strategic agreement builds on the respective areas of expertise of the company and its two partners:

- **Renewable Energy:** TotalEnergies and its partners have entered into power purchase agreements (PPAs) covering a commitment of more than 500MW of renewable

generation capacity in the United States and Europe, with the goal of expanding their collaboration to the Middle East and Asia-Pacific. By providing renewable energy and, where appropriate, battery storage solutions, the group is contributing to its partners' commitment to use 100% renewable energy for their operations by 2030 and to achieve carbon neutrality.

- **Cloud Computing:** TotalEnergies has entered into a cloud solutions agreement with its partners to accelerate its transition to the cloud, and consequently its digital transformation, the digitization of its operations and digital innovation. In particular, the Digital Factory will benefit from the breadth and expertise of the partners' services: infrastructure, speed, reliability and innovative services.

The approach, motivations and conditions on which companies build and implement their digital responsibility strategies vary according to their respective backgrounds. While some stem from senior management initiatives, others leverage the momentum and achievements of joint employee initiatives to develop their global strategy. Still others draw on digital responsibility and circular economy business models based on collaborative ventures and partnerships. The goals of these strategies are diverse too. Some businesses use digital responsibility mainly as an additional lever to achieve their decarbonisation targets, while others perceive it as a business opportunity to reduce costs or win new markets.

Notwithstanding these concrete achievements and the advances in digital technology, the question arises of why emissions from the sector continue to increase so rapidly. The rebound effects are massive and any efficiency solution leads to a proliferation of uses that reduce the benefits. The special efforts being made to better understand and control impacts are an attempt to address this paradox.



Measuring the environmental impacts of digital technology

The current state of knowledge already allows companies to identify and implement actions to reduce the environmental footprint of their digital activities. While the precise measurement of this footprint is not a prerequisite for reducing it, the results of such an exercise are useful in several ways, such as determining the contribution of digital technology to a company's total footprint and consequently assessing the materiality of the subject, identifying the key metrics, raising awareness, implementing targeted priority reduction actions and monitoring their effectiveness. Measurement methodologies and tools also provide better guidance for making decisions, for example by simulating the environmental footprint of different project creation and development scenarios or comparing the abatement costs of various solutions. Moreover, disclosing the outcomes contributes to corporate transparency, lends credibility to the company's environmental approach, enhances its reputation, and promotes dialogue on environmental issues with stakeholders (investors, NGOs, etc.).

Yet, despite these plentiful benefits, the relatively new focus on digital responsibility coupled with rapid corporate innovation have hampered the spread of measurement methodologies due to their immaturity and the absence of proper standards. Lack of accurate, granular and up-to-date data (emission factors by type of products and services, electricity consumption factors, etc.), as well as the complexity of connected and shared systems (whose impacts need to be allocated to different users) also complicate any implementation of an environmental measurement approach. Some businesses, however, are starting to base their decisions on the measurement of their environmental footprint to better integrate digital responsibility into their strategies and operations.

1 Measuring to inform and guide decisions

In some cases, measuring identifies the main environmental impact metrics and helps target priority reduction actions. The work of EpE's Digital and Environment Commission reveals that most of the pilot projects carried out

by companies focus on carbon footprint measurement, for which life cycle analysis (LCA) methodologies and data are more readily available than is the case for other environmental indicators.

1.1 GHG emissions: the maturest indicator

The scope of assessment also varies according to companies and their objectives. Some, like Engie, calculate the carbon footprint of their information system in order to identify priorities and reduction action opportunities, and

monitor progress. The Carbon Footprint® method was chosen for its ability to account for GHG emissions across the value chain.



Measuring the environmental footprint of the Information System (IS) using the methodology developed by IJO

As ENGIE's internal IT operator, ENGIE IT has set itself the goal of contributing to the decarbonisation of its internal customers. This strategy is broken down into two main areas:

- offering low-carbon alternatives to conventional IT services in the portfolio;
- offering new digital technologies to help decarbonise IT activities.

In order to identify the most relevant actions to reduce its environmental footprint, ENGIE IT first conducted an exhaustive carbon footprint assessment campaign by following a series of steps:

- Choose from the beginning of the project a methodology to clearly identify the scope of the exercise. The ADEME Bilan Carbone® methodology was chosen for its ability to measure scope 3;
- Identify rules to avoid the risks of double counting. For example, ENGIE IT has chosen to account for its employees on external contracts in the same way as internal employees when they use the same production resources (IT equipment and real estate).
- Accounting principles that are compatible with the reduction measures implemented. For example, the

carbon footprint associated with the manufacturing of computers (between 75 and 80% of the total footprint) is attributed to the year of purchase rather than being amortized over their entire life cycle. This practice makes it possible to measure the impact of extending the lifespan of equipment, which should ultimately reduce GHG emissions from the computer fleet by 15 to 20% (scopes 1, 2 and 3).

- The measurement of the footprint of the Networks & Cybersecurity department has confirmed that the carbon footprint of data transport depends essentially on the number of equipment installed and not on the volume of data transported.
- The exercise revealed, for example, that the weight of offshore services, often carried out in countries whose energy mix has a high carbon intensity, and of software was greatly underestimated. For the latter, the use of monetary emission factors is preferred, as they are more accurate and exhaustive than factors linked to hosting conditions.

The large number of choices and assumptions made highlighted that, in the absence of a more formalised measurement protocol, it was useless to use these results for any other purpose than monitoring progress over time.

Other corporations, like Saint-Gobain, rely on external support to calculate the carbon footprint of their subsidiaries' digital operations across the value chain. The main purpose

here is to carry out a materiality analysis and subsequently deploy targeted actions, which requires relevant analysis rather than highly detailed data.



The IT environment's carbon footprint

Saint-Gobain has made strong environmental commitments for the years 2025 and 2050, including the goal of carbon neutrality. To achieve this goal, roadmaps and programs have been developed in each region of the world and in each entity.

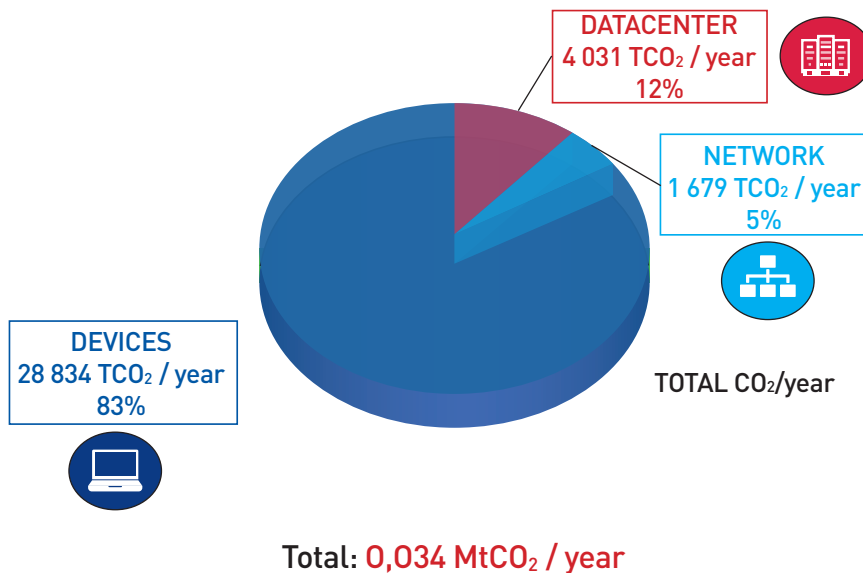
Although digital technology is not Saint-Gobain's largest carbon emission category, digital teams also have a role to play. Therefore, it seemed appropriate to start by conducting a carbon assessment of the digital and IT teams with the help of a service provider. First the scope of the study was defined, then the data and their sources were identified and collected. This study allowed to measure the GHG emissions of the IT department's activities throughout its value chain.

