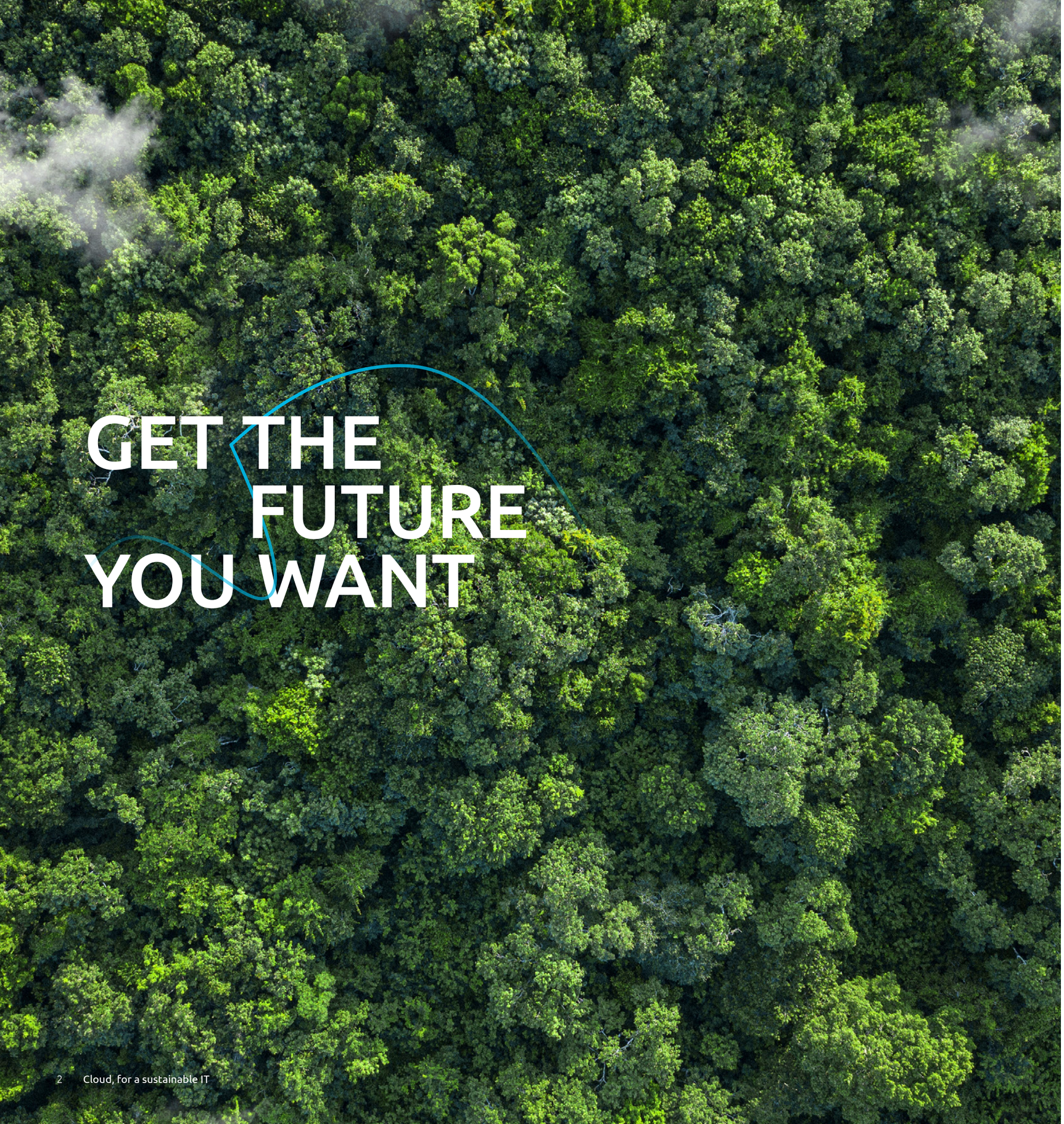
Capgemini

CLOUD, FOR A SUSTAINABLE IT

Combining performance and control over environmental footprint



EDITO

The cloud has emerged as a key driver for the digital transformation of businesses. When choosing their provider, companies must consider both their economic interests and the environmental impact of outsourcing. However, green IT strategies are still hindered by the lack of transparency in the industry.

