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Energy and Carbon Efficiency Benefits of Public Cloud Computing over Enterprise Datacenters

Extended InfoBrief

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Executive Summary

Enterprises must continue with digital transformation to achieve top-line growth and operational efficiency, which requires energy-intensive IT and datacenter resources. The modern enterprise also needs to prioritize environmental, social, and governance (ESG) criteria to drive business outcomes. This strategic focus is essential, as it aligns with customer-, stakeholder-, and employee-expected outcomes, boosts operational efficiency, and enables the management of regulatory, supply chain, and environmental risks.

This report is intended to provide executive leaders with recommendations and data-driven evidence of the potential carbon and energy efficiency benefits of moving enterprise workloads to the cloud as part of any digital transformation.

IDC's Approach

- Datacenter operators need to demonstrate that the rapid growth in the digital economy is underpinned by sustainable operations, but they are early in the journey of transparently reporting on key supporting metrics, such as power capacity, energy consumption, and carbon emissions. Recognizing this, IDC has created the *Sustainable Builds and Carbon Emissions* model, aiming to quantify the energy consumption and carbon emissions of the datacenter market.
- This study compares the carbon impacts of enterprise datacenters and public cloud datacenters using IDC's research and models to help enterprise datacenter operators quantify the potential energy and carbon efficiency benefits of moving workloads to the public cloud.

Key Findings

- The combined energy consumption of enterprise datacenters and public cloud datacenters is projected to grow from **123TWh** in 2023 to **314TWh** in 2027.
- IDC expects that, by 2027, globally, energy consumption related to GenAI workloads will collectively account for **3%** of enterprise and public cloud datacenter energy consumption, but GenAI is also expected to help achieve more sustainable operations. IDC estimates running GenAI workloads in public cloud datacenters is more energy and carbon efficient than running them in enterprise datacenters.
- The datacenter industry is making significant progress in reducing its carbon emissions growth, with year-on-year growth forecast to slow from **22.5%** in 2023 to **4.9%** in 2027.
- Public cloud datacenters were **4.7 times** more carbon efficient (and **3.8 times** more energy efficient) than enterprise datacenters in 2023. IDC projects that public cloud datacenters will widen the carbon-efficiency gap to seven times by 2027 as they continue to invest in carbon-free energy, more energy-efficient facilities, custom-designed energy-efficient silicon, and increased server utilization.
- Moving IT workloads to public cloud datacenters can support enterprises' sustainability strategy and help them achieve energy and carbon efficiency benefits.

Recommendations for Executive Leaders

Assess your current footprint. Start by understanding your existing IT infrastructure's energy consumption and carbon emissions. Senior executives should consider what workloads should move to the public cloud to support their sustainability strategy and to achieve energy and carbon efficiency benefits.

Select the right public cloud provider. Select a provider that aligns with your values and sustainability goals and offers relevant solutions for your needs.

Consider the location of the datacenter. The overall grid generation mix and availability of carbon-free energy can affect your environmental impact.

Use CloudOps tools and implement best practices. CloudOps tools and practices optimize server utilization and workloads, right-size resources, and effectively enable demand-based scaling.

Datacenter Types Covered in the Study

Enterprise datacenter

- A private internal datacenter is utilized by a single enterprise and is often referred to as on premises.
- The datacenter is a dedicated space for critical IT infrastructure — including servers, storage systems, and networking equipment — located on corporate premises, such as a regional office, and is distinct from edge deployments.

Public cloud datacenter

- A datacenter used for shared cloud services provides computing for unrelated enterprises and consumers, is open to a largely unrestricted universe of potential users, and is designed for a market, not a single enterprise.
- The public cloud market includes a variety of services designed to extend or, in some cases, replace IT infrastructure deployed in internal corporate datacenters. These services are called **public cloud services**.
- The public cloud market includes **digital services**, such as media/content distribution, sharing, search, social media, and ecommerce.

Note: The quantitative analysis employed to compare the environmental impact of enterprise datacenters with that of public cloud datacenters is based on all providers that meet the respective definitions. However, the analysis of embodied carbon outcomes and the benefits of custom silicon are specific to those public cloud datacenters intended to extend or, in some cases, replace enterprise datacenters.

Challenges and Opportunities

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To remain competitive, enterprises aim to leverage datacenter capacity for digital transformation while contributing to environmental sustainability goals.

- Organizations are increasingly integrating digitalization into their core strategies and operations, **fueling the growth of the datacenter industry**.
- Stakeholders (customers, employees, investors, and communities) expect the enterprises they work with to demonstrate a commitment to environmental sustainability by reducing their carbon footprints.
- **It is not just an ethical imperative; it is also a strategic business decision**.

Digital transformation

Creating business efficiency and new value through services enabled by IT

Stakeholder expectations

Innovative products and environmental leadership

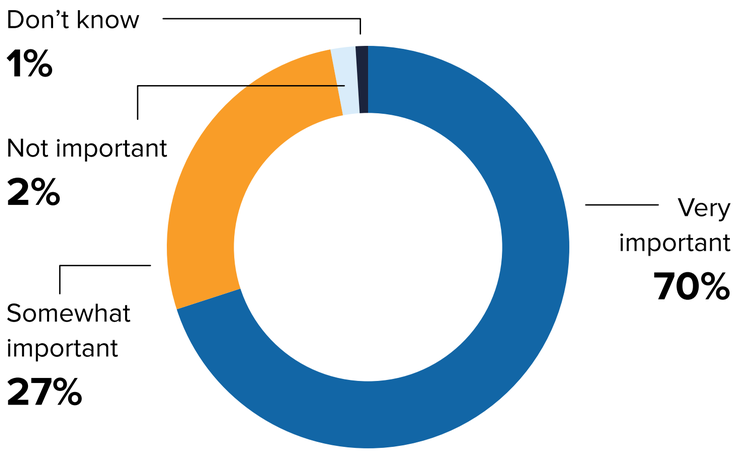
Environmental sustainability

Responsible use of the earth's resources, mitigating risks associated with regulatory bodies, supply chains, and climate events

Most enterprises are making ESG a corporate priority.

- Prioritizing ESG can secure long-term value for enterprises, helping them mitigate risks, enhance reputation, and drive operational efficiency.
- ESG goals can ultimately drive business, as they can help enterprises attract the best talent and can align with investor and customer values.

Q. How important do you consider environmental, social, and governance (ESG) factors to be for the enterprise value of your organization?



ESG priorities do not stop at the executive level; they cascade through the organization.

Surveyed enterprise datacenter operators indicated that **sustainability will become their second highest priority** in the next two years.

Q. What are your company's top 3 initiatives for the next two years regarding datacenters?

Source: IDC's *Worldwide ESG Business Services Buyer Value Survey*, 2023 (N = 1,021)

Source: IDC's *Datacenter Operations and Sustainability Survey*, March 2023, enterprise respondents (n = 257)

IDC expects datacenter energy consumption to expand at a compound annual growth rate (CAGR) of 26.4% through 2027 due to rising IT demand.

Examples of technologies driving datacenter growth:

GenAI

Spending on GenAI (software, related hardware, and IT/business services) is expected to reach **$143 billion** in 2027, representing a **CAGR of 73.3%** over the **2023–2027** forecast period.

Big Data

Spending on business intelligence and analytics tools and platforms is expected to expand at a **CAGR of 23.6%** over the forecast period.

Edge Computing

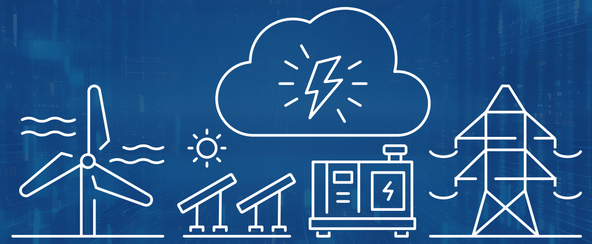
Worldwide spending on edge was **$201 billion** in 2023 and is expected to grow at a **14.4% CAGR** through **2027**.

Internet of Things

Investments in the IoT ecosystem are expected to surpass **$1 trillion** in 2026, with spending rising at a **CAGR of 10.4%** over the **2023–2027** period.