The study takes into account all the digital activities of each Saint-Gobain subsidiary in 16 regions of the world. In the scope were included terminals (smartphones, PCs, desktop computers, tablets, screens), SaaS applications, data center and cloud infrastructures, as well as all network infrastructure. Printers, office waste and employee mobility were not taken into account.

The study revealed that 83% of the carbon footprint of the group's digital activities is linked to terminals. A list of actions has been created with the aim of reducing the emissions of this item by focusing on the life cycle of the equipment, in particular: repairing terminals, donating and reconditioning devices removed from the IT fleet, and recycling of certain components. At the same time, awareness was raised among Saint-Gobain's employees by publishing articles in internal newsletters, distributing videos and setting up awareness-raising stands at certain events, such as the «Agir Durablement» day, which highlights environmental issues.

With the aim of giving subsidiaries autonomy, each is free to set up its own actions, as best suited to its activities and its economic and geographical context. The central teams relay as much as possible the best practices and actions implemented in the various subsidiaries in order to inspire them and create a movement within the group.

IT Carbon Footprint by Category



Yet other players choose to limit the scope of measurement to the segment of digital activity with the greatest environmental impact, i.e. terminals. For the last seven years, for instance, La Poste group has been monitoring the carbon footprint of its IT stock and updating its equipment by carrying out a measurement exercise every two years. Even though the methodology

used for this has been developed by a supplier, the regularity of measurements enables updating of calculation assumptions and widening of the scope of measurement. During the last such exercise, for example, data relating to Group suppliers was included.



A sustainable IT - Measuring La Poste group's footprint

As part of its new strategic plan, La Poste group wants to accelerate its digital transformation, develop digital trust services and contribute to digital inclusion while aiming for digital sobriety. The group's stated vocation is threefold:

- to contribute to the advent of an ethical digital world, to develop digital trust services and to deploy innovative solutions;
- to assert itself as a privileged partner of the French State and local authorities to reduce the digital divide and digital illiteracy;
- to promote the ethical and responsible use of digital technologies while reducing their environmental impact.

Within the framework of the responsible digital governance in place, the subject of measurement has taken its place in the strategic challenges of La Poste group.

The carbon footprint of La Poste and La Banque Postale's IT equipment has been measured every two years since 2015 using a market tool called GreenArgile Carbon. The campaign consists of evaluating the environmental footprint of the owned IT fleet. This initiative brings together various stakeholders to conduct a survey of equipment, involving technical departments, the group's IT, and the CSR departments, in order to identify the main areas for reducing environmental impacts, to carry out a contextual analysis and to draw up an action plan to reduce or limit these impacts.

The volume of associated GHG emissions is relatively low (less than 1,200 tons for the use phase), as the electricity that powers the buildings and equipment is 100% renewable.

With a fleet of nearly 818,000 items of equipment (telephones, computers, tablets, servers, photocopiers, etc.), the group has already taken several concrete initiatives:

- improving the waste management of electrical and electronic equipment (repair policy promoting reuse, collection of cell phones, etc.) allowing for the monitoring of indicators of average life span and user equipment rate;
- an approach to raising awareness of the sustainable design of digital services, which goes far beyond software eco-design. The vision is now understood as a complete life cycle analysis;
- in the skills development plans, the responsible digital dimension has been taken into account in the training programs, with the possibility of certification;
- the implementation of an energy management system aimed at reducing energy consumption and raising user awareness of digital eco-actions.

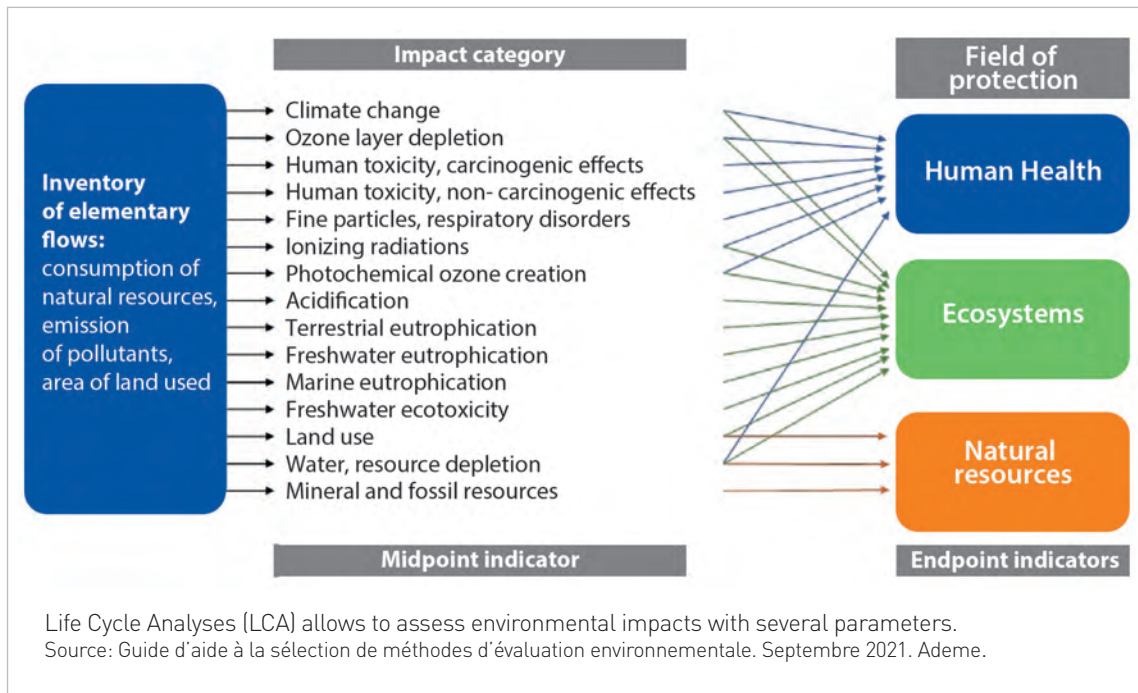
Efforts are underway to complete this «internal» footprint measurement with emissions and consumption linked to outsourced datacenter services. The objective of the scope 3 study is to establish a methodology for measuring the volume of GHG emissions related to scope 3 in the digital domain. At this stage, this concerns outsourced datacenter services, i.e., dry hosting, hosting with data, outsourcing and management in cloud/SAAS mode.

1.2 Multi-criteria analysis of environmental impacts

In addition to the carbon footprint, a more comprehensive multi-criteria analysis of digital technology's environmental footprint allows possible impact transfers to be identified, since the reduction of one environmental pressure can at times lead to an increase in another.

Life Cycle Analysis (LCA), sometimes considered the most successful tool, enables overall assessment of the impacts

of digital technology on other parameters, such as water and abiotic resource consumption, or acidification. Drawing on recently developed granular LCA digital databases (created as part of the NégaOctet project), RTE has used this methodology to assess the environmental benefit of a new digital solution to optimise electricity transport management on the grid.