The cloud market is a global market estimated at $217 billion*, dominated by AWS, Microsoft Azure, and Google Cloud - major technology and service providers, commonly referred to as hyperscalers. These providers have vast financial resources to address the current challenge: balancing economic interests with sustainability, while the rising cost of energy and climate change call for a push towards frugality.

The rapid and widespread adoption of cloud computing by companies makes it crucial to optimize their consumption, from both a financial and environmental standpoint. Behind the broad term “cloud” are technological solutions with varying levels of antiquity and virtue that user companies must be capable of dissecting.

Certainly, achieving transparency is a challenge for hyperscalers, given the difficulty of establishing precise consumption levels for a company utilizing their multiple services via data centers that themselves pool resources for the benefit of many clients. Nonetheless, it falls upon companies to hold these providers accountable to obtain the necessary indicators to steer their strategies.

Combining environmental ambition and technological expertise, Capgemini has established itself as a trusted third party, providing reliable measurement tools. The purpose of this e-book is to share our convictions on the significant issues at hand, encompassing the selection of a supplier and the best practices to be implemented at the enterprise level to achieve a certain degree of digital frugality.

Sergio Werner
Director of the Cloud Center of Excellence
Central and Southern Europe

Laurence Jumeaux
Head of the sustainable digital offer
Capgemini Invent

1 Source: Synergy Research Group, estimated global market from September 2021 to September 2022

CLOUD, ON THE PATH TOWARDS A SUSTAINABLE IT

CLOUD: HYPERSCALERS AT THE FOREFRONT OF CORPORATE SOCIAL RESPONSIBILITY

By pooling their resources across a multitude of customers, the major cloud players are achieving energy efficiency like no others.

According to various studies, digital technology accounts for 3 to 4% of global greenhouse gas emissions, and this figure is expected to increase with the growth of the sector, driven by both companies and the general public, and the significant increase in the volume of data and devices. Without action, emissions from the digital sector could increase by over 60% by 2040. However, the good news is that the cloud represents a leading solution for reducing this environmental impact.

digital technology accounts for

3 to 4 %

of global greenhouse gas emissions

Optimized infrastructures

The first strength of cloud operators lies in the processes they have implemented to control and automate the use of resources. Their infrastructures are virtualized, and server management is automated to the maximum extent possible, as are the resources associated with storage and data archiving services.

In addition, they have implemented tools to measure and monitor the use of their cloud services.

This optimization of resources has already made it possible to contain data centers' energy consumption. To put this into perspective even though Internet traffic has increased by 12-fold since 2010, energy consumption has only increased by 6% over the same period , according to the International Energy Agency.

Optimized life-cycle

Hyperscale servers not only consume less energy but also have an improved environmental impact over their entire life-cycle. Operators have deployed monitoring processes to extend the life of hardware, replacing only those components that need to be replaced. This knowledge, which can still be improved (see our next article), is becoming an important consideration for enterprises when choosing their cloud provider.

Servers located closer to companies

The third element concerns the location of cloud services. All major cloud operators have an international presence, but they also establish local networks as close as possible to major economic centers. This is a strategic choice to reduce the energy consumption of data processing, which is always lower when carried out close to the company.

Data centers with lower power consumption

Cloud operators are at the forefront of this issue. They have reduced the energy costs associated with their buildings and the energy consumption of data centers. Their cooling systems are as energy-efficient as possible and use low-carbon energy sources (wind, solar, hydraulic, biomass, hydrogen, etc.). Today, few companies can compete with such a significant R&D investment.

1 https://theshiftproject.org/article/pour-une-sobriete-numerique-rapport-shift/ https://www.greenit.fr/empreinte-environnementale-du-numerique-mondial/

SHEDDING LIGHT ON THE IMPACT OF THE CLOUD

Although more sober, the cloud is experiencing a growth not without consequences on the planet. It is up to companies to choose the best providers. Problem: they don't hold all the cards.