Source: IDC Press Releases

Projected enterprise and public cloud datacenter energy consumption growth:



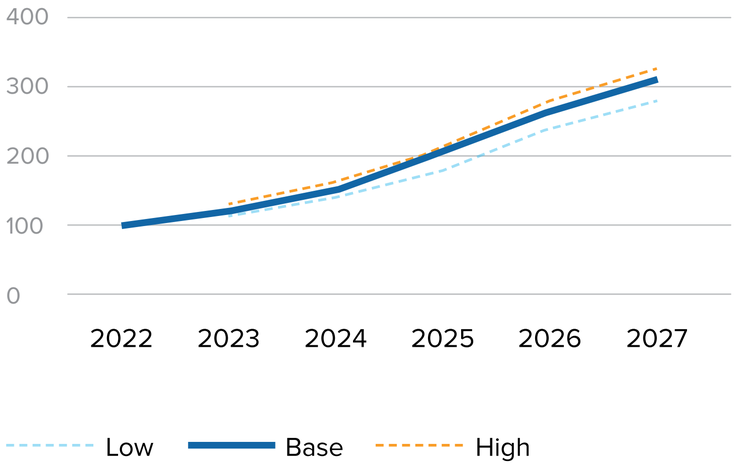
26.4% CAGR,
from **123TWh in 2023**
to **314TWh in 2027**

Source: IDC's Datacenter Trends: Sustainable Datacenter Builds and CO_2 Emissions (SIS, IDC_P33186)

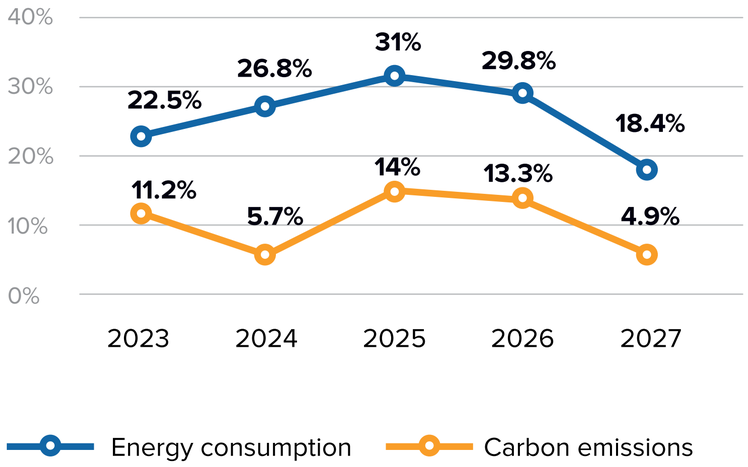
While energy consumption is projected to increase at a CAGR of 26.4% through 2027, carbon emissions are expected to rise at a more moderate 9.4% CAGR, with only a 4.9% year-on-year increase forecast for 2027.

Enterprise datacenter and public cloud providers' innovations and investments are driving the rise of sustainable datacenters.

Global Datacenter Energy Consumption (in Terawatt Hours)



Energy Consumption and Carbon Emission Growth Rates



Rising energy consumption trends: IDC estimates that enterprise datacenters' and public cloud datacenters' energy consumption totaled 123TWh in 2023 and that it will grow to 282–329TWh in 2027. The increasing need for computing and data storage, the proliferation of internet-connected devices, and GenAI adoption will all likely contribute to this rising energy consumption.

Decelerating carbon emissions: The datacenter industry is making progress in decelerating its carbon emissions growth rate, which is currently half that of the energy consumption growth rate and is expected to decline to 4.9% year-on-year growth in 2027. This deceleration will likely result predominantly from the increased use of carbon-free energy sources.

Innovation in energy efficiency: While carbon-free energy has the largest impact on reducing carbon emissions, energy efficiency also contributes to the reduction. Datacenter providers are investing in more efficient server architectures, custom silicon, AI-driven energy management, and advanced cooling systems, such as liquid immersion cooling, to improve energy efficiency.

While IDC projects that GenAI will consume 3% of global datacenter energy by 2027, it also expects GenAI to help drive more sustainable business operations.

- The C-suite leaders surveyed cited improved customer experience/service as the top business outcome of GenAI.
- IT energy optimization, sustainable/responsible production and operations, and overall energy efficiency optimization were identified by survey respondents as the top sustainability use cases of GenAI.

Top Benefits Sought by the C-Suite

44%

Improved customer experience/service

36%

Improved performance-related decision making

35%

Improved revenue generation and order velocity

Base = respondents who indicated that the C-suite is actively engaged on a recurring basis with IT leaders or that the C-suite has held high-level discussions with IT leaders but with no recurring engagements yet

Source: IDC's *GenAI ARC Survey*, August 2023 (N = 1,187); data weighted by IT spending

What are the most important sustainability use cases for GenAI?

IT efficiency optimization **46%**

Sustainable/Responsible production and operations **45%**

Overall energy efficiency optimization **44%**

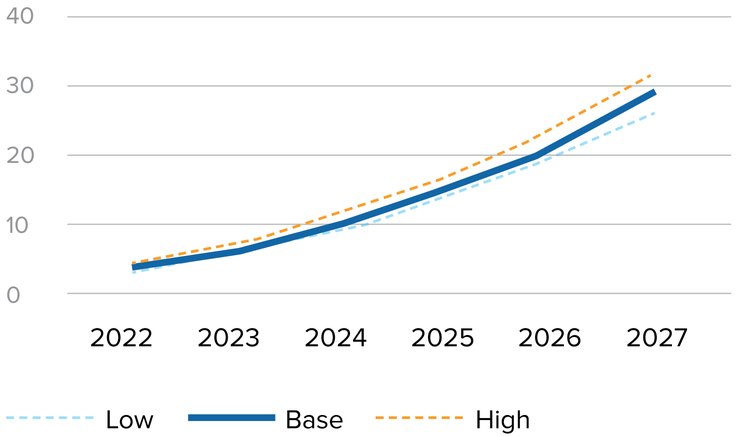
ESG data analysis **42%**

Migration to low carbon & renewable energy sources (water, wind, solar, biomass) **36%**

Source: IDC's *Global Sustainability Maturity and Readiness Survey, 2023* (n = 1,800)

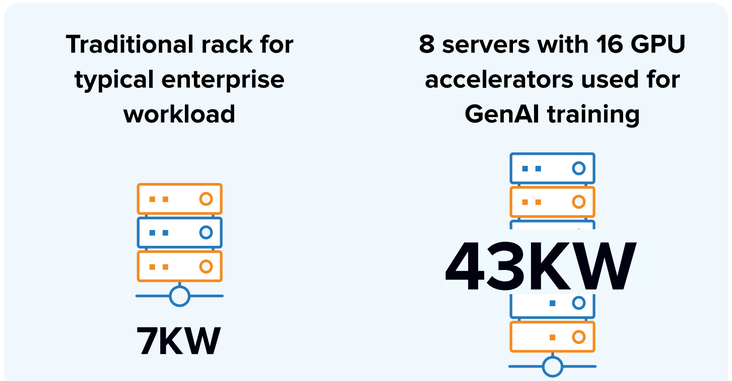
GenAI is energy intensive but has some sustainability advantages.

Generative AI Energy Consumption (in Terawatt Hours)



When GenAI Is More Energy Intensive

Accelerators are increasing rack density.



Note: This is an estimation of a rack configuration used for training a GenAI model.

- The adoption of GenAI is expected to lead to increased investments in IT infrastructure, greater power capacity requirements, and higher overall energy consumption.
- GenAI workloads require the use of accelerators. To illustrate, rack density equipped with 16 GPU accelerators to serve a GenAI training workload could be more than six times the density of a typical rack of general-purpose servers. Water cooling could lead to an even higher rack power density.
- In 2023, GenAI contributed 1% to global enterprise and public cloud datacenter energy consumption. IDC predicts that, by 2027, GenAI's contribution to datacenter energy consumption will have increased to 3%.

Sustainability advantages of GenAI

Training, the most energy-intensive portion of GenAI, is not latency dependent, which means training workloads can be located where power is available, especially when that power has low or no carbon emissions.

Customers generally intend to use third-party datacenters, which are more energy efficient and are more likely to be powered by carbon-free sources.

IDC estimates running GenAI workloads in public cloud datacenters is more energy and carbon efficient than running them in enterprise datacenters.

