OxygenIT

WHITEPAPER

THE JOURNEY TO IT GREENOPS

And Why You Should Take It Now!

A whitepaper for IT leaders ready to align digital infrastructure with environmental responsibility — using accurate, actionable data.

CTOS | CIOS | Product owners | CCoE | ESG Leaders | DevOps Engineers | Cloud Architects

Published by: OxygenIT
www.oxygenit.io

Table of contents

Executive Summary

As sustainability becomes a boardroom priority, IT teams find themselves at a critical crossroads. Cloud infrastructure and digital services — once seen purely as cost centers or innovation enablers — are now in the spotlight for their growing carbon footprint. Regulations like the EU's Corporate Sustainability Reporting Directive (CSRD), the SEC's climate disclosure rules, and rising stakeholder expectations are all pushing companies to measure, reduce, predict and report their IT emissions with precision.

This has created a fundamental new operational challenge: how do you optimize infrastructure not just for performance and cost, but for carbon? GreenOps — the practice of aligning IT operations with environmental sustainability — is the answer. But for most teams, the journey toward GreenOps has barely begun. The majority are still "flying blind," with no granular emissions data, no integration between ESG and engineering teams, and no framework to guide action.

This whitepaper maps out the five-stage journey to IT GreenOps, highlighting:

- Why traditional carbon reporting isn't enough
- Where most teams stall (and why)
- How to build carbon awareness into technical decisions
- What kind of data and tooling unlocks real optimization

And most importantly, how platforms like OxygenIT provide the granularity and integration needed to turn GreenOps from vision to practice.

Introduction: The Urgency of GreenOps

The digital world runs on physical infrastructure — data centers, cloud regions, network fabric, storage farms. While most of this infrastructure is abstracted away from users and even from developers, its environmental impact is anything but virtual.

According to the International Energy Agency, data centers now account for roughly 1.5–2% of global electricity demand, and this is expected to at least double before 2030. The massive impact of AI has yet to be determined. Cloud adoption continues to surge, with worldwide spending on public cloud services forecasted to reach $1 trillion USD by 2026 (Gartner). But this growth comes with growing emissions, especially for companies relying on compute-heavy workloads, the introduction of AI, high-availability architectures, or multi-region deployments.

For IT leaders, this means that digital decisions are now environmental decisions. Where you run workloads, how you configure services, and what tools you use — these choices affect both your carbon footprint and your company's ability to meet regulatory and investor expectations. Unfortunately, most organizations lack:

- A clear understanding of their IT emissions
- Granular data on what contributes most
- A practical way to act on this insight

The result? Many teams are optimizing cloud usage for cost, but are completely unaware of their carbon impact. This disconnect risks compliance failures, stakeholder backlash, leadership responsibility consequences, and missed opportunities for efficiency.

Enter GreenOps.

GreenOps is the practice of embedding environmental sustainability into IT operations, especially in how cloud, infrastructure, and digital services are built, deployed, and optimized. It draws inspiration from the principles of DevOps and FinOps but centers on reducing the carbon footprint of IT systems without compromising performance, cost, or agility.

At its core, GreenOps is about making emissions a first-class metric, on par with latency, availability, and cost.

Introduction: The Urgency of GreenOps

Instead of retrofitting sustainability into reporting dashboards, GreenOps brings carbon-awareness into the decision-making process itself—where engineers select instance types, schedule workloads, and design architectures.

This means asking new questions, such as:

- What is the carbon intensity of this region or cloud provider?
- How much embodied carbon is associated with this instance or hardware upgrade?
- Can we delay this workload to a time of day when greener energy is available?
- Are we keeping zombie infrastructure alive with no business value?
- What infrastructure downsizing can I carry out to reduce our carbon footprint, and how many kg of CO2 did I save?
- Do my eco-design actions have a real impact on our carbon footprint?
- Can I emit the same amount of carbon and, at the same time, free up infrastructure for innovation that I already have?
- What applications emit the most carbon? Can they be optimized?
- Are there any old applications emitting carbon that we don't use anymore?