While cloud providers are undoubtedly the most environmentally friendly option, they need to go further in managing the impact of the rapid digitalization of the economy. Even though it may seem virtual, the consequences of digitalization remain very real. Servers, storage units, appliances, network equipment, and cooling systems all consume energy, just like any other components of an IT infrastructure.

Other variables must also be considered, such as the energy mix of the country where the data center is located. In France, for example, primary energy production in 2021 was 75% nuclear and 24% renewable, according to the Ministry of Ecological Transition.

Beyond the carbon footprint, digitalization has other impacts. Water consumption (for manufacturing equipment and processors, and cooling data centers) is a parameter to consider, as well as the exploitation of mineral resources, which is a factor of pollution. For example, the number of metals used by digital technologies has multiplied by 6 between 1980 and 2010. By 2050, the amount of mineral raw materials to be produced is expected to be 3 to 10 times higher than current levels.

Server manufacturers note that the extraction and processing of precious metals (such as copper and gold) required to manufacture their printed circuit boards and integrated circuits are the main drivers of environmental impact.

The use of rare earth materials must also be considered. Most of these minerals come from China (graphite, cobalt, antimony, tungsten, tantalum...), which accounts for over 80% of current global production. While it is necessary to account for them in manufacturing cycles, their recycling must also be closely examined. This is the challenge of the European directive on the valorization of waste electrical and electronic equipment (WEEE).

6 to 10 %

the share of digital in the world's electricity consumption, very carbon-intensive on a global scale according to the CNRS[1].

1 « Digital : the huge energy waste », CNRS, 2018

Calculating the environmental impact of the cloud

For cloud solution providers, the challenge is to provide their customers with visibility of their energy and resource consumption. Communications in this regard still lack transparency and precision, making it difficult to assess their overall impact, but progress is being made. While AWS, Microsoft Azure, and Google Cloud offer calculators to estimate CO2 emissions, the accuracy and completeness of the results remain questionable. OVHcloud is also working to provide visibility to its customers.

For companies looking to measure the environmental impact of the cloud, it is imperative to measure the entire lifecycle using the LCA (life-cycle analysis) method, from the manufacturing of various servers, storage units, and other equipment (including networks) to their final use, through their decommissioning and recycling.

8 500 kg

of purifying rock to produce one kilo of vanadium, particularly used in the manufacture of batteries

MIGRATING TO THE CLOUD: KPIS TO STAY ON TRACK

Energy efficiency, equipment life cycle... Companies must adopt new KPIs to succeed in their migration to the cloud.

In addition to its economic business case, a company must also consider its carbon and energy footprint. From the contractual stage and the selection of a cloud provider, it is necessary to closely examine all these aspects as well as the services provided to achieve real energy savings. The goal is to determine what the company "gains" by moving to the cloud through an indicator measuring the energy efficiency of data centers, the Power Usage Effectiveness (PUE). Traditional data centers' PUE is typically estimated between 1.6 and 2.2, while cloud provider's PUE ranges from 1.1 to 1.2.

Similarly, there are several migration paths to the cloud (see 6R). Organizations can perform rehosting or re-platforming to rebuild its applications and choose microservices-based models. Thanks to this approach, organizations can reduce their environmental impact by scaling up from the level of the entire application but only on the bricks concerned. Adjustments can also be made to redundancies and applications, and their usage, considering that not all applications need to be available 24/7. FinOps processes assist and become essential in this regard.

What actions for companies that have already migrated to the cloud?

For companies that have already migrated to the cloud, they must also challenge their provider on the environmental impact of their equipment, from purchase to end-of-life. For example, for a server assembled and used in France, the overall environmental footprint of this equipment is divided between approximately 85% for usage and 15% for manufacturing. However, for a server used in France but assembled in China, the carbon footprint increases due to differences in energy mix and transportation impact. Calculators provided by some cloud providers provide initial information, but they are insufficiently comprehensive and precise for analyzing the long-term impact of usage.

