

For a responsible and sustainable digital future

## **WHAT LEVERS CAN BE ACTIVATED WITH CLOUD AVENUE FOR REDUCING IT ENVIRONMENTAL IMPACT?**

Life Cycle Assessment (LCA) of an IaaS service  
An expert report by AdVaes





## BACKGROUND



**ASSESSING THE ENVIRONMENTAL IMPACT OF AN IT INFRASTRUCTURE HOSTED IN THE CLOUD IS A COMPLEX EXERCISE.**

**ORANGE BUSINESS HAS USED A LIFE CYCLE ANALYSIS (LCA) TO ESTIMATE THE ENVIRONMENTAL IMPACT OF ITS CLOUD AVENUE OFFERING.**



### Cloud Avenue from Orange Business

Cloud Avenue is an Infrastructure as a Service (IaaS) offering based on VMware technologies. It is a public and private cloud offering designed and marketed by Orange Business.

The initial objective was to address an internal need to migrate all the legacy platforms providing VMware-based IaaS services within the Orange Business perimeter to a modern, new-generation infrastructure completely overhauled from a technical point of view. This new infrastructure also had to be hosted in state-of-the-art data centres. Orange France's data centres in Val-de-Reuil (Normandy) and Chartres (Centre-Val de Loire) were selected as the ideal solution.

In addition, and in line with its sustainable development commitments, Orange Business wanted to assess the environmental impact of this offering. To do this, the company used a life cycle analysis (LCA)\*, "the most advanced tool in terms of global and multi-criteria evaluation of environmental impacts" according to ADEME\*.

### LCA: a key approach to assessment

Market standards and stakeholders (regulatory bodies, customers, suppliers, partners, investors, etc.) are increasingly pushing digital service providers to carry out an LCA to assess the environmental impact of a product or service. LCA is a recognised and standardised tool (in accordance with ISO 14040 to 14044). In the regulation compliance framework, ADEME's various guidelines for environmental labelling in the digital sector are fully in line with LCA-based assessments and cover specific French laws, such as the anti-waste law for a circular economy (also named Loi AGECC\*).

**To find out more about Cloud Avenue, Orange Business' IaaS offering based on VMware technologies, see [its online presentation](#).**

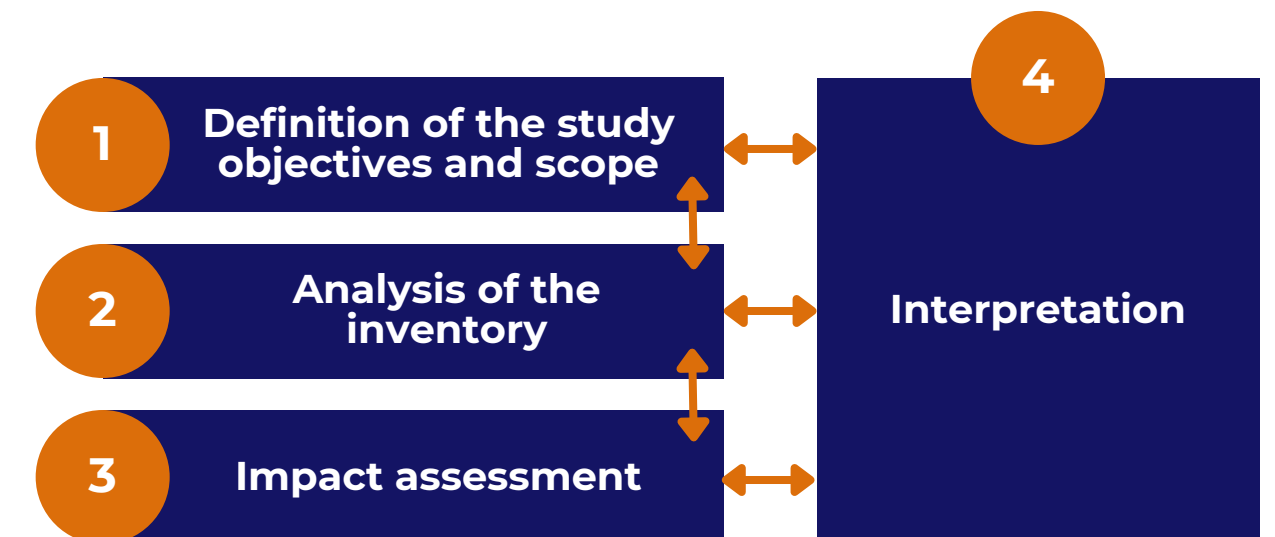


### A pilot approach for the Group

As part of the work initiated at Orange Group level on eco-design methodologies, it also became apparent that it was necessary to be able to assess the overall environmental impact of an offering via an LCA.