Source: IDC Research

Public Cloud Datacenters' Energy and Carbon Efficiency

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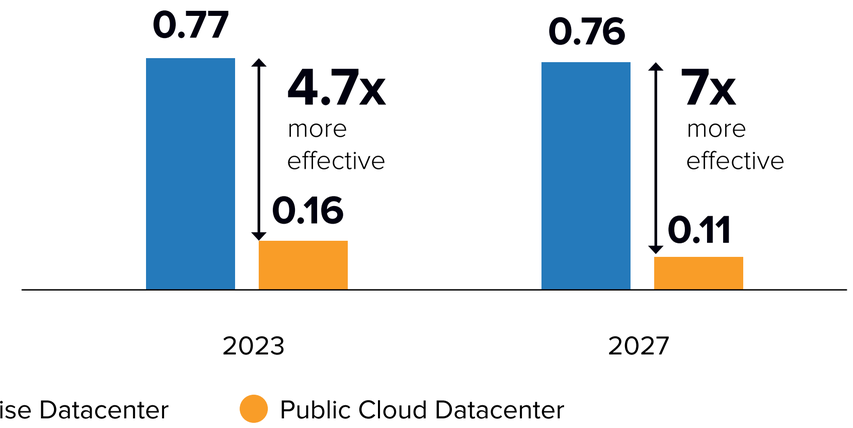
IDC estimates that public cloud datacenters, globally, were 4.7 times more carbon efficient in 2023 than enterprise datacenters and will be 7 times more efficient by 2027.

Public cloud datacenters are projected to innovate faster, widening the gap from enterprise datacenters in energy efficiency and carbon efficiency. In addition, because public cloud datacenters and their portfolios are larger, they achieve greater returns on investment.

Carbon usage effectiveness (CUE) is a metric used to measure the carbon emissions associated with operating a datacenter. It is particularly useful for assessing the environmental impact of datacenters, as it directly relates energy consumption to carbon emissions.

CUE Comparison



Note: CUE is calculated by dividing carbon emissions (kilograms of CO_2) by IT equipment energy consumption (kilowatt hours).

Some reasons behind the greater carbon efficiency of public cloud datacenters in 2023:

Carbon-free energy sources: Public cloud datacenters increasingly rely on carbon-free energy sources, such as solar, wind, nuclear, and hydroelectric power.

More efficient hardware and facilities: Modern public cloud datacenters are designed with efficiency in mind, utilizing advanced cooling systems, optimized server layouts, and smart building technologies.

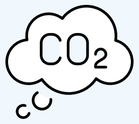
Improved utilization: Public cloud datacenters maximize resource utilization by leveraging virtualization and containerization technologies.

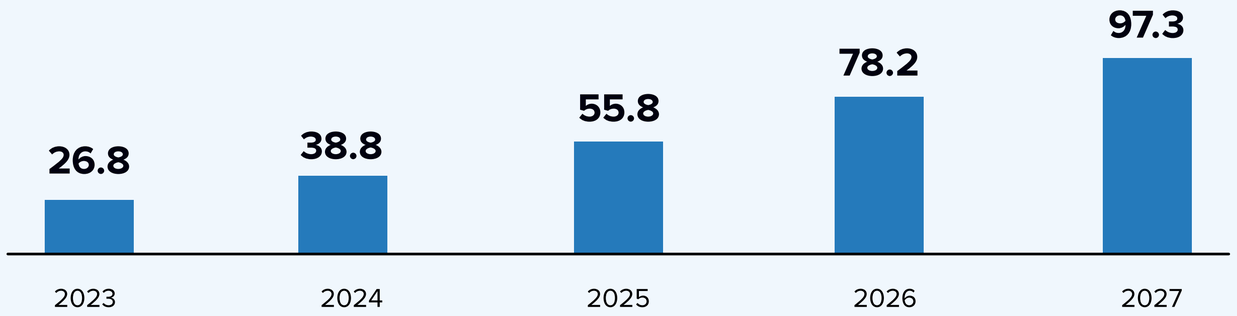
More energy-efficient silicon: Custom-designed silicon for purpose-built custom environments has led to the development of more energy-efficient silicon chips. These chips are designed to deliver higher performance with lower power consumption, significantly reducing the overall energy requirements of public cloud datacenters.

The carbon avoided due to public cloud is expected to continue to increase, amounting to the equivalent of removing 21 million cars from the road* in 2027 alone.

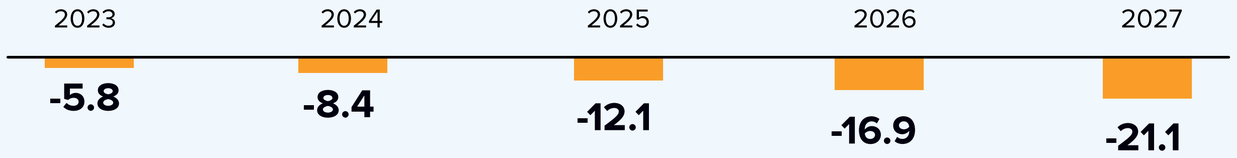
With their investments in carbon-free energy and their drive toward net-zero emissions, public cloud providers are avoiding, and are expected to continue to avoid, carbon emissions.

Annual Carbon Avoided by Public Cloud Providers (in Millions of Metric Tons of CO_2 Equivalent)

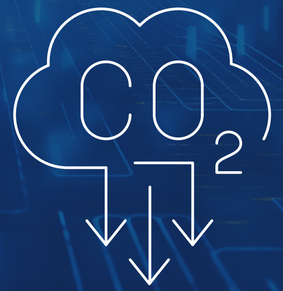




Equivalent Benefit of Cars Being Removed from the Road* (in Millions)



Carbon avoided: The amount of direct carbon dioxide (CO_2) emissions avoided from being released into the atmosphere due to investments in carbon-free energy sources



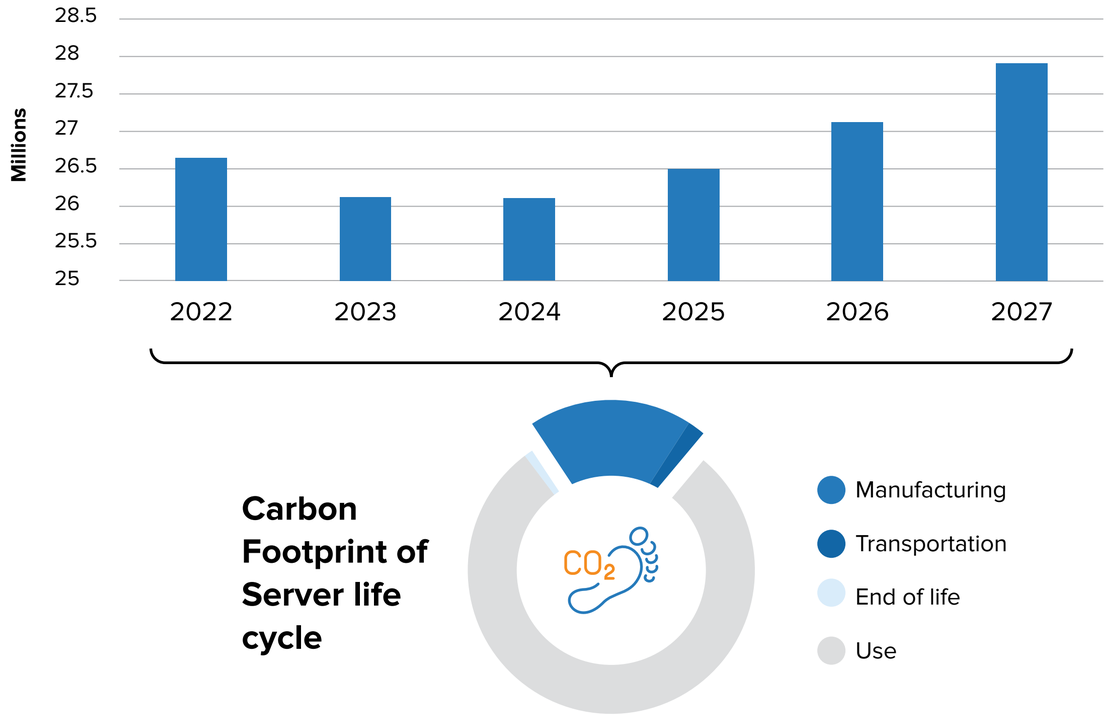
Source: IDC, Datacenter Trends: Sustainable Datacenter Builds and CO_2 Emissions (SIS, IDC_P33186)
*Based on the EPA of annual emissions from a U.S. car being 4,617.217kgCO_2e

IDC expects the use of public cloud datacenters to result in 34–37% less embodied carbon, annually.