Beyond these aspects, since the cloud is a lever for performance, especially environmental, companies must learn to manage their activities and be responsible throughout the value chain by asking the right questions:

- What digital products and services should be developed in the cloud?
- How to manage the infrastructures?
- How to manage the environments hosted on these infrastructures?

Previously, companies used to create a new test environment each time they wanted to develop an application or deploy it. Today, they must ensure that they optimize their use of servers by systematically questioning the need for such a requirement. By limiting these practices, they become more eco-responsible. Once again this is where FinOps comes into play to help organizations..

There are still barriers, not to the establishment of indicators, but to their tracking and accuracy. Today, unfortunately, some data remains complex to obtain: determining a data center's PUE relative to its energy consumption, Water Usage Effectiveness related to water, or its equivalent carbon, the CUE (Carbon Usage Effectiveness). There are still transparency issues regarding data.

To support companies in their digital environmental footprint reduction projects, particularly in the cloud, Capgemini has partnered with companies specializing in in-depth analysis of data centers and servers. This enables companies to compare themselves to generic data and to implement metrics to appreciate their ability to reduce their environmental impact by migrating to the cloud and adopting green IT.

FINOPS AND GREENOPS: FAKE TWINS BUT REAL ALLIES

Companies already familiar with the FinOps approach can benefit from extending their approach to GreenOps.

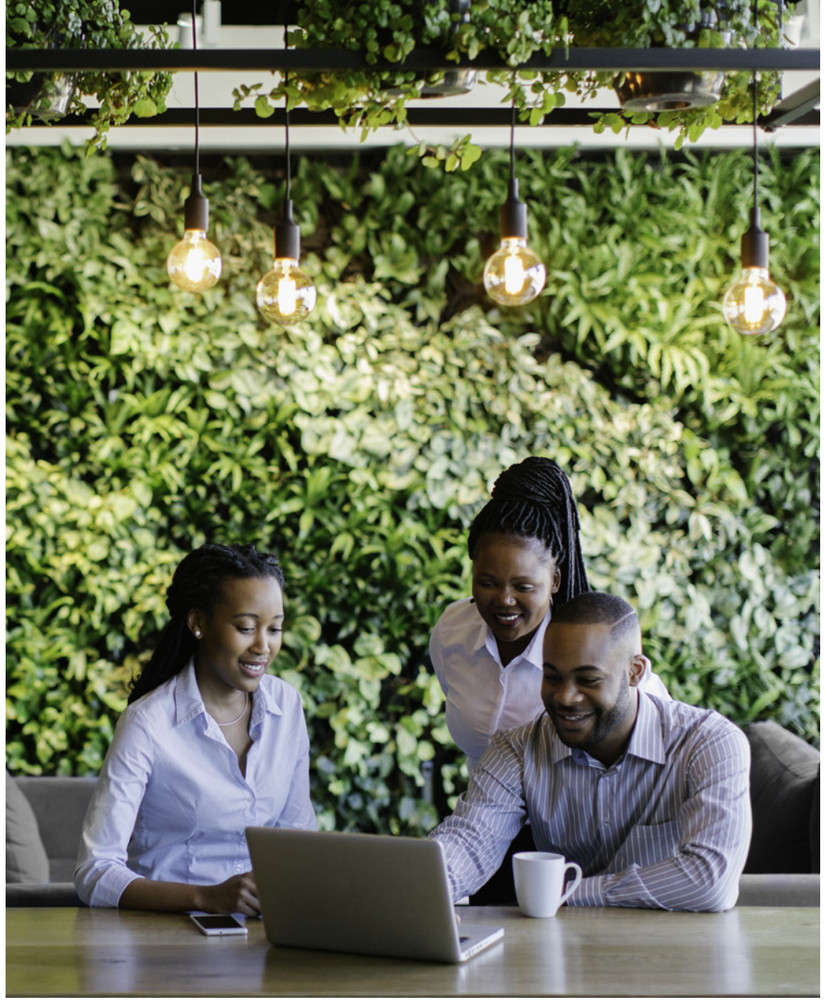
FinOps - a contraction of finance and operations - aims to control and optimize consumption and ultimately costs. This approach is a powerful lever for addressing the environmental impacts of digital technology by rationalizing its use. When a company practices FinOps, it primarily acts on two levers:

- The unit costs to negotiate with its cloud service providers;
- The quantity or volume of services it uses.