An application of life cycle assessment (LCA) to a digital innovation

Although digital technology is often presented as an ally of the energy transition, it is not always easy to carry out an overall assessment, to ensure that the reductions in greenhouse gas emissions are greater than the specific impact of a digital solution. As part of its eco-design approach, RTE has quantified the impact of digitising its network, using a concrete case study. The DLR (Dynamic Line Rating) system was chosen for a Life Cycle Assessment (LCA) study in 2020. The DLR, through a real time evaluation of overhead lines conductor's geometry, allows to increase the electrical transit capacities of the line compared to the static method traditionally used. RTE took advantage of an external R&D project called «Negaoctet», with data specific to digital services, to calculate the overall environmental balance of DLR.

The digitisation of the electricity network is a major challenge for RTE, and a key part of its «roadmap» for the power grid up to 2035. This means implementing flexible solutions to articulate new modes of electricity production and consumption, while maximizing the use of the existing network. A set of sensors, associated with calculation models, grants access to a better knowledge of the network state in real time, to information on the optimal transit capacities of the structures, and to an estimate of the state of equipment failure. The DLR is one of the bricks of the digitalisation.

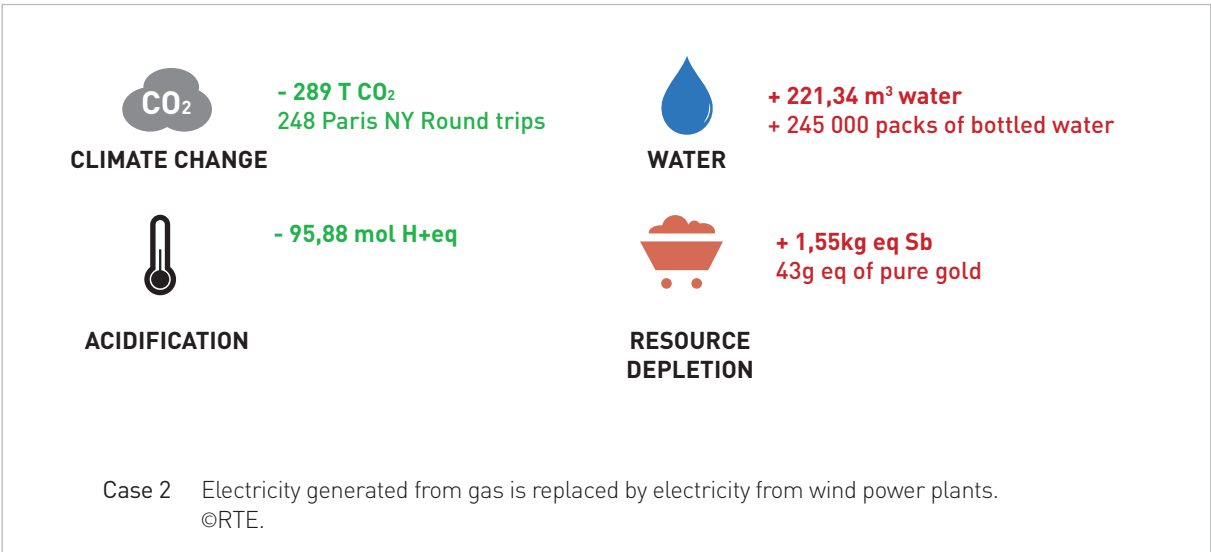
The LCA therefore consisted in quantifying the environmental impacts of the DLR system implemented on two power lines. For case n°1, the installed system allows to avoid the production of 2,880 MWh of electricity in com-

pared cycle gas, which is mostly substituted by nuclear electricity. Indeed, the DLR system, by maximizing the transit on the electric lines, avoids the congestion on the network which would require the starting of conventional thermal groups, producing a more carbonated electricity than nuclear plants. For case 2, it could allow the connection of a larger number of wind turbines: 570 MWh of additional wind-generated electricity could thus be injected into the grid in one year.

The majority of the negative impacts of the DLR system are related to the manufacturing of the datacenter equipment and sensors as well as their installation. The gross carbon footprint is 1 tCO₂eq for case 1, and 643 kgCO₂eq for case 2 (when focusing on greenhouse gas emissions, the most robust and known indicator).

Regarding the positive or avoided impacts of this device, a factor of about 1,500 between the negative impact of the DLR and the avoided impact on the system for case 1 is observed. In other words, for every kg of CO₂eq emitted by the device, about 1,500 are avoided. The factor is 289 for case 2. The environmental balance is therefore largely positive on the climate change indicator in particular (but this is not the case for all the indicators), and thus confirms the interest of the digitisation of the electrical network, which allows significant gains at the system level.

The results confirm the strong interest of the DLR system from an environmental perspective, since it allows the replacement of fossil fuels by low-carbon production.



However, LCA is not the only multi-criteria environmental analysis methodology. Since 2012, Kering Group has been measuring GHG emissions, water consumption, air and water pollution, land use and waste generated by its activities across the supply chain. Based on the «Environmental profit & loss account» methodology, the impacts

are converted into monetary values, thereby enabling environmental value to be factored in management processes. The utilisation of this methodology to measure the environmental impact of the group's digital activities has allowed several lessons to be drawn.



Measuring the environmental footprint of digital activities with the Environmental Profit & Loss (EP&L) tool

In 2020, the acceleration in the digitalisation of Kering activities, amplified by the sanitary crisis, has increased the attention of the group on the environmental impact of technologies, with a view to integrate it into Kering environmental monitoring and reporting. What is the magnitude of the impact of technologies? Which technological component has the greatest impact? How can this impact be controlled and reduced in a group whose core business is not technology?

Kering leveraged the EP&L (Environmental Profit and Loss account), a measurement tool used for 10 years for its core activities, to assess the group's greenhouse gas emissions and indicators relating to land use, water consumption and air pollution for all scopes, from the extraction of raw materials to the product end of life. Technologies have been broken down into 5 elements: employee hardware (smartphone, computer, printer...), software, hosting (datacenter and cloud), network and the organisation dedicated to technologies.

Kering therefore initiated exchanges with its key technology partners to learn about the Green IT topic and obtain visibility on its footprint with the same level of granularity as that applied in the EP&L.

Among the first lessons learned: the group's partners do not measure or communicate their impact with this degree of precision. As part of a continuous improvement strategy, Kering is gradually enriching the measurement of its tech-

nological impact, using public data for consumer equipment, with its technological partners and with the support of Green IT experts, such as in the carbon intensity benchmark for its e-commerce websites.

Another lesson and clarification provided by the measurement of the group's technological impact, which each EP&L evolution confirms, is that the main environmental challenge of technology is located around IT equipment. Kering has therefore launched an action plan aimed at reducing the number of devices - starting with desk phones and printers as the development of flexible working was helping - at selecting equipment that has been assessed on an environmental criterion, at extending its lifespan, and developing the repair and proper management of its end-of-life.

The technical equipment of Cloud or network operators remains poorly known and not very measurable. Cloud services and software are measured by approximation while waiting for more precise information from its partners.

In the current state of measurement, digital activities weigh little in the group's total footprint (< 1%). Nevertheless, awareness-raising actions are being undertaken towards tech and user audiences. The Green IT component is now systematically integrated in the relations between Kering and its partners (Request for proposal evaluation, contractual clauses and annual reporting).

2 Measuring to raise employee awareness

Another approach is to develop in-house measurement tools and intuitive easy-to-use calculators that can be used across the board to monitor the environmental impact of employee digital operations with the aim of raising awareness and encouraging the implementation of reduction best practices. Such calculators are often based on scientifically recognised methodologies and have the advantage of being more accurate than some generic solutions because they take into account organisation-specific assumptions and data.