Shared cloud infrastructure can result in less server infrastructure being used for the same output and thus can lead to lower embodied carbon emissions.

- IDC defines embodied carbon emissions as greenhouse gases released during the manufacturing and transportation phases of a product life cycle.
- For this research, IDC calculated the potential embodied carbon emissions reduction associated with running servers in public cloud datacenters compared with running them in enterprise datacenters.
- Since server infrastructure in public cloud datacenters is utilized more efficiently, fewer servers are required than in enterprise datacenters to perform the same amount of computing. IDC calculated the embodied carbon emissions that can be saved by public cloud server infrastructure in terms of the amount of carbon emitted during server manufacture and transportation.
- As a result, IDC predicts that the use of public cloud services will reduce the embodied carbon emissions of servers by 34–37% in 2027. The total potential savings are estimated at 28MMTCO_2e in 2027, which is equivalent to removing more than 6 million cars from the road.*

Potential Reduction in Embodied CO_2 Emissions from the Use of Public Cloud Datacenters (in Metric Tons of CO_2 Equivalent)



*Based on the EPA of annual emissions from a U.S. car being 4,617.217kgCO_2e

Why Public Cloud Datacenters Are Carbon Efficient

IDC

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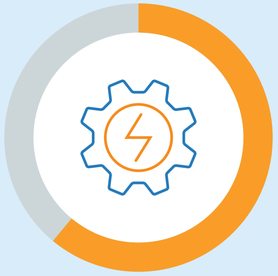
Investing in carbon-free energy sources is central to achieving net-zero emissions.

IDC estimates that public cloud datacenter providers are investing in, and will continue to invest in, carbon-free sources. The percentage of public cloud energy consumption powered by carbon-free energy is expected to increase from 61% in 2023 to 74% in 2027.

2023

Public Cloud Providers:

Percentage of Energy Consumption Powered by Carbon-Free Sources



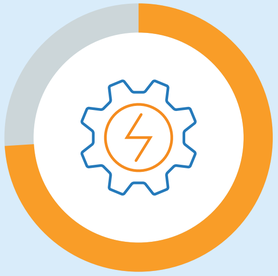
61%

- Investment in carbon-free energy is a large contributor to public cloud datacenters being more carbon efficient than enterprise datacenters. IDC estimates that public cloud providers will be able to increase their coverage of carbon-free energy sources while increasing the amount of energy they use to accommodate ongoing migration to cloud.
- Public cloud providers make investments in datacenters based on several criteria, including carbon-free energy availability. Conversely, enterprise datacenter locations are often determined by corporate HQ and office locations.
- Additionally, due to the scale of their operations, public cloud datacenter providers have invested in the technology and skillsets needed to implement carbon-free energy and have negotiated power purchase agreements (PPAs) to power their datacenters.

2027

Public Cloud Providers:

Percentage of Energy Consumption Powered by Carbon-Free Sources



74%

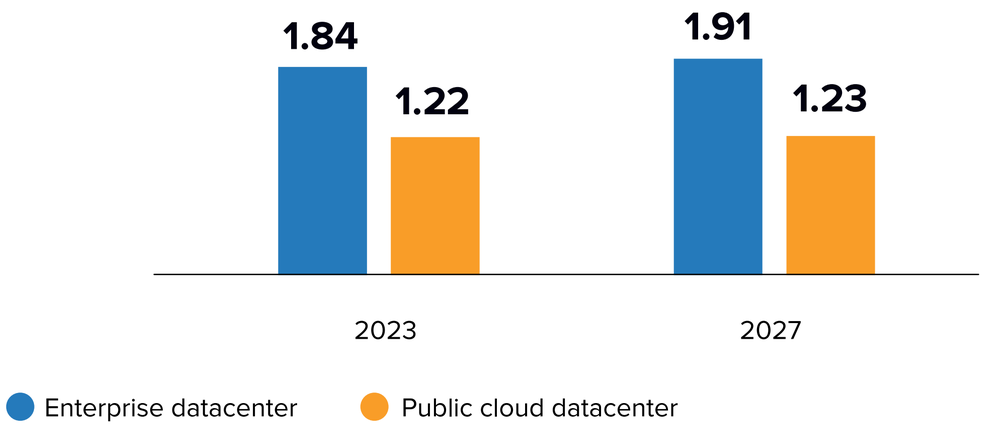
Source: IDC, Datacenter Trends: Sustainable Datacenter Builds and CO_2 Emissions (SIS, IDC_P33186)

Notes: The percentage of carbon-free energy is not guided by vendors but is based exclusively on IDC research, which aligns with the GHG Protocols Scope 2 Guidance on carbon accounting.

Public cloud datacenter facilities were 3.8 times more energy-efficient than enterprise datacenters in 2023.

Power usage effectiveness (PUE) is a metric used to determine the energy efficiency of a datacenter. It is calculated by dividing the total amount of power a datacenter uses by the power that its computing equipment uses. The closer the PUE is to 1.0, the more energy efficient a datacenter is.

PUE by Datacenter Type



Why do public cloud datacenters have lower PUEs (1.22) than enterprise datacenters (1.84) in 2024?

Location and climate control: Public cloud providers strategically locate their datacenters in areas that facilitate natural cooling, such as cooler climates.

Economies of scale: Due to their size, public cloud datacenters benefit from economies of scale in purchases and operating efficiency. Due to the size of public cloud datacenters, public cloud providers can achieve better returns on their efficiency investments and therefore invest more.

Expertise: Public cloud providers often employ specialists in datacenter design and management, who focus on optimizing every aspect of a datacenter's operations for energy efficiency.

Standardization and optimization: Public cloud providers typically standardize their hardware and software, enabling more efficient resource management and optimization.

Note: While the PUE of a datacenter is expected to decrease (and become more energy efficient over time), IDC expects a modest increase in the PUE of datacenter portfolios. PUEs are optimal when a datacenter is at full capacity. During periods of growth, many datacenters will have phases when they are in production but not fully utilized.

Source: IDC, Datacenter Trends: Sustainable Datacenter Builds and CO_2 Emissions (SIS, IDC_P33186)

A shared environment improves environmental sustainability, as more computing is done in an energy-efficient environment, powered by carbon-free sources.

Utilization

What is the average power utilization currently as a percentage of capacity in your datacenters?

47%

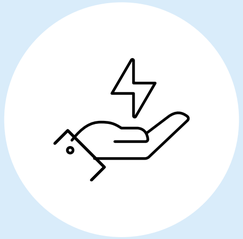
Enterprise datacenter

n = 257

56%

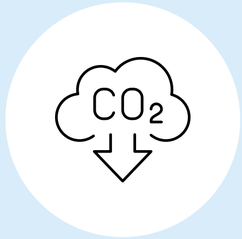
Public cloud datacenter

n = 60



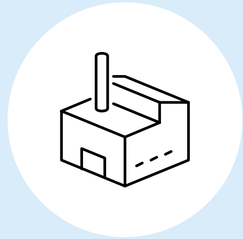
Energy efficiency

Higher utilization means more efficient use of computing resources. This decreases the energy consumption per unit of computing work, reducing the overall energy footprint.



Reduced carbon emissions

Improved energy efficiency can equate to lower carbon emissions. Service provider resources have a lower CUE, which means a higher percentage of computing being powered by carbon-free sources.



Lower resource consumption

Higher utilization means fewer servers are needed overall, which translates into less construction, less cooling, and lower costs.

Public cloud providers often use custom processors, which are more energy efficient.

Public cloud providers invest in more energy-efficient custom processors tailored to specific workloads.

Today, **public cloud providers increasingly collaborate with semiconductor manufacturers** to influence the design and development of more energy-efficient processors specifically tailored for certain workload types — such as AI, machine learning, and high-performance computing — and to optimize their compute infrastructure. Such processors can fulfill the same tasks as general-purpose CPUs but more efficiently, meaning lower energy consumption and CO_2 emissions.

The benefit of custom processors is that they enable public cloud providers to lower their long-term datacenter operating expenses through the customization of processor performance and power utilization to fit certain AI workloads, thus increasing efficiency and reducing energy consumption.