GreenOps is not about slowing down delivery or increasing technical debt—it's about enabling teams to make smarter, data-informed trade-offs between emissions, performance, and budget.

Chapter 1: Why IT Needs GreenOps Now

From compliance pressure to operational clarity — the case for immediate action

1.1 The Pressure Is Mounting

The carbon footprint of IT systems is no longer an abstract or future-facing concern—it's a measurable, reportable, and financially material factor for modern enterprises. As infrastructure grows more complex and energy-intensive, particularly with the rise of cloud computing and AI workloads, IT leaders face intensifying pressure to understand and reduce their environmental impact.

Key Forces Driving Change:

Regulatory Compliance Is Becoming Unavoidable

Governments and regulatory bodies are tightening the scope and specificity of emissions reporting. What was once a voluntary ESG effort is now a legal requirement in many regions:

- EU Corporate Sustainability Reporting Directive (CSRD): Mandates disclosure of Scope 1, 2, and 3 emissions for large companies, including IT-related emissions from data centers, cloud infrastructure, and software supply chains.
- U.S. SEC Climate Disclosure Rule (2024): Requires publicly listed companies to report material climate-related risks and emissions, including indirect emissions from digital operations and outsourced IT.
- IFRS S2 & Global Baseline Reporting: The International Sustainability Standards Board (ISSB) released global sustainability disclosure standards that incorporate IT operations under Scope 3.

Financial Markets Are Prioritizing Climate Risk

Investors increasingly view unmanaged carbon emissions as a proxy for operational inefficiency and long-term business risk. This has real implications for access to capital and valuation:

- As of 2021, ESG-focused investment products accounted for over $35 trillion, representing 36% of professionally managed assets globally.(1)
- Ratings agencies and institutional investors now routinely factor climate transparency and IT sustainability into risk assessments and ESG scoring.

Public Scrutiny and Reputational Risk Are Growing

Cloud infrastructure has moved from a backend function to a front-page issue. Public awareness of the environmental impact of digital services is growing—particularly around energy-intensive technologies such as AI, blockchain, and high-performance computing:

- A single AI model can emit as much CO_2 as five cars over their lifetimes if trained without carbon-aware practices.

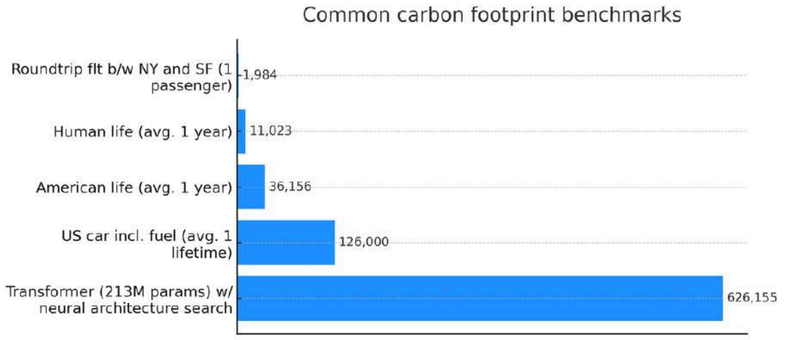


Chart: MIT Technology Review

- Environmental groups and civil society are pressuring cloud providers to disclose and cut their carbon intensity.

(1) Global Sustainable Investment Alliance (GSIA) 2021 Trends Report

Chapter 1: Why IT Needs GreenOps Now

From compliance pressure to operational clarity — the case for immediate action

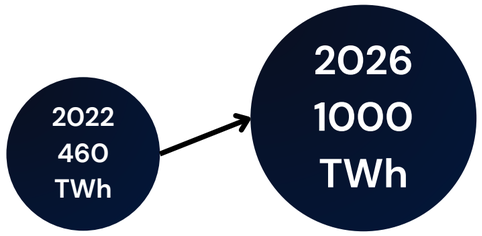
1.2 IT's Carbon Impact: Key Stats

The environmental footprint of IT infrastructure has scaled rapidly—and yet, most organizations still lack the visibility or tooling to manage it effectively. Below are some of the most critical and up-to-date data points highlighting the urgency of applying GreenOps practices.