Société Générale Group has developed various carbon calculators, each of which meets specific needs. They are used to estimate emissions from ISD activities, or those associated with projects launched or pursued by other departments under various scenarios.



Presentation of the different CO₂ calculators for digital activities and their specificities of use

In order to effectively monitor the implementation of the group's responsible digital strategy, Société Générale has developed a first calculator, which follows the bottom-up approach of the Shift Project. This tool makes it possible to measure the energy consumption of all the infrastructure equipment hosted in the group's data centers or at third parties, to identify the energy consumption of all the equipment provided to employees and external parties, to assess the energy consumption of cloud providers and to calculate the energy consumed by the buildings that house the group's IT teams.

These elements make it possible to calculate CO₂eq emissions related to equipment, the activity of IT teams and that of digital service providers according to the local energy mix. The objective is to provide two measures per year to the Business Units and Service Units in order to allow them to monitor and adapt their trajectories and contribute to

the reduction objective defined at group level. Two other calculators will meet the demands of project managers and the Group's IT functional teams who wanted a simple and quick way to assess the effects of their actions. These tools, which use the same benchmarks and calculation assumptions, make it possible to measure CO₂eq footprints during the project scoping or application design phases, then at the end of the project or during the delivery of the applications; this comparison therefore makes it possible to measure the emissions avoided as a result of the responsible digital approach.

These first versions of calculators are essential elements for the management and acculturation of teams. In parallel with this work, it was necessary to launch a «Data» action plan in order to guarantee the reliability and quality of the data necessary for the tools by specifying their governance, documentation and characteristics.

Similarly, VINCI has developed an in-house calculator whose distinctive feature is that it uses external databases and supplier data. One application, still in the pilot phase,

allows teams to compare GHG emissions from their activities with the reduction pathway set by the group.



Development and use of the «Green IT» calculator and the «GreeT» application

After adopting a responsible digital strategy in 2020, VINCI Energies developed a «Green IT» estimator to measure the environmental footprint of its entities' digital activities. The tool is based on several LCA databases (ADEME, Ecoinfo, Boavizta) but also uses data provided by suppliers.

The Green IT estimator aims to enable VINCI Energies Group companies to:

1. measure and understand the environmental footprint linked to their digital activities;
2. visualize different reduction scenarios linked to the adoption of good practices;
3. implement concrete actions (extending the lifespan to 5 years, more responsible purchasing, moving to the cloud, etc.).

On the strength of this experiment, in 2021, VINCI SA then developed the GreeT tool, currently in pilot version at the group's headquarters, to meet three objectives:

1. enable teams to measure and track the carbon footprint of Microsoft 365 usage: storing and sending emails, sharing documents, backing up in the cloud, and using Teams platform;
2. inform and raise employee awareness of this impact;
3. mobilize through regular fun challenges.

The GreeT tool makes it possible to calculate the carbon footprint of these activities at the level of a user, a team and the company. It makes it possible to follow the evolution of this footprint over the last 12 months and to compare it

with the trajectory set by the VINCI group (40% reduction by 2030 compared to 2018). The GreeT tool also provides recommendations for soberer use of Microsoft 365 solutions: for example, it will recommend favoring the use of OneDrive to share documents rather than sending them as an email attachment, deleting obsolete emails and documents, to empty the baskets, or to unsubscribe from newsletters and notifications by email.

Finally, the application offers educational content to users. A «challenge» page invites teams to take up challenges to accelerate the adoption of soberer uses: for example, limiting the volume of attachments sent by email (to less than 50 MB per month) or deleting a specific volume of obsolete documents in the OneDrive space (500 MB per person per month).

The next evolution of the tool is already in the works and will include new functionalities:

- addition of monthly and annual thresholds not to be exceeded in order to respect the trajectory set by the VINCI group (40% reduction by 2030 compared to 2018);
- monitoring the carbon impact of SharePoint usage and videoconferencing on Teams;
- awareness of the level of reduction to be achieved by showing the volume and carbon impact of e-mails and OneDrive documents dating back more than 2 years and which could be obsolete;
- sending by e-mail of a monthly summary of the carbon impact generated, thresholds, objectives and soberer uses to adopt.



«The GreeT tool makes it possible to measure and manage the carbon impact of Microsoft 365 usage.»
©Vinci

While environmental standards and data for measurement purposes remain piecemeal, many companies are starting to use the few benchmarks available to estimate the environmental impacts of their digital activities. This means calculating their carbon footprint first because the methodologies are more developed and the data more reliable. By sharing the results obtained from the application of those methodologies, they actually contribute to their own continuous improvement. Methodologies, scopes

of assessment and targets vary according to the specific circumstances of each business. Some companies carry out a materiality study to identify initial actions; others restrict the scope of analysis so as to carry out more accurate assessments of certain activities or equipment; still others develop their own tools and applications to raise awareness within the company. There seems to be a diversity of methodologies catering to a diversity of uses.



The emergence of «IT for Green»

The links between digitalisation and the environment are often perceived as complex because of a certain duality: while digital equipment and practices generate impacts, the technology can be used to reduce other environmental impacts. The use of digital technologies to accelerate the ecological transition, commonly known as «IT for Green», combines a diverse set of technologies and practices to enable the ecological transition of different sectors, including access to real-time information, modelling, artificial intelligence, decision support tools, automation, dematerialisation of some processes, traceability, teleworking, etc. EpE studies show that IT for Green mainly involves the development of tools to facilitate and mainstream the measurement of the environmental impacts of digital activities and uses. Some companies develop or upgrade their information systems to better address the sustainability issues facing their business or profession. However, it is difficult to measure the positive contribution of digital technology to emissions reduction as the effects are complex, variable and sometimes unexpected.

1 Digital tools to reduce the environmental footprint

Measuring the environmental impacts of economic activities is a complex exercise because inventory data is extremely voluminous and has to be combined with an even greater amount of environmental data (such as environmental pressure factors) that varies according to methodology, year, or even location. The vast data calculation, analysis, processing and storage capabilities delivered by information technology is a major ally for compa-

nies seeking to measure and reduce their environmental impacts. The following examples show how businesses are exploiting this potential in order to measure and improve the environmental performance of their industrial operations, inform their customers better, guide their purchasing practices, and support the ecological transition of a sector or group of stakeholders.

1.1 Improving operations

Some companies harness the extensive data collection, processing, analysis and storage capabilities of information technology to analyse operations in greater detail and identify ways to reduce energy consumption, GHG emissions and costs.

To this end, ERM has developed a digital solution to meet the specific needs of operators of industrial plants with a big environmental impact.



Emissions.AI uses data to drive savings on GHG emissions, energy use and costs in carbon intensive industries

The way carbon intensive facilities are operated can affect operational emissions and costs (OPEX) by as much as 7.5% every year. In dynamic environments, companies need to understand where they should focus effort and action to drive improvements, but the intelligence required to unlock emissions savings is often hidden in a mass of data.

Granular emissions data and actionable intelligence holds the key to empowerig corporate and site teams to contribute to decarbonisation targets, and gain a much deeper understanding of the emissions profile of their assets and the actions they can take to make a difference.

Developed by OPEX Group, an ERM Group company, **emissions.AI** is a digital solution that helps carbon intensive companies to overcome challenges related to inaccessible data and a lack of robust insights so they can quickly decarbonise their operations and reduce emissions, energy and fuel costs.