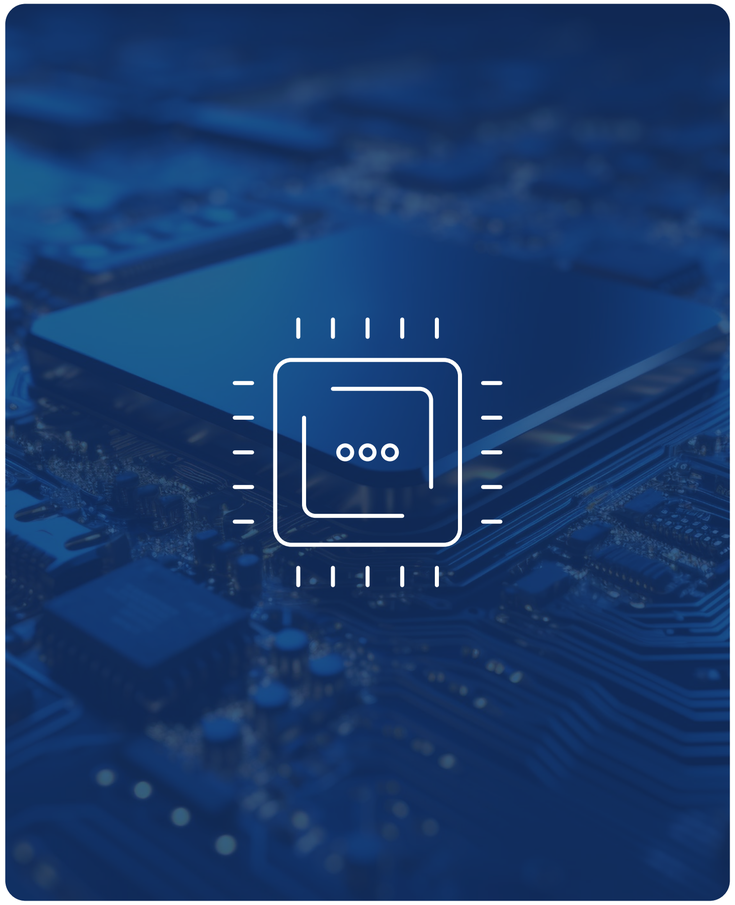
Demand for generative AI is increasingly driving the growth of custom processors. These processors take advantage of the unique qualities of GenAI models to accomplish:

Increased processing speeds

GenAI tasks can be processed substantially faster because of custom processors' greater ability to parallelize computations.

Reduced power consumption and improved cost-effectiveness

Public cloud providers report that custom processors with optimized hardware architecture use less energy than CPUs and GPUs, which also means lower OPEX.



Increased efficiency and cost savings from technological advances can inadvertently lead to higher overall consumption and demand — a phenomenon referred to as the "rebound effect."

Most public cloud datacenter operators provide CloudOps tools to automate and optimize cloud management, covering everything from provisioning resources to monitoring performance and cost, thus ensuring efficiency and control in the cloud journey.

Implement resource optimization strategies to ensure the most efficient use of resources, reducing waste and costs.

Monitor and track cloud usage closely to identify and eliminate unnecessary expenditures and overuse.

Choose appropriate pricing models that align with your usage patterns and budget to optimize spending.

Develop clear policies for cloud resource allocation and utilization to maintain control and prevent resource misuse and sprawl.

What are the most important factors when thinking about moving workloads to a sustainable public cloud? (Top 3 listed)

31%

Cloud-based sustainability reporting and management tools

29%

Analytics for improved facility and asset management

27%

Efficient water management for cooling

Source: IDC's Sustainable IT Infrastructure Survey, 2023, autumn 2023 (N = 1,640)

Recommendations

Recommendations for executive leaders to improve the environmental sustainability of their datacenter portfolios:

#1

Assess your current footprint and set goals.

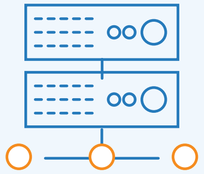
Start by understanding your existing IT infrastructure's energy consumption and carbon emissions. This will establish a baseline for forecasting the benefits and measuring the energy and carbon efficiency of moving to public cloud, helping you gauge potential reductions.

#2

Select the right public cloud provider.

Select a provider that aligns with your values and sustainability goals and offers relevant solutions for your needs. Additionally, look at more than the environmental sustainability of the datacenter portfolio. ESG goes beyond energy consumption and carbon emissions. Choose a public cloud provider with strong social and governance practices that align with your values.

#3



Consider the location of the datacenters.

The overall grid generation mix and whether carbon-free energy is available can affect your environmental impact. Datacenters in cooler climates can reduce energy needs for cooling systems.

#4

Use CloudOps tools and implement best practices.

CloudOps tools and practices optimize server utilization and workloads, right-size resources, and effectively enable demand-based scaling. Additionally, CloudOps tools limit the rebound effect by implementing resource quotas and monitoring tools to prevent scope creep.

Regional View

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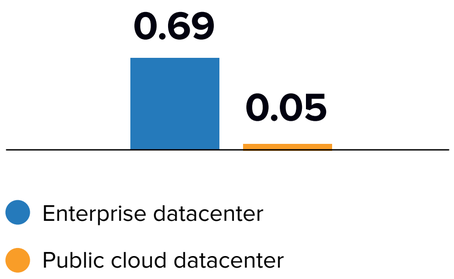
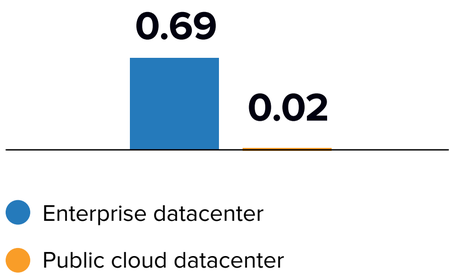
U.S. and Canada

2023: Carbon Usage Effectiveness



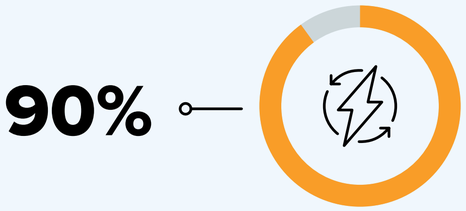
2027: Carbon Usage Effectiveness



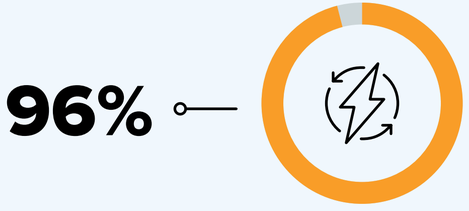
Key Insights

- Energy consumption from enterprise datacenters and public cloud datacenters is projected to grow from 56TWh in 2023 to 155TWh in 2027, representing a CAGR of 29.0%.
- **90%** of all public cloud datacenter energy consumption was powered by carbon-free sources in 2023. This is forecast to grow to **96%** in 2027.
- In 2023, public cloud datacenters were **14.3 times** more carbon efficient than enterprise datacenters.
- In 2023, public cloud datacenter facilities were **3.5 times** more energy efficient than enterprise datacenters.

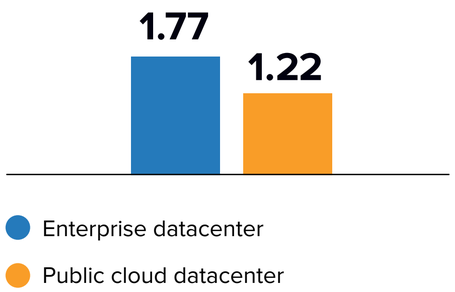
2023: Percentage of Energy Consumption from Carbon-Free Sources of Public Cloud Datacenters



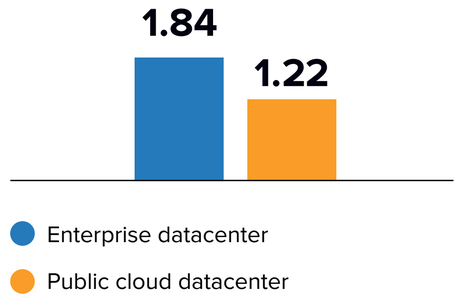
2027: Percentage of Energy Consumption from Carbon-Free Sources of Public Cloud Datacenters



2023: Power Usage Effectiveness



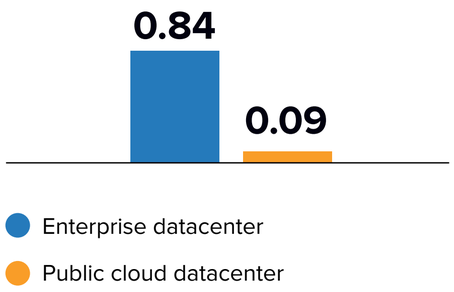
2027: Power Usage Effectiveness



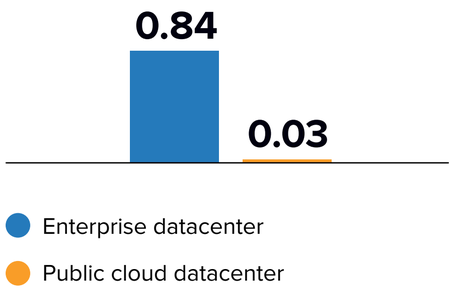
* See the Appendix for a list of the countries included in the regional views.