The LCA of the Cloud Avenue offering served as a pilot. However, as it was too far advanced in terms of design, it was not able to benefit from the eco-design methodologies defined as part of this work supported by the Group. Indeed, at the time the LCA was carried out, Cloud Avenue's technological components had already been selected.

**The LCA methodology is based on 4 distinct but interdependent stages. Frequent feedback is necessary, making the overall approach iterative.**



# OVERVIEW OF THE CLOUD AVENUE LCA

## Comparison between two offerings

At the end of 2020, Orange Business decided to launch several LCAs to analyse and compare the environmental impact of the infrastructures of its first-generation platform (1GP) with those of its new Cloud Avenue offering.

The server infrastructures and hardware components have been completely renewed for Cloud Avenue. The same applies to operational methods and approaches. Operating practices were a major point of differentiation between the two offerings compared.

The only element common to both offerings is the choice of VMware technology.

## Integration of the entire life cycle

To carry out these LCAs, Orange Business followed the principles set out in the ISO 14040 and 14044 standards, without being certified. These LCAs cover the entire life cycle of its offerings, from design to decommissioning. The data centre is fully integrated into the scope of the analysis.

## A multi-criteria approach

The scope taken into account for these LCAs meets 9 impact criteria, including those recommended by ADEME for all environmental labelling\* in the digital sector. These 9 criteria are listed below.

### CLOUD AVENUE LCA: 9 IMPACT CRITERIA ADDRESSED



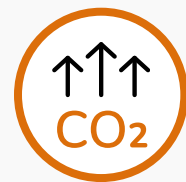
**climate change**



**acidification**



**natural abiotic resources**



**fine particle emissions**



**ionising radiation**



**depletion of water resources**



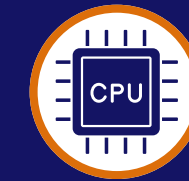
**MIPS\* material footprint**



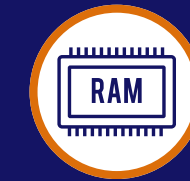
**waste production**



**primary energy consumption\***



**2 vCPU**



**8 Go vRAM**



**160 Go Storage**

## 3 scenarios, 1 reference functional unit

Three scenarios have been selected based on the following types of data centre and technical:

- 1GP in Val-de-Reuil data centre;
- Cloud Avenue in Val-de-Reuil data centre;
- 1GP in Rueil Malmaison (old generation data centre).

A typical VM (Virtual Machine) is defined, known as the reference VM. This reference VM constitutes the functional unit (UF). It consists of 2 vCPUs\*, 8GB of RAM\* and 160GB of storage..

For each scenario, an LCA is carried out and several comparisons are made. The elements taken into account in the calculation are:

- The size of the VMs and their execution time;
- The volume of storage and the associated class;
- Network services consumed;
- Consumption of shared equipment or managed services (hypervisors, control planes, standby equipment);
- Consumption of data centre cooling system;
- The emission factor of the data centre energy mix (according a location-based approach).



# ORGANISATION AND CONDUCT OF THE LCA, POINTS OF ATTENTION

## Project organisation

To carry out the LCAs for the 1GP and Cloud Avenue offerings, Orange Business was assisted by APL, a consultancy and engineering company specialising in the design and construction of data centres in France. A critical review was carried out at the end of the project by another company called DDemain.

Internally, Orange Business created a project team supervised by a project manager. The project manager was responsible for leading the LCA process and collecting the data to be delivered to APL. APL was in charge of the methodology to be applied. The project manager was responsible for liaising APL with the people who had the data needed to carry out the assessment, in particular those at Orange France for the data centres.