While it increasingly incorporates the impact on costs, FinOps must now consider environmental impacts such as carbon footprint and energy consumption. The two therefore work hand-in-hand. For example, shutting down instances during off-hours allows for savings and reduces energy consumption. FinOps thus leads to digital frugality, provided that the right levers (processes, organization, tools...) are put in place and users understand their daily personal impact.

Going further with GreenOps

Today, companies can go further by engaging in a GreenOps approach. This approach focuses on metrics other than costs: CO2 emissions, energy consumption, and environmental impact. FinOps and GreenOps are often addressed together due to their very similar logic of application: eliminating unnecessary resources, as well as designing sustainable architectures and applications.



"The maturity curve of companies is more advanced on FinOps than on GreenOps, with projects engaged for a longer time."

It is now essential to create synergies between the two. The maturity curve of companies is more advanced on FinOps than on GreenOps, with projects engaged for a longer time. They have mastered this approach on simple services: such as IaaS (Infrastructure as a Service), cloud storage services (Storage as a Service), virtual machines, computing capacity. However, when it comes to more complex service categories, such as aggregated environment and platform services (PaaS or Platform as a Service), organizations do not have all the keys to obtain an overview of the economic impacts at stake.

What is difficult for FinOps is even more difficult for GreenOps. It also needs reliable data to produce concrete results. The information provided by cloud providers is still very macro and does not sufficiently cover microservices or disaggregated services that they operate. Under these conditions, it is impossible to accurately know the CO2 emissions of a cloud service when it is shut down or resized.

Today, few companies are truly capable of operationalizing a GreenOps approach. However, they can engage in such projects with a FinOps approach already initiated. They can also ensure that the choice of their partners aligns with their Green IT and CSR strategy, even if they do not have all the data to measure their progress.

Due to the many commonalities between the two disciplines, todays FinOps actors are potentially tomorrow's GreenOps actors. We must begin to implement this organizational transition and study whether the identified profiles have the right skills to assume broader responsibilities. On the cultural front, companies have begun to raise awareness among architects, developers, and engineers about these new practices. The same should be done with users so that they are aware of the financial and environmental weight of their decisions for the company.

3 BEST PRACTICES AT THE HANDS OF COMPANIES

TOM, A MODEL TO FOLLOW

The target operating model (TOM) supports the development of companies' activities as well as their CSR challenges.

The role of a CIO is to design products and services that will allow business teams to satisfy customers. To align their operational capabilities (teams, processes, rules and standards, technological assets, etc.) with their strategic objectives, they rely on a target operating model (TOM) to address business development and societal issues from a sustainable perspective.

Until now, CIOs have focused on reducing the energy consumption of their infrastructure, with a cost-control mindset. By committing to sustainable IT, the benefits are much greater. Improving brand image, and consequently the employer brand, is essential in a tight IT market, where candidates prefer companies that are in line with their values.

"Companies must structure themselves, regardless of their level of maturity or the number of dedicated employees, so that sustainable IT irrigates all transformation projects.."

Another major objective is to achieve a certain frugality. This can be achieved in different ways, in terms of operational efficiency and innovation. Finally, when FinOps and GreenOps concepts (read our article on page 12) meet, the company realizes budget reductions and generates significant financial gains.

To achieve these goals, it is necessary to adopt a holistic and systemic approach as all parts of any ecosystem are interconnected. For example, reducing a data center's energy consumption also involves consuming less water, eco-designing applications, and rethinking the organization of the CIO.