Latin America*

2023: Carbon Usage Effectiveness



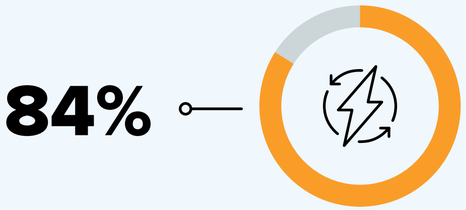
2027: Carbon Usage Effectiveness



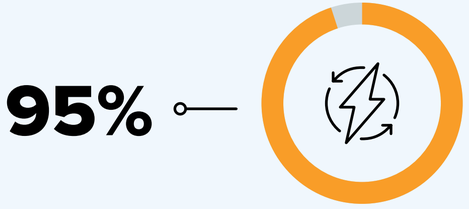
Key Insights

- Energy consumption from enterprise datacenters and public cloud datacenters is projected to grow from 2.2TWh in 2023 to 4.6TWh in 2027, representing a CAGR of 19.3%.
- **84%** of all public cloud datacenter energy consumption was powered by carbon-free sources in 2023. This is forecast to grow to **95%** in 2027.
- In 2023, public cloud datacenters were **9.5 times** more carbon efficient than enterprise datacenters.
- In 2023, public cloud datacenter facilities were **3.7 times** more energy efficient than enterprise datacenters.

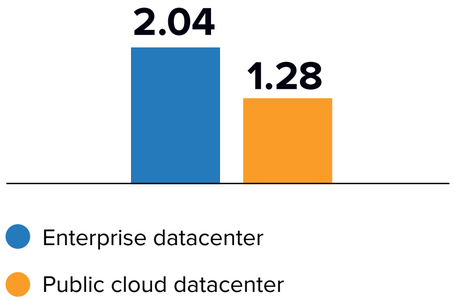
2023: Percentage of Energy Consumption from Carbon-Free Sources of Public Cloud Datacenters



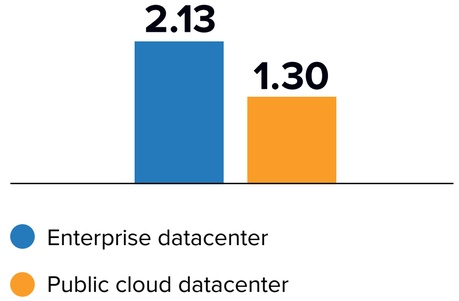
2027: Percentage of Energy Consumption from Carbon-Free Sources of Public Cloud Datacenters



2023: Power Usage Effectiveness



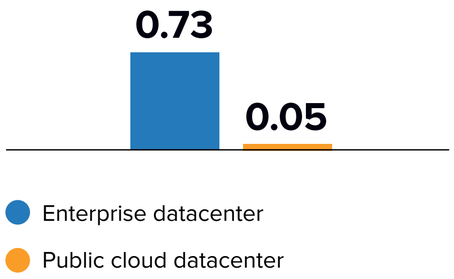
2027: Power Usage Effectiveness



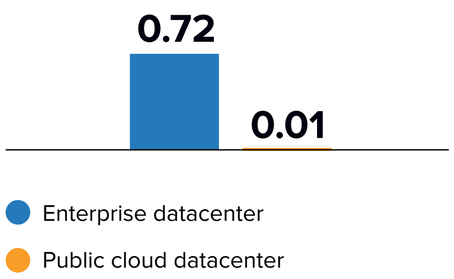
* See the Appendix for a list of the countries included in the regional views.

EMEA*

2023: Carbon Usage Effectiveness



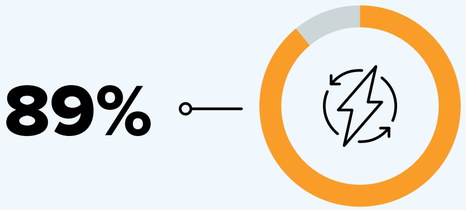
2027: Carbon Usage Effectiveness



Key Insights

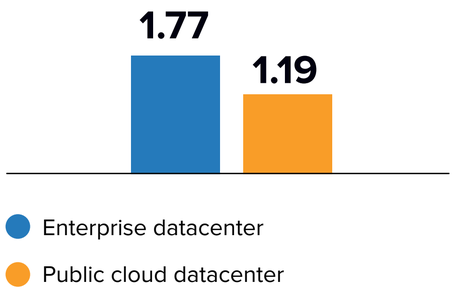
- Energy consumption from enterprise datacenters and public cloud datacenters is projected to grow from 14TWh in 2023 to 27TWh in 2027, representing a CAGR of 16.4%.
- **89%** of all public cloud datacenter energy consumption was powered by carbon-free sources in 2023. This is forecast to grow to **97%** in 2027.
- In 2023, public cloud datacenters were **14.6 times** more carbon efficient than enterprise datacenters.
- In 2023, public cloud datacenter facilities were **4.1 times** more energy efficient than enterprise datacenters.

2023: Percentage of Energy Consumption from Carbon-Free Sources of Public Cloud Datacenters

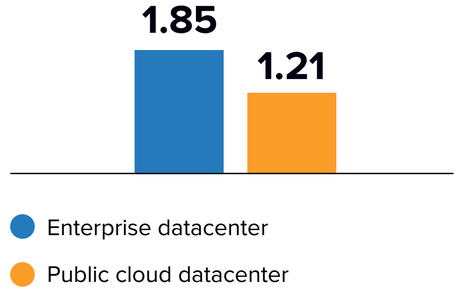


2027: Percentage of Energy Consumption from Carbon-Free Sources of Public Cloud Datacenters

2023: Power Usage Effectiveness



2027: Power Usage Effectiveness



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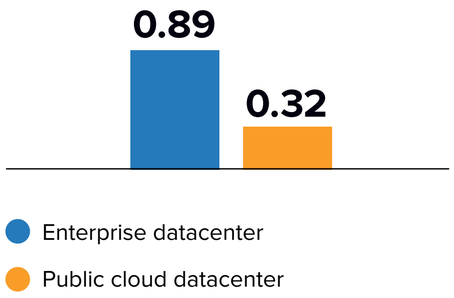
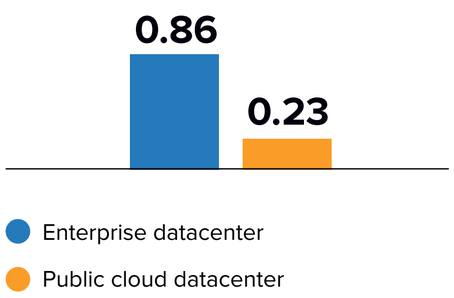
Asia Pacific*

2023: Carbon Usage Effectiveness



2027: Carbon Usage Effectiveness

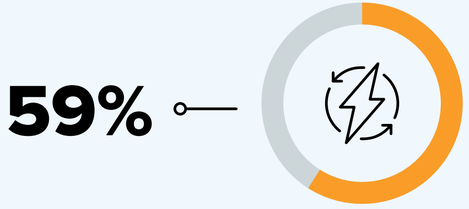


Key Insights

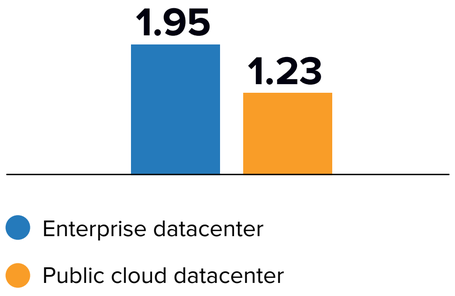
- Energy consumption from enterprise datacenters and public cloud datacenters is projected to grow from 50TWh in 2023 to 128TWh in 2027, representing a CAGR of 26.4%.
- **42%** of all public cloud datacenter energy consumption was powered by carbon-free sources in 2023. This is forecast to grow to **59%** in 2027.
- In 2023, public cloud datacenters were **2.7 times** more carbon efficient than enterprise datacenters.
- In 2023, public cloud datacenter facilities were **4.2 times** more energy efficient than enterprise datacenters.