## Planning

The LCAs for the two offerings, 1GP and Cloud Avenue, were decided at the end of 2020. The pilots were launched in January 2021 and completed in September 2021.

In 2022, as part of the work of the ADEME's PCR\* Datacenters and Cloud Services, Orange Business proposed Cloud Avenue as a pilot test.

A second LCA of the Cloud Avenue offer has been carried out, focusing on 5 criteria (instead of 9) and incorporating changes in the meantime.

Regardless of the margins of error reported in terms of measurement and evaluation, due to the different input sources used (see below), this second LCA confirmed the trends in terms of impact and the benefits of migrating from the 1GP offering to Cloud Avenue.

## Data sources used

The evaluation is based on several sources of data: monthly consumption of services, actual measured consumption of data centre equipment, conversion matrix of a billed service into percentage(s) of physical equipment, electricity consumption profiles of the physical equipment involved.

APL carried out the assessments with Orange Business, also using data supplied by NegaOctet\*. At the time of the first LCAs, the NegaOctet database was still under construction. By the time of Cloud Avenue's second LCA, this database had been completed. As the environmental impacts of certain components and servers were revised between the two periods, the final results necessarily changed.



## POINTS OF ATTENTION

Data is a key issue. An LCA needs a lot of data: precise inventory, energy consumption, etc. This data did not exist, or only partially, at the start of the project. It was therefore necessary to:

- Carry out an internal data collection exercise, which required significant resources;
- Use third-party data sources (e.g. NegaOctet, Shift Project, ADEME, etc.).

However, for a same component, there are major differences between these data sources (a multiplication factor of two or more for certain IT equipment such as servers). There is (as yet) no absolute, uniform calculation benchmark. As a result, the uncertainties between these various external sources, combined with the internal uncertainties reported, can generate significantly different results for a same perimeter.

Resistance to change is another obstacle. The subject of environmental issues requires change management, awareness-raising, training, etc. Orange Business has taken steps in this direction with the deployment of Climate Fresks (known as "Fresques du Climat"), eco-design awareness-raising sessions, etc.

For Orange Business, the environmental impact of digital technology is a subject that needs to be integrated at all levels of the organisation, in all business lines, processes, etc. It requires change management, because it has to affect 100% of employees and be adapted to each business line. This is a long process. It involves identifying the Green IT components in each business line that need to be addressed. The LCA is a step along the way, which has enabled the company to understand the key issues. But it remains just one component among many to support this change.

# TAKING INTO ACCOUNT THE ACV CARRIED OUT AT ORANGE FRANCE'S DATA CENTRES

Data centres do not account for the lion's share of the carbon impact, and more broadly the environmental impact, of an IT infrastructure. They account for between 10% and 20% at most. The manufacture of all the equipment that makes up the infrastructure remains the biggest part.

Data centres that consume less energy and are of sized for specific types of IT processing are more efficient today. The key to this lies in cooling systems chosen, particularly those based on "free cooling" technology, which uses fresh outside air to cool IT rooms.

For Cloud Avenue, Orange's data centres, where the offering is hosted, are a key differentiator. From a latest-generation, these data centres have been eco-designed by a team of LCA experts.



**Systems other than free cooling can be implemented. Orange France can, for example, implement oil immersion cooling systems for specific use cases such as intensive scientific or financial computing.**

## LCA to identify levers for action

LCAs carried out aimed to identify, on a macro level, the levers on which to act in order to reduce the environmental impact of Orange France's internal information system infrastructures. These had to take account of the technological choices already made (e.g. free cooling) and, if necessary, improve them.

The two latest-generation data centre sites concerned by these LCAs were Val-de-Reuil in Normandy and Chartres in the Centre-Val de Loire region. At both sites, free cooling technology means that air conditioning systems are not needed 85% of the time. This choice was made when Normandie 1 was built, the first data centre to be inaugurated in 2012 on the Val-de-Reuil site.

## LCA specific to data centres

The first LCA for the Normandie 1 data centre was carried out in 2021. Another was carried out the same year for a legacy data centre in Aubervilliers. Based on the data provided, APL carried out the LCAs.

These LCAs include aspects relating to the building and the IT infrastructure. They are based on a multi-criteria approach and on actual data measured and supplied: square metres of IT rooms, references for technical equipment deployed (e.g. cooling systems, UPS or Uninterruptible Power Supply systems, generators, fire detection systems, etc.) and reference documents available for the IT infrastructures hosted in the data centre.