The importance of standards

To support this approach, CIOs can rely on standards. Developed within the framework of the inter-ministerial Green Tech mission, the RGESN (general reference for eco-design of digital services) aims to reduce the consumption of IT and energy resources, as well as to combat equipment obsolescence.

Implementing a reference framework necessarily has an impact on design authorities and how architects, security experts, and buyers' work. Thus, buying an intellectual service while ensuring that the supplier follows these rules strongly influences the strategy of developing skills, particularly in terms of programming languages. For example, using C instead of Python or Perl can vary the energy efficiency of an application in a ratio of 1 to 80.

The way data is stored is another major area of reflection. Should all data be kept indefinitely to be able to define new algorithms tomorrow? Conversely, is it preferable to choose a certain frugality by limiting oneself to essential data, even if it means depriving oneself of a means of developing performance? For CIOs, finding the right balance generally requires realigning their strategies by finding the right level on certain data sets to effectively respond to the company's business challenges.

The challenge of recruitment

As data hosting on the cloud becomes more widespread, it is urgent for companies to acquire multidisciplinary profiles, which are currently in high demand on the job market. While sustainable IT roles have emerged in most companies, there is no specific training program. The most sought-after talents stand out for their excellent understanding of ecological and societal issues to bridge the gap between CSR policy and its strategic application in IT.

While the *Target Operating Model* seems essential today, companies must structure themselves, regardless of their level of maturity or the number of dedicated employees, so that sustainable IT irrigates all transformation projects.

APPLICATIONS: GOING FURTHER IN ECO-DESIGN

Application development is a driver of environmental and financial performance. Micro-services are emerging as a new standard.

If an application is developed in a simple and efficient way, it will not only be faster but also less resource-intensive, and therefore have a lower environmental impact. The cloud enables companies to do better and faster. Compared to a model using data centers and traditional hosting, it reduces the provisioning time for processing resources (compute) by 10, 100, or even more. In fact, with the cloud, provisioning a virtual machine takes only a few minutes, compared to several weeks for traditional architectures. The IT department can also quickly scale up an application, for example in the case of an online retailer organizing a sales period. As soon as the operation is over, it will deprovision these resources to only consume useful server capacities. This leads to cost savings and a reduction in CO_2 emissions.

Serverless and containerization

Another possibility offered by cloud operators is to do away with hardware provisioning of the infrastructure. The microservices approach involves breaking an application down into smaller pieces that can be architected and hosted on different servers in a more restricted way. This serverless technology contrasts with so-called “monolithic” approaches (or giant applications). The leverage effect is immediate: the more components are broken down, the easier it is to disable them when they are not needed.

The other important concept is containerization, which means the mutualization of certain IT resources for the benefit of several applications. And once again, the leverage effect is very clear thanks to the reduction in the size of applications and their environmental impact.

Best practices

The first step in eco-designing applications is to initiate a reflection as early as possible, starting from the expression of needs. By reducing some of the business requirements, some needs and levels of performance, it is possible to produce 90% or 99% of the business value while generating only 30% of the initial environmental impact. The second step is about designing applications using a cloud-native approach. Adopting this approach involves thinking about applications in an evolutionary (scalable) way so that their operation adapts to any increase in load. The third step concerns the running of these applications and their performance, which concentrates most of their environmental impact. Two examples illustrate the importance of this step: the availability of applications and the latency required to serve users. In both cases, the real question for companies is whether it is worth doubling or tripling the investment - and energy expenditure - for an extremely small business gain.

EDGE COMPUTING, THE GOAL OF SOBRIETY

By consuming data as closely as possible, edge computing could change the game.

To achieve decentralized computing, as close to the user or data source as possible, edge computing relies on a multitude of small data centers located on the network's periphery, rather than on large, centralized data centers. This architecture is poised to address the explosion in the number of connected devices, which could reach 80 billion by 2030. By consuming data at the edge, edge computing could change the game in terms of data flow and processing. Most use cases involve industry, particularly process optimization in manufacturing, and smart cities (such as traffic management and video surveillance).