The first of its kind, **emissions.AI** is a sophisticated technology solution created specifically for complex carbon intensive facilities. It makes use of existing operational data to help companies understand and minimise emissions from their operations; reduce operational inefficiencies and losses; optimise energy use and power consumption. Emissions.AI contextualises operational emissions and leverages engineering first principles, analytics, and AI to identify hidden operational inefficiencies, improvements and opportunities for lower emissions, energy, fuel and carbon costs.

Emissions.AI is currently being used by a number of global companies in the energy and chemicals sectors. Canadian Natural Resources (CNR) estimates that emissions.AI helped them to identify annual savings of >7,000 tonnes of CO₂ from one of their UK assets and INEOS has stated they believe the technology has the potential to identify up to a 10% reduction in existing emissions.



Emissions.AI - a digital solution developed by OPEX Group, an ERM Group company.

In the agricultural sector as well, digital tools are being used to support implementation of the ecological transition. Digital agriculture is booming with many solutions emerging. More and more farmers and cooperatives are using decision support tools to optimise farm management. For example, sensors provide a more accurate measurement of the texture, chemical composition and water content of soils. The readings allow farmers to optimise

crop irrigation, fertilisation and health monitoring and so reduce inputs.

Here, too, digital technologies process huge volumes of data and automate complex calculations. The consultancy firm Agrosolutions, a member of InVivo group, develops digital tools for agriculture.



Créateur d'Intelligence Alimentaire

CarbonExtract: to measure is to value

Farmers have an essential role to play in the climate transition: responsible for 20% of GHG emissions, agriculture is also the first French carbon sink by the potential of carbon sequestration in the soil.

Farmers must therefore adapt their practices: reduce fertilizer use (60% of GHG emissions) and produce more biomass (to store carbon). Seemingly simple, the necessary transformations can present risks for farmers. Above all, the climatic effects of certain changes are counter-intuitive and can lead to negative environmental externalities; hence the need to preventively measure the impact before undertaking the transition.

This requires the use of robust and scientifically validated methods, for the reliability of the results but also in order to be able to value the efforts made by the farmer: currently via carbon credits or access to «low-carbon» grain premiums, and in the future to meet regulatory obligations.

This is why digital technology is essential: on a farm, carrying out a carbon assessment and simulations using a scientifically validated method can require the collection of more than 8,000 data from the farm, which must be interoperated in several different calculation engines with data from meteorological and pedological databases and specific emission reference systems.

By connecting to the digital tools already used by the farmer and to all the databases and calculation engines certified by the scientific body, CarbonExtract is the first tool to automate the entire data collection and calculation process. The tool allows the farmer and his technical advisor to perform a complete and certified climatic diagnosis of the farm without being limited by technical complexity.

The process is done in three steps: first, a complete carbon assessment of the farm (emissions and storage) is calculated and compared to a regional reference, then the farmer can perform simulations of changes in practices, and finally he has the opportunity to initiate his transition by using the tool to monitor, measure and certify his results.

CarbonExtract automates the calculation methods certified by the French certification framework «Label bas-carbone» (Low Carbon Label) and is validated by Ademe; it is developed by Agrosolutions, a leading consulting firm on the environmental transition of agriculture. Launched in October 2021, CarbonExtract is already used by more than 40 cooperatives, chambers of agriculture, technical institutes and companies with more than 1,500 farmers.

The digital sector, for its part, can adopt tools to understand and reduce its impacts. There are many ways of doing

so. Such a tool can facilitate the adoption of ecodesign, as exemplified by Publicis.



Razoscan, a tool to measure the environmental footprint of websites, designed for companies

Razorfish, a digital agency of the Publicis group, has teamed up with GreenIT.fr to build a solution to measure, monitor and continuously improve the environmental footprint of companies' digital platforms.

Based on the EcoIndex algorithm, the Razoscan tool generates an eco-score of key paths, page or website and identifies the main improvement areas of their environmental performance.

Razoscan helps companies to easily measure the environmental footprint of their digital activities and thus to anticipate the European regulations to come in the next 3 to 5 years.

In concrete terms, this solution provides a grade ranging from A to G per page, similar to the energy label for household equipment. The score is calculated according to objectives and quantified parameters:

- the number of elements on a page (the DOM);
- the number of requests necessary for its execution;
- the weight of the elements loaded on each display of the page.

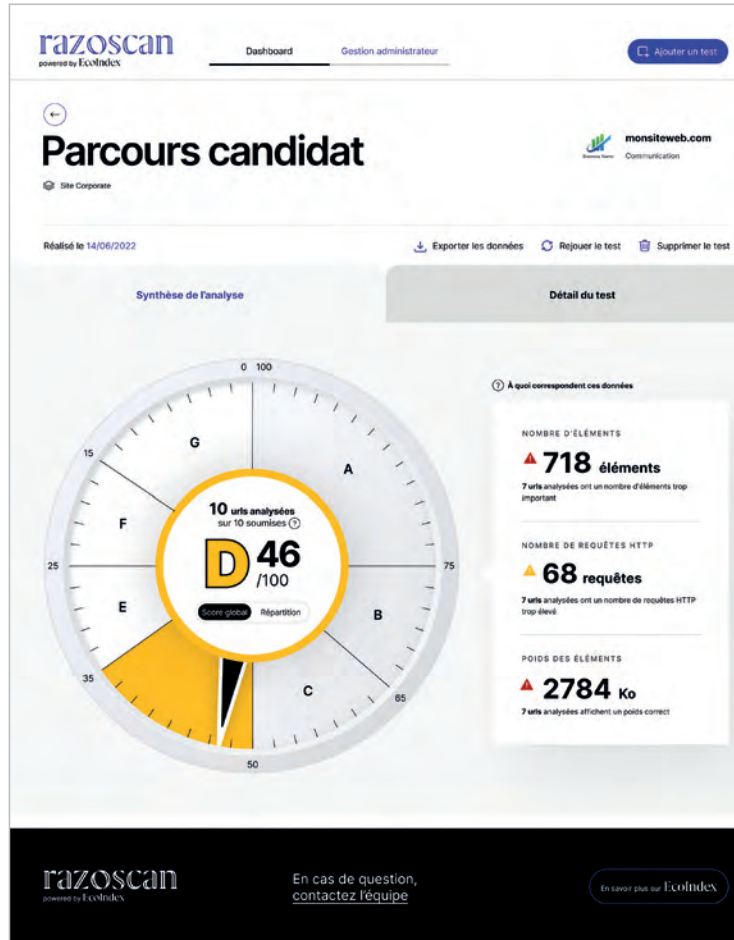
The Razoscan tool can thus analyse the volume and weight of a web page's elements, the quality of the code and the use of media or navigation tracking.

In the continuity of this approach, Razorfish launched on September 22, 2022, alongside Frédéric Bordage, Founder of GreenIT.fr, the first digital eco-design barometer: a reference in the field, this document aims to raise awareness among companies and the French on a larger scale.

The barometer is based on the analysis of 40 corporate websites of CAC40 companies and the 50 websites most visited by French people. The results show that the majority of these sites are still well below the average grade of D. This confirms that the digital responsibility of companies is still in its early stages. «However, more and more brands are understanding the responsibilities associated

with their digital activities. As a result, their websites will have to evolve as it was the case with the introduction of the RGPD» acknowledges Sandrine Vissot-Kelemen, President of Razorfish.