## Positive reduction results

The LCA carried out confirmed that:

- Technologies chosen for the Normandie 1 data centres, particularly free cooling systems, had a lower environmental impact than Orange's other data centres using other technologies;
- Orange France's strategy of closing down the old generation of data centres and consolidating them into new-generation data centres in Val-de-Reuil and Chartres was the right way forward;
- In addition, hosting cloud solutions in the Normandie 1 data centre made it possible to reduce the carbon impact of these solutions, as well as the cost of related operations.

They identified the following reduction levers:

- Improving the energy mix for Scope 2 of the carbon footprint;
- Optimising technical environments, such as cooling systems, the positioning of variable electric motors on extractors, and the installation of floating high-pressure regulation;
- Improving the density of IT rooms, increasing the rate of shared use of equipment, their average age, and IT room temperatures ranging from 16°C to 26°C (see ASHRAE\* recommendations).

# SPECIFIC FEATURES OF ORANGE FRANCE'S VAL-DE-REUIL AND CHARTRES DATA CENTRES

## BIODIVERSITY

Green wall for the Normandie 1 building.

Beehives deployed on each site.

Eco-grazing set up at Chartres with Ouessant sheep.

## CIRCULAR ECONOMY

Selective waste with separation into 3 skips collected by Veolia.

Orange France's membership of Ecologic, an organisation approved by the public authorities for the recycling of electronic waste.

The Chartres conurbation is considering developing a water network and initiating a project.


In Val-de-Reuil, a recovery process heats the offices of Orange buildings.

## HEAT REUSED

ESG requirements included in calls for tenders for the purchase of IT equipment deployed.

## RESPONSIBLE PURCHASES

**+** ISO 14001, ISO 50001 standards  
EU Code of Conduct for Data Centres  
HQE\* certified buildings



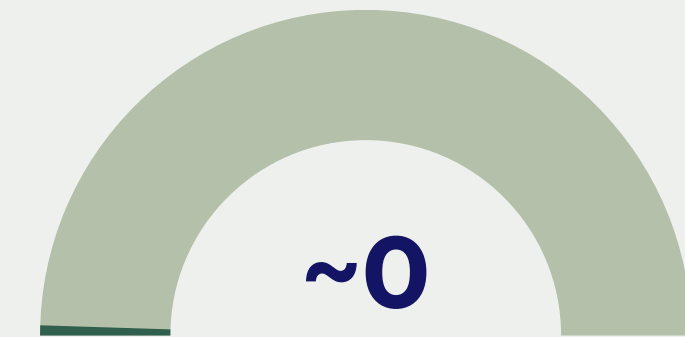
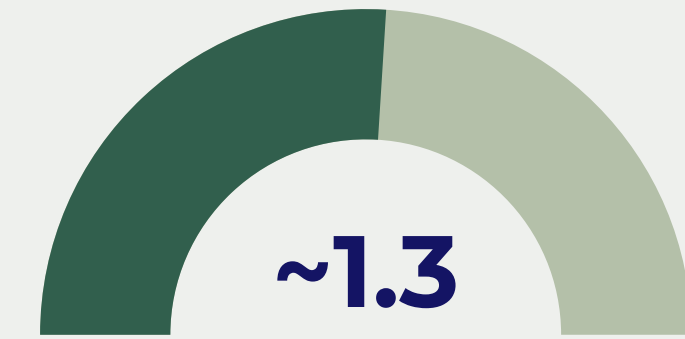
Solar project so that part of the energy consumed comes from the photovoltaic field deployed on the Normandie 1 site land reserve.

This could represent 5% to 8% of the site's annual electricity consumption.