2023: Percentage of Energy Consumption from Carbon-Free Sources of Public Cloud Datacenters

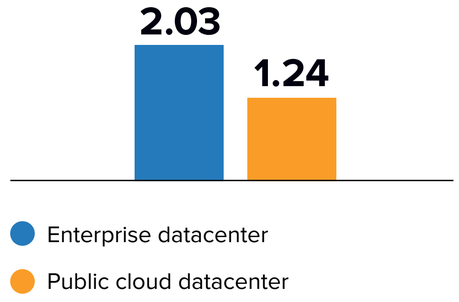
2027: Percentage of Energy Consumption from Carbon-Free Sources of Public Cloud Datacenters



2023: Power Usage Effectiveness



2027: Power Usage Effectiveness



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Message from the sponsor

About Amazon Web Services

Since 2006, Amazon Web Services has been the world's most comprehensive and broadly adopted cloud. AWS has been continually expanding its services to support virtually any workload, and it now has more than 240 fully featured services for compute, storage, databases, networking, analytics, machine learning and artificial intelligence (AI), Internet of Things (IoT), mobile, security, hybrid, media, and application development, deployment, and management from 105 Availability Zones within 33 geographic regions, with announced plans for 18 more Availability Zones and six more AWS Regions — in Malaysia, Mexico, New Zealand, the Kingdom of Saudi Arabia, Thailand, and the AWS European Sovereign Cloud. Millions of customers — including the fastest-growing start-ups, largest enterprises, and leading government agencies — trust AWS to power their infrastructure, provide more agility, and lower costs. To learn more about AWS, visit aws.amazon.com.

Commitment to Sustainability

Amazon is committed to becoming a more sustainable business and reaching net-zero carbon emissions across its operations by 2040, 10 years ahead of the Paris Agreement, as part of The Climate Pledge. Amazon cofounded The Climate Pledge and became its first signatory in 2019. As part of its Climate Pledge commitment, Amazon is on a path to power its operations with 100% renewable energy by 2025, five years ahead of the original 2030 target. Amazon has been named the largest corporate purchaser of renewable energy for the last four years in a row — a position it has held since 2020, according to Bloomberg New Energy Finance. Amazon now has more than 500 renewable energy projects in 27 countries. Additionally, AWS will be water positive by 2030, returning more water to communities than it uses in its direct operations.

Learn more

aws

Appendix

InfoBrief, sponsored by AWS
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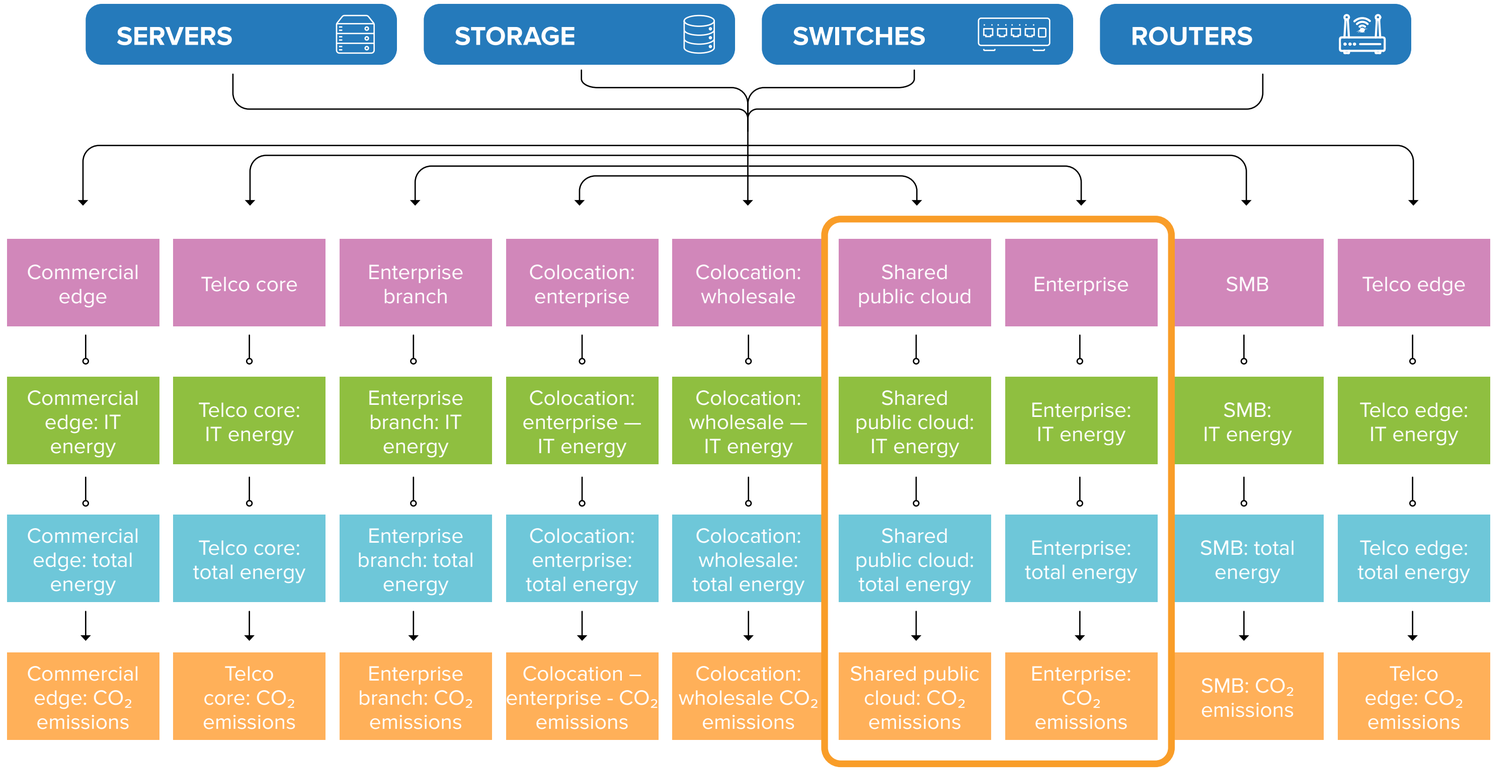
IDC Methodology

Despite all the talk about datacenter sustainability, surprisingly little credible quantitative information is available. IDC therefore developed its Datacenter Trends: Datacenter Builds and Carbon Emissions model to help customers and vendors understand market growth and make informed sustainability decisions.

1. IDC has relationships with all OEM and ODM infrastructure management vendors, enabling IDC to quantify all infrastructure shipped and to calculate the installed base of all infrastructure.
2. Using survey and shipment data, IDC approximates — by datacenter type — power draw and utilization and how infrastructure is deployed.
3. Using survey data and interviews, IDC uses PUE information to calculate datacenter energy facilities' energy consumption.
4. IDC estimates the carbon-free energy used by datacenters based on publicly available data and claims and uses the formula: total energy used − the percentage powered by carbon-free sources × the emissions factor.

IDC Datacenter Energy and CO_2 Methodology



Based on IDC Tracker data, an estimate of the number of devices in use by datacenter type

Approximate power draw and utilization by device and by type

Based on industry and survey data, an estimate of PUE by type for total energy

Total energy, minus the percentage powered by carbon-free sources, times the emissions factor

IDC Methodology

IDC's base analysis does not factor in Life Cycle Assessment (LCA), which provides in-depth analysis of up- and down-stream activities throughout the entire life cycle of a product. IDC estimates carbon emissions during the use phase of a product's life cycle; it also estimates embodied carbon emissions as greenhouse gases released during the manufacturing and transportation phases of a product life cycle.