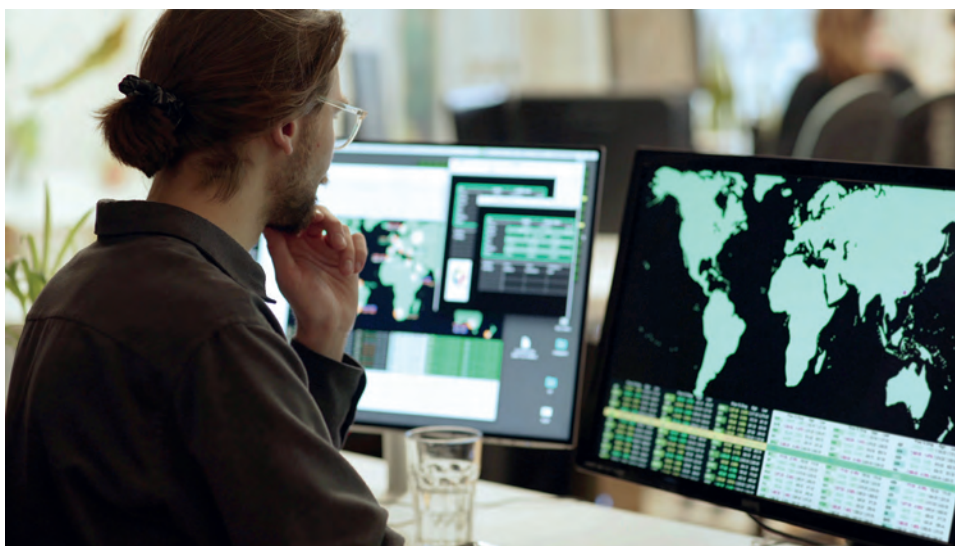
It is important to note that digital responsibility does not mean a step backwards in terms of digital experience. On the contrary, digital eco-design maximises efficiency for the user thanks to the search for new performance levers for companies and new creative and technological requirements. Sustainable IT represents an important opportunity for innovation for marketing, digital, communication, CSR and IT departments of companies.



Example of an analysis summary of a website on Razoscan ©Razorfish France

Environmental footprint measurement tools using digital technology allow a vast amount of criteria and data to be processed and analysed in detail and the environmental

profile of sometimes complex operations to be optimised. Better still, they can be adapted to specific uses and are adaptable to new user needs.



The large data collection, storage, processing and analysis capacities of certain digital tools make it possible to better take the environment into account in operations.
©iStock

1.2 Improving environmental information about products

Environmental information regulations are a mechanism for informing consumers, through a variety of methods (labelling, applications, etc.), about the environmental impacts of the products offered to them. Access to such information allows them to compare the environmental performance of products and favour more sustainable ones. By promoting environmental performance as a competitive advantage, this practice is also able to influence

downstream operations in the value chain where stakeholders are encouraged to reduce their impacts on the environment.

The specialist equipment distributor Rexel has moved in this direction with its customers. Essentially b2b, they are increasingly called upon to assess and reduce the «scope 3» emissions of their own major suppliers and customers.

The Carbon Tracker: the first environmental impact calculator for electrical equipment

Launched at Rexel Expo Paris in June 2022, Rexel's Carbon Tracker now gives customers access to information on the environmental impact of the electrical products they purchase at every stage of their life cycle (manufacturing, distribution, installation, use, and end of life). It includes four environmental indicators: climate change, depletion of natural mineral resources, energy consumption, and water consumption. The Carbon Tracker also calculates the TCO (Total Cost of Ownership) of products, thus favouring the most energy-efficient products. Thanks to the Carbon Tracker, eco-friendlier alternatives can be recommended to installers to help them reduce their impact as well as that of their customers, the end-users.

The Carbon Tracker was developed by Rexel in response to recurring requests from its customers. Firstly, the need to have an assessment of the greenhouse gas emissions linked to their purchases. For example, major customers, who have set ambitious climate targets, require more precise data from their suppliers. This allows them to integrate environmental criteria into their sustainable purchasing strategy.

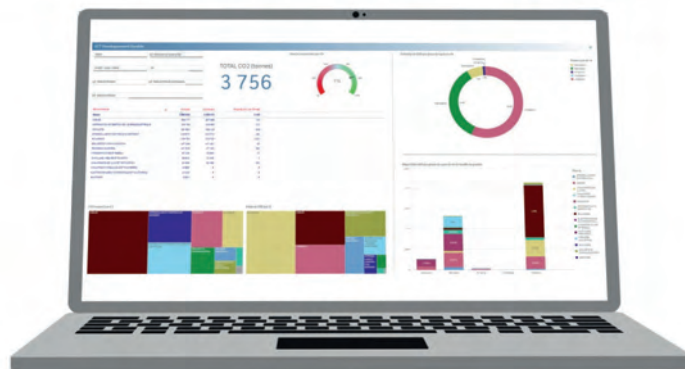
Secondly, many customers want to offer more environmentally and energy efficient products but find it difficult to identify these solutions. Before making a purchase, the Carbon Tracker allows customers to evaluate the greenhouse gases emissions impact of categories of products and, with the help of a Rexel expert, to select the most efficient and eco-responsible products.

More precisely, the Carbon Tracker is based on:

- A robust methodology, critically reviewed by Bureau Veritas;
- Reliable and verified data, Product Environmental Profiles (PEP);
- An evolving algorithm with over 500 formulas to date, which calculates the environmental impacts of products from a life cycle analysis standpoint, including products that do not have a PEP.

Rexel's work on the Carbon Tracker won the «Energy, Climate, and Decarbonisation» prize at the 2022 Sustainable Industry Awards (Trophées Industrie durable 2022), organized by the French magazine «L'Usine Nouvelle» at the end of June.

CARBON TRACKER



The carbon tracker calculates the environmental impacts of electrical equipment.

©Rexel

Recognition of the effectiveness of environmental labelling has led to its being mandatory for certain segments of digital activities. Following the enactment of the AGECE law, 2022 saw Internet service providers and telecom operators being placed under an obligation to inform their subscribers of the amount of data consumed and its equivalent in greenhouse gas emissions. This footprint reflects all the

equipment used in fixed and mobile telecommunications networks, including boxes. While the carbon footprint of data centre and cloud equipment has so far been excluded from the law's scope, those segments could well be subject to environmental labelling requirements in the coming years.

1.3 Anticipating and planning the ecological transition

Other digital tools seek to accelerate the ecological transition of a sector or group of stakeholders by proposing solutions that allow market participants to factor the environ-

ment as early as possible into their processes. This is the specific aim of the «360design» tool developed by Lafarge France Group.



360design: a digital tool developed by Lafarge to optimise the carbon impact of buildings

In order to help the construction sector implement the new requirements of the Environmental Building Regulations (RE2020), Lafarge has developed a free digital tool that is accessible to all, which estimates and optimises the carbon weight of a building site's shell.

360Design is aimed at project owners, architects, structural, thermal and environmental design offices, from the competition, feasibility and preliminary design phases to the drafting of written documents. The information obtained with this tool can then be compared with the thresholds of the RE2020.

After the project estimation, in order to reduce the CO₂ footprint of the shell, the simulator suggests several optimisation scenarios with a mix of low-carbon concretes

best suited to the project. This «simulation» mode saves considerable time upstream and helps to choose the most suitable concrete formulations that can be customised according to the type of project and structure. It proposes an optimisation based on the concrete formulas available in the localities near each project.

The environmental data used to characterise the impact on global warming, expressed in carbon dioxide equivalent mass (kg CO₂ eq.), comes from the Environmental and Health Declaration Sheets (EDS) of concretes. The 360 design tool and the compatibility of the calculation method used with the RE2020 have been audited by the French «Centre Scientifique et Technique du Bâtiment» (Center for Scientific and Technical Building).