In the consumer space, edge computing paves the way for connected health (for example monitoring a patient's vital signs, tele-transmission to healthcare professionals and remote diagnostics), smart homes, and autonomous vehicles.

Exercising discernment

Is *edge computing,* with its decentralized approach, more environmentally friendly? The question is particularly difficult to answer since it is not possible to consider the impact of edge computing in isolation. It relies on networks, particularly 5G networks, and terminals to function. However, the electronics industry is one of the most energy-intensive, resource-intensive, and water-intensive industries. Over 60 different metals are required to manufacture a smartphone.

Also, beware of the rebound effect: as edge computing becomes more successful, it could lead to massive terminal replacements to enable new use cases. However, these new devices often have very short lifespans. Only an environmentally friendly design approach will allow edge computing to contribute to the overall reduction of the digital footprint.

Achieving sobriety

Edge computing nevertheless presents a tremendous opportunity to create eco-designed and more sober services. Its mini data centers can be more easily integrated into local energy networks and therefore be powered by renewable or low-carbon energy. Their use reduces the volumes of data traveling over networks.

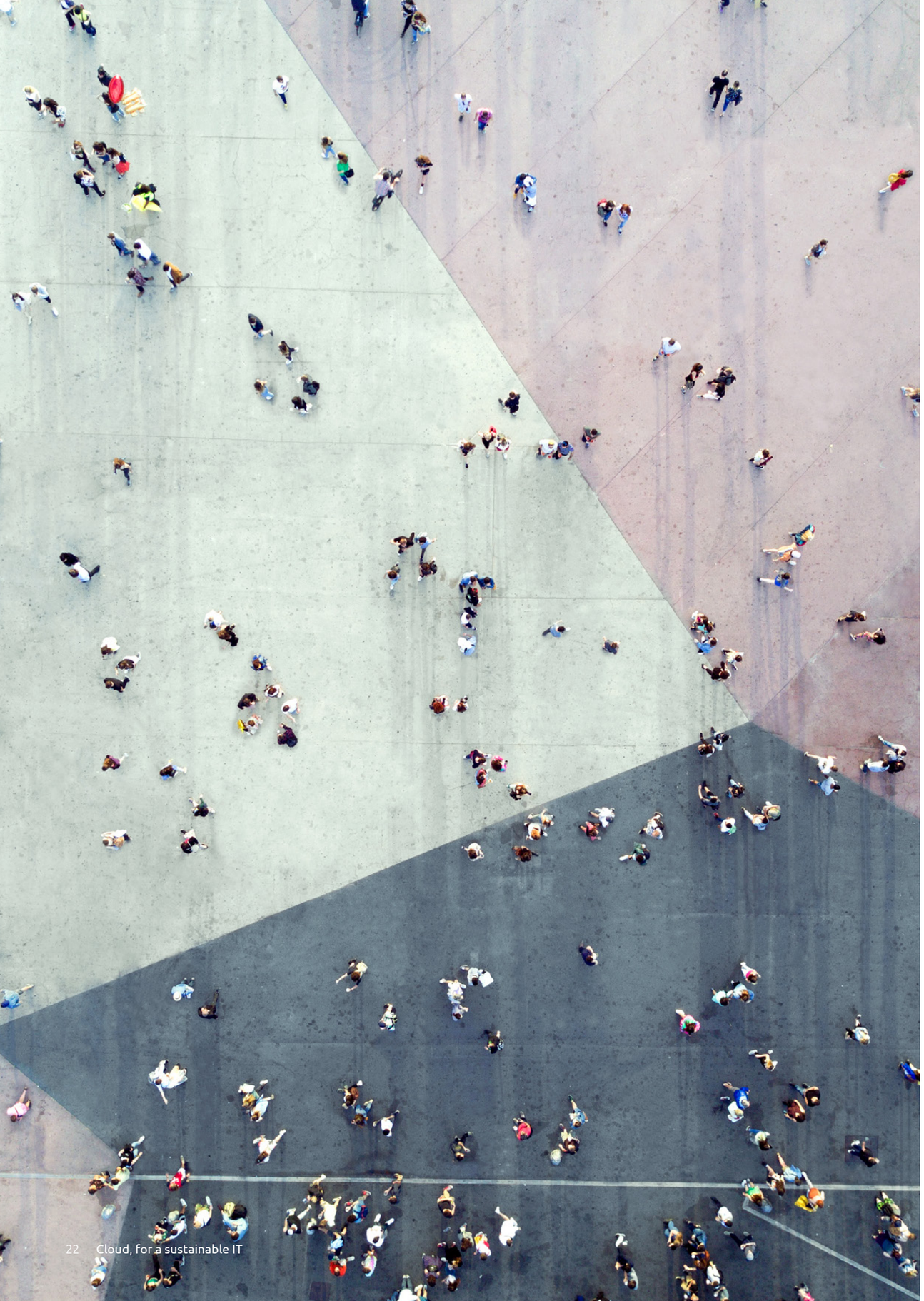
From an environmental perspective, edge computing also has positive externalities for optimizing energy and water consumption, improving road traffic, and reducing the impacts of mobility, which represents 30% of all greenhouse gas emissions in France.