## RENEWABLE ENERGY



PPAs\* avec Boralex sur la fourniture d'énergie éolienne



**7 to 8 years**  
lifespan of internal servers

*Note: considering data security issues, hard disks are shredded and the material is recovered by the company responsible for this process. In terms of storage bays, Orange France is considering the possibility of erasing disks, bearing in mind that the associated security issues remain complex to solve.*

*Veolia is a French transnational company involved in water management, waste management and energy services.*



## KEY RESULTS



**THE LCA SHOWED THAT THE TECHNICAL ARCHITECTURE CHOSEN FOR CLOUD AVENUE WAS MORE VIRTUOUS AND HAD LESS ENVIRONMENTAL IMPACT ON 8 OF THE 9 EVALUATION CRITERIA.**



### A low-impact offer

As Cloud Avenue's technological choices had already been defined, the LCAs carried out made it possible to:

- Show that the new architecture had less impact on the environment than the architecture chosen for 1GP. It was more virtuous than the 1GP architecture on 8 of the 9 measurement criteria;
- Identify the levers for action to reduce the environmental impact of these offerings;
- Gain a better understanding of the methodology used to calculate the environmental impact of a cloud service;
- Raise awareness of the subject and develop expertise in an eco-design approach;
- Identify the limits and maturity of teams involved.

The LCAs did not influence the design of the Cloud Avenue offering as such, although the technological choices made upstream did, by default, include environmental criteria, particularly for IT equipment and data centres.

### Identifying the levers on which to act

The LCAs has enabled Orange Business to identify the main components of the impact (manufacturing, use, IT equipment, data centres, etc.), as well as those that have the greatest impact and the criteria on which they act.

The LCAs confirmed that:

- The manufacture of equipment has a large impact on CO<sub>2</sub> emissions as regards the design of the offering;
- The data centres in Val-de-Reuil were more virtuous than those in Rueil Malmaison due to their more recent construction, the choice of "free cooling" cooling systems and a lower PUE (Power Usage Effectiveness).

Recommendations have identified other long-term levers for action, such as extending the lifespan of servers. Orange Business is working on these areas for Cloud Avenue.

It is also important to note that data related to indicators communicated are based on actual measurements and serious, proven methodologies.



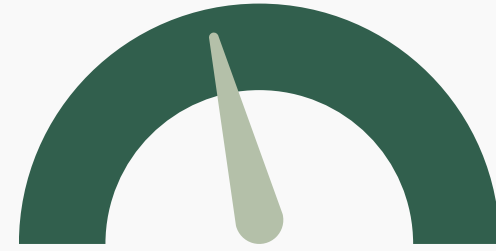
### Cloud Avenue customers benefit from these results

Orange Business is making every effort to progress and acquire expertise: investments, mobilised internal resources, use of the best tools currently available, such as LCA. LCA means integrating the entire life cycle of a product or a service and working according to a multi-criteria approach. It is more challenging and relevant than other methodologies that rely solely on the allocation of GHG (greenhouse gas) emissions or energy consumption factors. Today, few digital service providers have such a competence and a comprehensive view of their offerings. With this experience, Orange Business knows the levers for action and is acting on them for the benefit of its customers.

# BALANCE SHEET

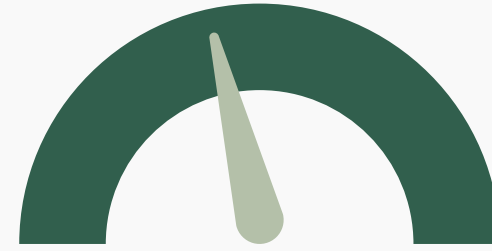
## reductions obtained with Cloud Avenue vs. 1GP

**-43%**



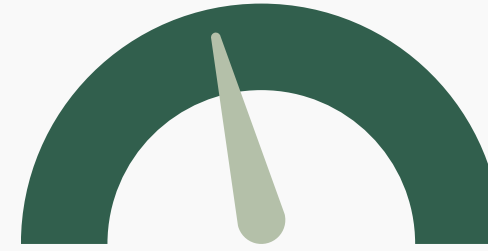
climate change  
GHG emissions

**-43%**



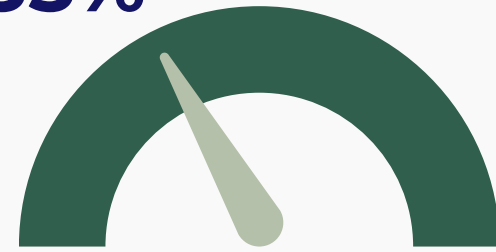
fine particle  
emissions

**-43%**



air  
acidification

**-35%**



depletion of natural  
abiotic resources

**-34%**



depletion of water  
resources

**-33%**



waste  
production

**-30%**



ionising  
radiation

**-25%**



primary energy  
consumption

## LCA CONCLUSIONS



- 1 confirmation that Cloud Avenue has less impact than 1GP for customers migrating from this offering to the other
- 2 validation of the major levers according to environmental impact
- 3 identifying recommendations for reducing Cloud Avenue's environmental impact
- 4 drawing up an action plan and implementation of the "Green IT" programme