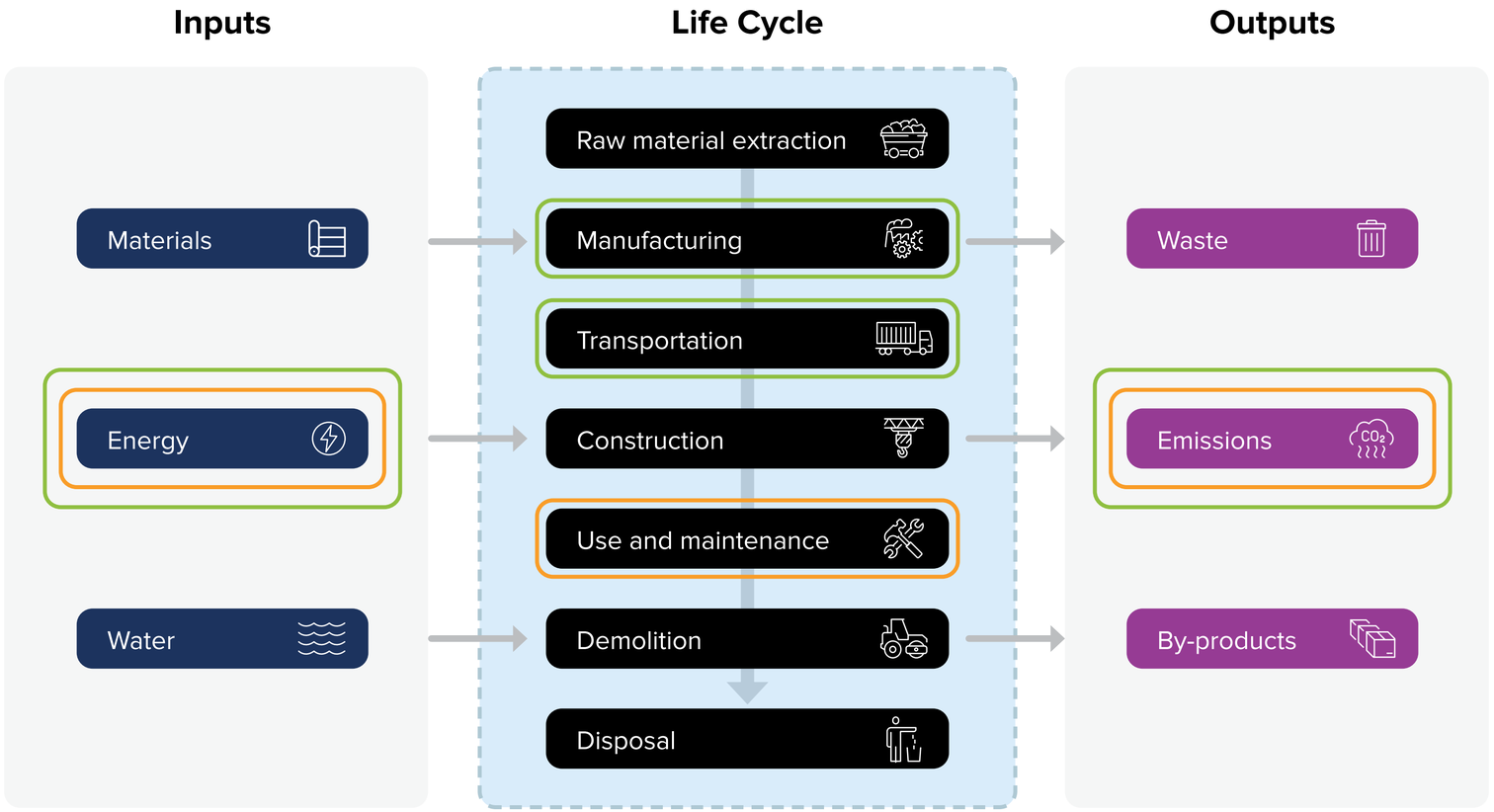
See the below LCA illustration for details.

Direct emissions:

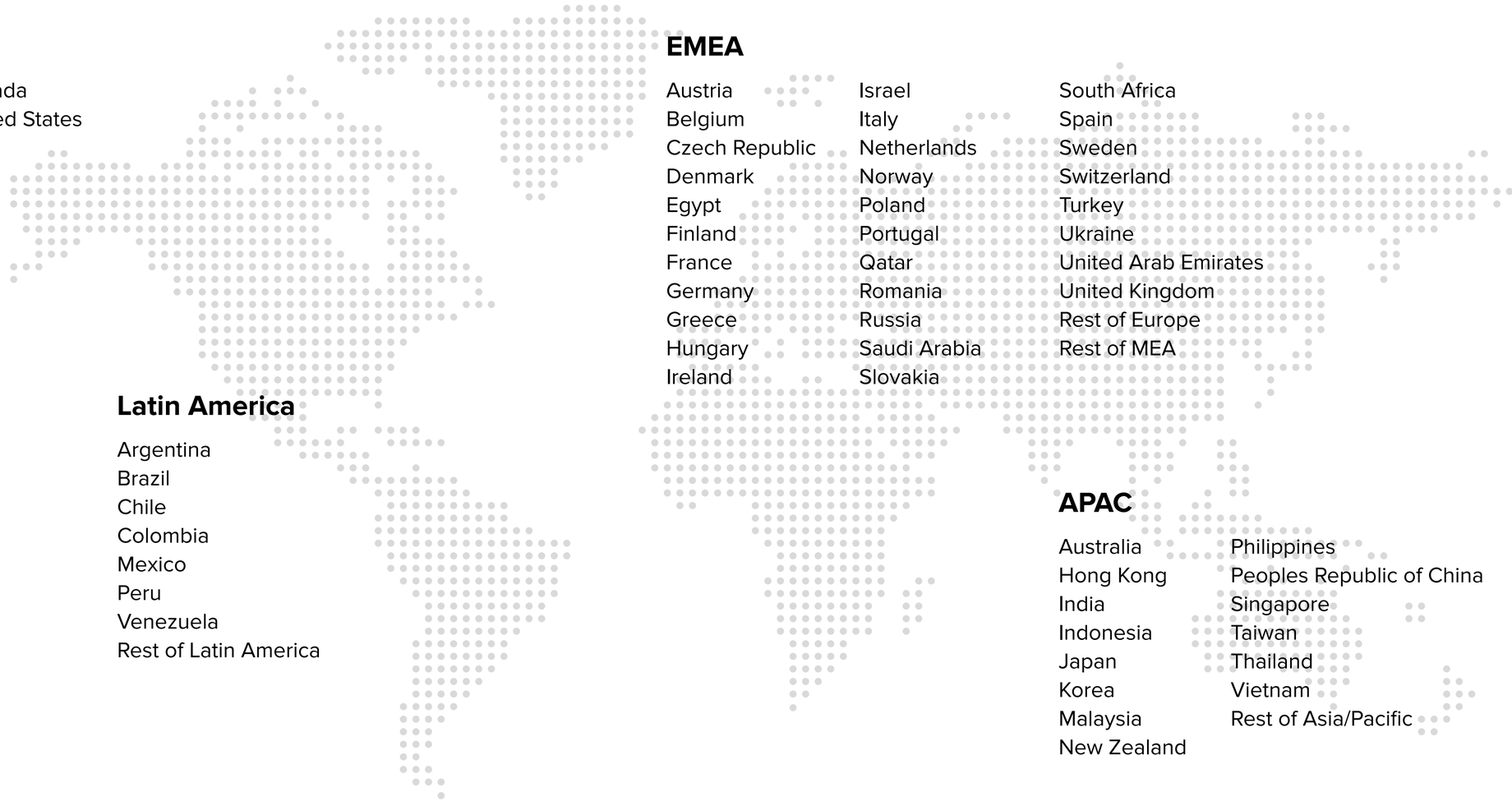
Inputs — energy
Life cycle — use and maintenance
Outputs — emissions

Embodied emissions:

Inputs — energy
Life cycle — manufacture and transportation
Outputs — emissions



Countries included in the Regional Views



Canada
United States

Latin America

Argentina
Brazil
Chile
Colombia
Mexico
Peru
Venezuela
Rest of Latin America

EMEA

Austria
Belgium
Czech Republic
Denmark
Egypt
Finland
France
Germany
Greece
Hungary
Ireland
Israel
Italy
Netherlands
Norway
Poland
Portugal
Qatar
Romania
Russia
Saudi Arabia
Slovakia
South Africa
Spain
Sweden
Switzerland
Turkey
Ukraine
United Arab Emirates
United Kingdom
Rest of Europe
Rest of MEA

APAC

Australia
Hong Kong
India
Indonesia
Japan
Korea
Malaysia
New Zealand
Philippines
Peoples Republic of China
Singapore
Taiwan
Thailand
Vietnam
Rest of Asia/Pacific

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