Mastering the impact

Eco-design is essential to master the impact of edge computing. It is necessary to integrate environmental and performance criteria at all stages of projects and equipment life cycles, for example in their selection and monitoring, as well as in network architecture. Users must also be given keys to understanding so that they can make choices regarding energy savings and evaluate the environmental impact of their digital usage (connected remote monitoring systems, videoconferencing, etc.). Environmental transparency is critical. Consistency throughout the value chain is necessary. Edge computing is an aggregation of actors who provide hardware, architecture, building, logical layers, and services. Moreover, their second life (reuse) remains difficult to organize.

In addition, the question of how to build IoT (Internet of Things) models must be addressed. Is it better to have many "simple" objects that do not last long, or fewer, more intelligent objects whose life-cycle can be better controlled? Only the combination of all these parameters will lead to more environmentally sustainable solutions.

1 Report from the Ministry of Sustainable Transition - Low carbon mobility February 2022



CONTRIBUTORS

Christian Carbonne
Practice Head – Business Technology Solutions
christian.carbonne@capgemini.com

Skander Guetari
Head of Portfolio – Cloud Infrastructure Services
skander.guetari@capgemini.com

Alban Korniloff
Managing Consultant
Capgemini Invent
alban.korniloff@capgemini.com

Cédrik Lime
Solution Architect
cedrik.lime@capgemini.com

Thomas Sarrazin
Head of global FinOps offer
thomas.sarrazin@capgemini.com

Caroline Vateau
Director of Sustainable IT
Capgemini Invent
caroline.vateau@capgemini.com

Manuel Gaulthier
Solution Architect
manuel.gaulthier@capgemini.com

Laurence Jumeaux
Head of the Sustainable IT Offer
Capgemini Invent
laurence.jumeaux@capgemini.com

Lucas Lauret
Manager Cloud
Capgemini Invent
lucas.lauret@capgemini.com

Sebastien Ollier
Director of Cloud Native Transformation
Capgemini Invent
sebastien.ollier@capgemini.com

Eymeric Tabou
Senior Consultant & Digital Architect
Capgemini Invent
eymeric.tabou@capgemini.com

Sergio Werner
Director of the Cloud Center of Excellence
for Central and Southern Europe
sergio.werner@capgemini.com

À propos de Capgemini

Capgemini is a global leader in partnering with companies to transform and manage their business by harnessing the power of technology. The Group is guided everyday by its purpose of unleashing human energy through technology for an inclusive and sustainable future. It is a responsible and diverse organization of over 360,000 team members in more than 50 countries. With its strong 55-year heritage and deep industry expertise, Capgemini is trusted by its clients to address the entire breadth of their business needs, from strategy and design to operations, fueled by the fast evolving and innovative world of cloud, data, AI, connectivity, software, digital engineering and platforms. The Group reported in 2022 global revenues of €22 billion.

Get the Future You Want | www.capgemini.com