*Note: It is difficult to make comparisons with other competing Cloud Avenue offerings, given the many different parameters involved. Each LCA is specific. Furthermore, few LCAs have been conducted to date for infrastructure cloud services (IaaS). As a result, any comparative data is lacking or, where it does exist, does not allow comparisons to be made on similar bases. The LCA does not allow Cloud Avenue to be positioned in relation to similar offers from competitors. It validates the seriousness, maturity and expertise of Orange Business as a solution provider.*



# RECOMMENDATIONS, AREAS FOR PROGRESS AND NEXT STEPS

## Taking action right from the design stage

To make progress over the long term, things need to be measured. Orange Business has not waited to take advantage of known levers and to act upstream of measurement, which can be long and complex to carry out. This dual approach, or parallelisation, is virtuous because it allows to act without waiting, all the more so if the technological perimeters evolve over time.

The knowledge acquired through the measurement work carried out thanks to the various LCAs done is now spreading throughout Orange Business. It allows teams to gain in maturity, and contributes fully to progress.

## Speeding up the “Green IT” programme

The levers for a cloud with a lower long-term environmental impact are now known. With this in mind, Orange Business has launched a "Green IT" programme for Cloud Avenue to include environmental issues throughout the life of the offering.

Beyond the design phase, the aim is to integrate environmental components over the long term through various actions. This involves, for example, operating services more efficiently, by concentrating loads or switching off unused VMs, or improving energy efficiency.

The purchase of reconditioned equipment and the extension of equipment lifecycles also contribute to the circular economy actions undertaken.

This "GreenIT" approach is part of Orange Business' "Green Act" programme which, since 2020, has been encouraging and accelerating the entire company and its stakeholders towards processes and activities that integrate environmental issues.

## Supporting decarbonation targets

The LCAs carried out, and more broadly the entire approach adopted by Orange Business around "Green IT", contribute to the overall objective of decarboning the Orange Group's activities (see [decarbonation roadmap 2040](#)).

This voluntary and comprehensive roadmap includes initial results to be achieved by 2025, namely for the Orange Group as a whole: -30% reduction in emissions on scopes 1 and 2 compared to 2015 and -14% on scope 3 compared to 2018. Similarly, 50% of electricity needs will have to be met from renewable sources by 2025 (compared with 31% in 2020).

Orange Business includes the Group's various commitments in terms of renewable energies, reduction of GHG emissions and other actions to reduce impacts.

## NEXT STEPS FOR CLOUD AVENUE



Orange Business focuses on achievable and understandable objectives:



**Offer customers a carbon calculator to help them better assess the impact of their uses**



**Have a clear vision of the measures needed to optimise the energy efficiency of infrastructures**



**Implement circular economy KPIs and deploy related tools (e.g. life cycle of equipment and assets, end of life, life cycle, etc.).**



**Optimise the "Green IT" programme by integrating actions and best practices of suppliers in the offering**



**Operationalise "Green IT" to integrate it into day-to-day processes and operations**

# GLOSSARY

**ADEME (Agence de la transition écologique):** French Agency for Ecological Transition, under the supervision of the French Ministries of Ecological Transition and Territorial Cohesion, Energy Transition and Higher Education and Research.

**ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers):** International technical organisation in the field of thermal and climatic engineering. These recommendations are followed by many data centre service providers.

**Cloud Avenue:** IaaS offering based on Orange Business VMware technologies.

**CPU (Central Processing Unit):** Processor or central processing unit of a computer system..

**Environmental labelling:** Environmental labelling "informs consumers about the environmental impact of the products or services they consume" (ADEME). In the digital sector, it covers a range of areas: fixed and mobile telecommunications networks, data centres and cloud, and user terminals.