360 design

Optimisez l'empreinte carbone du gros œuvre de votre projet

lafarge360design.fr

Simulez votre projet en 5 minutes !

- 1 Décrivez votre projet
- 2 Précisez vos données
- 3 Optimisez votre projet
- 4 Allez plus loin avec nos experts

MEMBRE DU GROUPE HOLCIM

LAFARGE

©Lafarge

Developing «IT for Green» technology that is available to the rest of the ecosystem free of charge on an open-access basis allows participants not only to implement their own ecological transition, but also to accelerate that of their ecosystem. If, moreover, that technology enables integration of the environment into the design phase, it will ensure the environment's inclusion from the planning stage and boost be a useful ally in the ecological transition of a sector or group of stakeholders. The TotalEnergies On start-up accelerator is a good example. This project, hosted at

Station F, selects and supports start-ups offering innovative digital solutions for deploying renewable energies quickly and more efficiently. Many of the collaborative platforms draw on collective intelligence as part of an open innovation approach that seeks constant technological improvements.

In so far as these rapidly changing technologies serve a collective interest, i.e. the climate, «open source» is best suited to accelerate their spread.

2 Incorporating sustainable development issues into information system design

As well as being useful for measuring the environmental impacts of activities, information systems are gradually emerging as strategic tools for driving the ecological transition. Their role in organising, streamlining and structuring the reporting and consolidation of environmental information in companies, from the operational level to senior management, facilitates environmental reporting and corporate responses to regulation, while promoting dialogue with stakeholders (financial players, customers, NGOs, civil society).

For example, Building Information Modelling (BIM) and parametric architecture technologies now allow Nexity to acquire and display well-structured building object databases. BIM technology is used to obtain a detailed digital identity card for a building and to monitor a construc-

tion project over its entire life, from design to demolition. It enables users to carry out studies and modelling exercises from the design phase so as to optimise energy consumption and reduce the material consumption index of projects.

At group level, the amount of granular information provided by that technology is driving the development of information systems with enhanced storage, structuring and environmental data reporting capabilities. Data consolidation permits linkage between this type of information and financial data. The resultant data can then be used to comply with new French or international regulations (RE2020, assessment of eligibility and alignment of corporate activities with the EU taxonomy for sustainable activities, CSRD, etc.), as well as current or future legislation.



Presentation of the BIM database to track the complete life cycle of buildings in digital format

In France, real estate is the second most emissive sector in greenhouse gases after the transport sector.

For Nexity, the main issue relates to its development promotion activity, on the one hand through the use of materials for the construction or renovation of buildings, and on the other hand through the consumption of the energy required during the life of the building. A building is made up of thousands of products, produced by hundreds of manufacturers, each located at varying distances from the site. How to design decarbonised and sustainable real estate projects when hundreds of parameters have to be taken into account?

For better building design, Nexity relies on tools such as BIM (Building Information Modeling). Beyond the 3D graphic representation of a building or a territory, BIM's major advantage is its ability to store and structure a large amount of data.

Some information is key, a long time before the submission of a building permit. At the draft model, the modelling techniques of BIM technology associated with Generativ

Design (or parametric architecture) help to optimize in a few clicks the orientation of the building in relation to the wind, the sun, the noise, or the energy contributions.

This detailed knowledge of building data is a tool for achieving the group's objective of reducing its carbon footprint (a 42% reduction in CO₂ emissions per square meter delivered between 2019 and 2030, a level 10% better than the requirements of the RE2020 environmental regulation. The RE2020 regulation, which has been in effect since January 1st, 2022, requires a carbon footprint assessment for buildings and sets increasingly virtuous carbon performance thresholds every three years.

To better measure the effects of these carbon footprint reduction actions in real estate operations, the information system is also evolving. This information on the carbon footprint of buildings as well as the objectives set by the regulations are centralised in the performance monitoring tools. These initiatives also have an impact on the financial information system, which must link financial data to environmental performance ones.

Aware of the environmental issues at stake, Imerys Group has also begun restructuring its information systems.

The mining and primary metal processing group is a major emitter and any reduction of impacts on the environment

delivers economic gains. Its upgraded information systems facilitate the management of supply chains, processes, sites and, of course, financial and non-financial data flows.

An ongoing structuring of information systems meeting the needs of sustainable development

The development of Imerys, essentially through external growth, has led to a highly decentralized IT system with no overall consistency. In 2016, Imerys launched a multiyear digital transformation program aimed at modernizing its information systems (IS).

This program first started on cross-functional systems (network, collaborative, ERP, etc.). The IT function then began to set up a specialized team, with regard to the Group's «SustainAgility» structure, dedicated to sustainable development issues.

In this functional area, the Group follows a pragmatic approach:

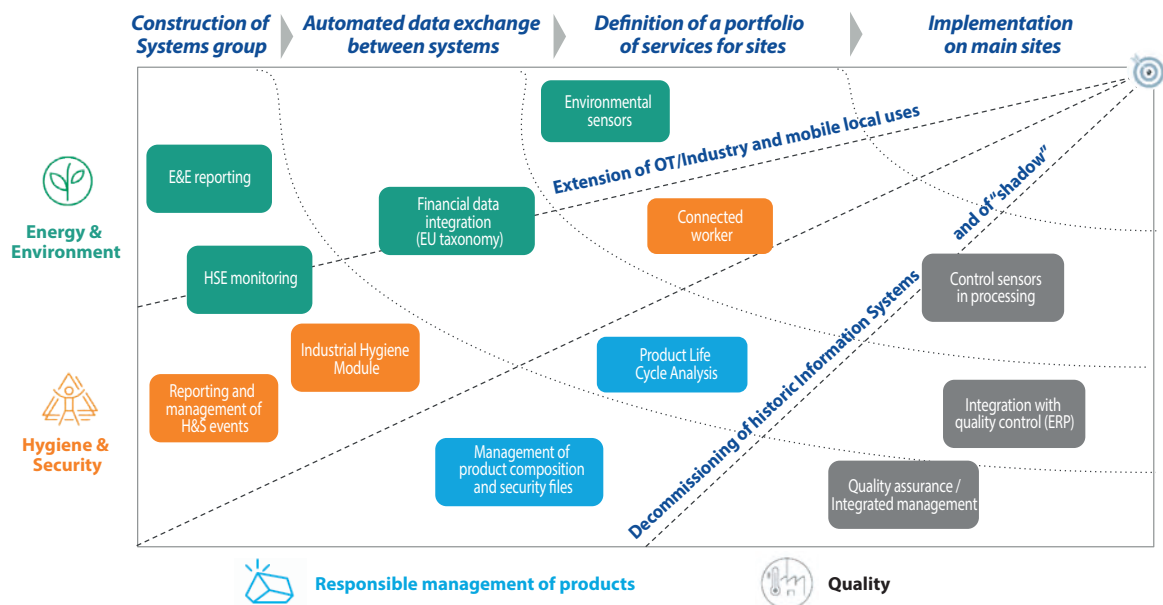
- the first step consisted in bringing out the tooling needs (inventory and support for the use of the first basic tools: spreadsheets, databases, etc.); in parallel with the exploration of market solutions, mature or emerging;
- secondly, “best of breeds” group applications were selected.

The adoption of these solutions, hosted on the Cloud, at a supply cost globally equivalent to internal management, allows:

- improving functional coverage;
- the decommissioning of dozens of legacy applications - facilitating internal maintenance and obsolescence management.

As these tools constituting the backbone of the new IS are deployed and as the common and unique language on data (sites, products) is structured, the group:

- connects its various IS to facilitate the production of information, communication and management between the various stakeholders - and deal with future developments in terms of European taxonomy for green finance;
- explores local solutions in connection with Imerys' Industry 4.0 program - for example with use cases on optimizing the energy consumption of production processes through collection.



Illustrative trajectory of the «IT for Green» Group.
©Imerys

Digital technologies for driving the ecological transition abound and can be deployed at different levels of a company. Some tools measure and reduce environmental pressures, while others track and trace environmental data more efficiently. The virtuous nature of all «IT for Green» solutions derives almost exclusively from the ability of digital technologies to provide detailed, efficient and rapid information tracking, sometimes in real time, which enables decision makers to take informed and effective environmentally-friendly measures.

It should be noted, however, that an information system is built to plot, operationally support and optimise the facilities, flows, products and data related to a specific productive system. Digital representations tend to promote ongoing progress (efficiency) more than changes in business or production models. Similarly, they contribute to the fragmentation of optimisation tasks, and so are not appropriate for switching to a business model (economy of functionality) that jeopardises the company's data and management systems architecture. Nevertheless, it is necessary for teams to maintain a global view of the productive system and be mindful about reducing its environmental impact.

CONCLUSION

Two new planetary boundaries⁵⁵ concerning the introduction of new entities into the environment and the use of fresh water were exceeded in 2022, in addition to the four already crossed: climate change, biodiversity loss, nitrogen and phosphorus cycle disruption, and land use change. Initial studies to measure the environmental footprint of digital technology in France and elsewhere suggest that the digital sector is contributing to the overshooting of each of those thresholds.

Containing global temperature rise to below 1.5°C, limiting biodiversity loss, and conserving natural resources require companies to reduce rapidly and radically all pressures exerted by them on the environment, including those from their direct and indirect digital operations. When used properly digital technologies can contribute to environmental conservation and people's well-being. More importantly, though, they are responsible for considerable damage to the environment. The rapid and massive rise in the number of digital devices and their uses could further increase the sector's impact. In France, its carbon footprint could rise 60% by 2040. These direct impacts occur in addition to the effects of digital activities on lifestyles. Digital technologies are already projecting the image of Western lifestyles around the world, while everyone now knows that they are unsustainable.

Digital activities may for the time being only account for a small proportion of the total environmental footprint of business, but the fact that most companies have dedicated digital action plans demonstrates awareness and a cross-cutting environmental commitment. Even in highly emitting companies, where digital emissions are very low in relative terms, teams are initiating reduction plans. And in companies whose core business is digital, ambitious impact reduction commitments are being adopted.

The new challenge for businesses, therefore, is to reduce this footprint while pursuing their opportunity-rich digital transformation. At EpE's Digital and Environment Commission, nearly forty managers and experts from the sustainable development and IT departments of large companies have examined the conditions for accelerating the adoption of digital activities with a smaller digital footprint («Green IT») that is more relevant for the implementation of their and society's ecological transition («IT for Green»). The corporate practices presented in this report show encouraging outcomes for the most direct emissions.

An analysis of these practices reveals that deployment of the first reduction drivers can start quickly, without awaiting the completion of methodology studies. Many companies are already implementing their first pilot projects whose results will help to improve methods, guide companies to make better decisions, significantly raise awareness, and promote dialogue with stakeholders.

Meanwhile, the uses of digital technology in supporting the ecological transition are multiplying. This publication identifies two of the key ones. First, the increased data collection, processing and storage capabilities offered by digital technologies are often used to develop decision support tools that help reduce the impacts of industrial operations, better communicate environmental information, guide purchasing practices, and factor in the environment from the project design phase. Second, the incorporation of sustainable development into corporate information systems makes businesses important allies in the management and reduction of all environmental impacts, while meeting the expectations of their stakeholders. Preparing responses to the requirements of the upcoming *Corporate Sustainability Reporting Directive* (CSRD) would be unthinkable without massive data collection and processing capabilities.

Yet the scale of the transformations to be carried out seems to require more far-reaching changes than mere optimisations and reductions offered by digital technologies («IT for Green»). The adoption of digital technologies exacerbates other undesirable effects. By eliminating distance, these technologies encourage mobility of goods and people, and facilitate impulsive goods' consumption under buy and return schemes that generate waste. Lastly, they distance us from physical reality by introducing technical intermediaries between people and the outside world, especially nature to which we are becoming less sensitive as a result. In short, they affect and transform our perceptions about and relationships with our environment. By dematerialising our interactions and introducing an extra intermediary in them, digitalisation already organises and shapes the development of new lifestyles. Can the digital civilisation we are building become an environmental civilisation?

⁵⁵ [The nine planetary boundaries](#). Stockholm Resilience Centre. Stockholm University.

The urgency of the environmental situation could warrant a transformation of our relationship with digital technologies involving drastic reductions in the manufacture and use of new equipment and the benchmarking of innovations placed on the market to their societal and environmental utility. The best use we could make of digital technology for environmental conservation purposes would undoubtedly be to quickly adopt more restrained behaviour in all aspects of our lives, including digital restraint. Such a transformation is subject to close collaboration between all parties, i.e. consumers, businesses and public authorities alike.

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Glossary

Blockchain: a ledger or large database whose singular feature is that it can be shared simultaneously by all its users, all of whom own this ledger and can write data into it based on specific rules set by a very highly-secured computer protocol using cryptography.

Data centre (or datacenter): a place that hosts a set of servers that perform data processing tasks, usually for a company.

Cloud: cloud computing refers to the use of the memory and calculation capabilities of computers and servers distributed around the world and linked via a network. Applications and data are no longer located in a specific computer but on a cloud consisting of many interconnected remote servers.

WEEE: Waste Electrical and Electronic Equipment, which is produced by end-of-life electrical and electronic equipment (EEE) and considered hazardous waste under environmental regulations because it contains controlled substances.

Digital Service Company: a company that offers IT solutions to companies (consulting, engineering, design, development, maintenance, training, etc.).

Quantum computing: theoretical computing system that uses the properties of the quantum world offering huge computing power.

Artificial Intelligence (AI): set of theories and techniques to develop complex computer programs capable of simulating certain features of human intelligence such as reasoning, learning, etc.

Critical raw materials: raw materials of utmost economic importance that present a high risk of supply shortfalls.

Metaverse: an entirely virtual space, created artificially by a computer program, in which people interact through avatars.

Ionising radiation: radionuclides that can be released during a number of human activities. When radionuclides disintegrate they release ionising radiation. Exposure to ionising radiation causes DNA damage, which in turn can lead to various types of cancer and birth defects.

Server: hardware and software connected to a telematics network that makes data banks and specialised programs available to users of that network.

Terminal: in computer science a terminal is the endpoint of a computer network. Most often it is a personal computer, workstation, smartphone or touch screen tablet.

Rare earths: rare earth elements are a set of 17 metals, including scandium, yttrium, and the fifteen lanthanides.

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Founded in 1992, Entreprises pour l'Environnement (EpE) is gathers of some sixty French and international companies that exchange their best practices and work together to better factor the environment into their strategies and operations. Its purpose, **a single planet and a thriving world**, sums up the determination of its members to drive their own ecological transition as well as that of society, and to achieve economic development compatible with planetary boundaries and with what is socially accepted, or even desired. EpE is the French partner of the World Business Council for Sustainable Development (WBCSD).

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