**IGP (First Generation Platform):** Former IaaS offering from Orange Business.

**Free cooling:** Cooling system used in data centres that uses the temperature difference between the air leaving the servers (and other IT equipment) and the temperature of the outside air.

**HQE (Haute Qualité Environnementale):** French standard evaluating building environmental quality.

**LCA (Life Cycle Assessment):** LCA "identifies and quantifies the physical flows of matter and energy associated with human activities throughout the life of products. It assesses the potential impacts and then interprets the results obtained according to its initial objectives", according to ADEME.

**Loi anti-gaspillage pour une économie circulaire (AGEC):** French anti-waste law for a circular economy that "intends to accelerate the change in the production and consumption model in order to limit waste and preserve natural resources, biodiversity and the climate" (detail).

**MIPS (Material Input Per unit of Service):** MIPS is an indicator that calculates the material input (such as materials and ores) per unit of service or product used.

**NegaOctet:** French framework for assessing the environmental impact of digital services.

**NGP (New Generation Platform):** Previous name for Orange Business' Cloud Avenue offering.

**Product Category Rule (PCR):** Repository for calculating impacts based on rules defined by product category (see Datacenter and Cloud PCR below as examples). Each PCR defines rules, requirements and guidelines.

**PPA (Power Purchase Agreement):** Energy contract negotiated over the long term, increasingly targeting renewable or low-carbon energies certified as "guarantee of origin"..

Primary energy: Energy directly available in nature before any transformation..

**PUE (Power Usage Effectiveness):** Indicator of the energy efficiency of a data centre. It is the ratio between the total energy consumed by the data centre and the energy consumed exclusively by the hosted IT systems. An indicator close to 1 means that the data centre is efficient in its energy consumption..

**RAM (Random Access Memory):** The random access memory of a computer.

**Référentiel méthodologique d'évaluation environnementale des services d'hébergement informatique en centre de données et de services cloud:** Also known as the PCR Datacenter and Cloud, this French standard "provides the method to be used to calculate the environmental display indicators for this product category"" (latest version: January 2023).

**WUE (Water Usage Effectiveness):** Indicator that measures the quantity of water used by a data centre for cooling and other building needs. The closer it is to 0, the better it is.



# ABOUT

## Methodology

The information analysed and published in this report comes from internal Orange Business documents (reports, technical documentation, use case studies, notes and internal work), interviews with experts on the subject addressed, supplemented by information from recognised external public sources and/or AdVaes internal databases and analyses.

## CSR at Orange Group

As a subsidiary of the Orange Group, Orange Business follows the charter of its majority shareholder.

[This charter is available on the Group's website.](#)

The Orange Group's Corporate Social Responsibility (CSR) policy focuses on the following areas:

- Governance;
- Fundamental freedoms;
- Digital inclusion and territories
- Ecological and energy transition;
- Responsible products, services and uses;
- And the responsible employer.

**Detailed information on the Orange Group's CSR policy and commitments is available on the online media library: [gallery.orange.com/RSE](https://gallery.orange.com/RSE).**

## About Orange Business

Orange Business is a digital services company belonging to the Orange Group, with expertise in networks, connectivity and digital solutions integration (service platforms, data analysis, cloud solutions, etc.).

The company supports private companies and public organisations worldwide in their sustainable digital transformation. It combines a global presence with a local approach, supported by more than 29,000 employees who are experts in business issues. It defends an ethical, responsible and inclusive vision of digital, while helping its customers to reinvent their services.

## About AdVaes

AdVaes is a neutral and independent market intelligence and operational strategy consultancy specialising in the analysis of cloud computing and data markets and the ESG approaches of digital service providers.

The company helps organisations to develop and implement their strategy, to enhance the value of their actions and investments, and to make informed decisions in terms of innovation with the cloud, and on ESG issues of digital and reducing the environmental impact of IT activities. The company supports executives, their managers and their employees in 4 operational areas: insights, assessments, anticipation and/or awareness.



**ORANGE BUSINESS  
THANKS ADVAES  
AND ITS INTERNAL  
TEAMS FOR THEIR  
CONTRIBUTION TO  
THE PREPARATION  
OF THIS REPORT.**



**Business**





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