Data Centers and Energy Use

Data centers consumed approximately 460 TWh of electricity in 2022, equivalent to ~2% of global electricity demand. This is expected to more than double to 1,000 TWh by 2026, driven largely by the rise in cloud and AI workloads.

Trends in global power consumption for data centers, AI and cryptocurrencies



Source: IEA – Data Centres and Data Transmission Networks (2024)

This growth in energy use is concentrated in hyperscale and colocation facilities, many of which are still powered by grids with high carbon intensity, particularly in North America and parts of Asia.

Cloud Computing's Emissions Footprint

Cloud computing is responsible for 50% to 70% of an enterprise IT department's emissions (1), depending on workload distribution and infrastructure mix. The majority of these falls under Scope 3, which is the hardest to track and report.

Despite promises of efficiency, many organizations overprovision resources or fail to decommission idle infrastructure, compounding emissions unnecessarily. Idle and non-production VMs represent about 44% of cloud spend, suggesting a similar magnitude of emissions waste. In 2022 alone, idle and oversized resources amounted to $43.3 billion in wasted IaaS spend. (2)

AI and High-Performance Computing

Training a single generative AI model such as GPT-3 can emit over 550 metric tons of CO_2e, primarily due to the compute-intensive nature of transformer models and non-optimized training environments.(3)

With millions of daily inference requests, the lifecycle emissions of AI applications now rival those of traditional industrial workloads, especially if deployed across carbon-intensive data centers.

Lack of Visibility Is the Norm

According to Capgemini's Sustainable IT Report (2021), only 17% of organizations currently have visibility into IT-specific carbon emissions, and even fewer have the granularity needed to inform architectural or operational decisions. This blind spot makes compliance with Scope 3 regulations and internal ESG targets significantly harder, and it prevents teams from taking meaningful action on optimizations.

Optimization Opportunity

According to an Accenture report, cloud carbon optimization alone could reduce enterprise emissions by

(1) McKinsey – Cloud's Trillion-Dollar Prize (2021)
(2) CAST.AI blog, "Cloud Waste: How to Stop Overprovisioning Resources in 2023"
(3) MIT Technology Review – The Hidden Cost of AI (2022)

Chapter 1: Why IT Needs GreenOps Now

From compliance pressure to operational clarity — the case for immediate action

5.9% on average across all industries. Yet most organizations don't integrate emissions data into their DevOps or cloud orchestration pipelines, leaving significant savings on the table.

1.3 Why Traditional Reporting Falls Short for IT Emissions

Most organizations still rely on basic, high-level tools or manual methods to measure IT-related carbon emissions. These include:

- Cloud provider dashboards (e.g., AWS, Azure, GCP)
- Lifecycle analysis tools based on average assumptions
- Manual carbon accounting via Excel or static reports

While helpful for compliance or board-level summaries, these approaches fail to support operational decision-making, especially in fast-moving environments like DevOps or FinOps.

Key Limitations:

Lack of granularity: Most tools aggregate data across services or accounts, offering little insight into emissions.

Delayed and backward-looking: Data is often updated quarterly or monthly, making it unusable for real-time optimization or daily operations.

Disconnected from engineering workflows: Traditional reports don't integrate into CI/CD pipelines or infrastructure-as-code setups, leaving developers blind to the carbon impact of their choices.

Real-World Example Limitations:

AWS Customer Carbon Footprint Tool: Provides emissions estimates only at the account level with quarterly updates, lacking per-service, per-region insights.

Microsoft Azure Emissions Impact Dashboard: Offers static Excel exports, aggregates numerous services into broad categories, and is not designed for real-time or engineering use.

Without detailed, continuous, and actionable data, teams cannot embed carbon awareness into daily IT operations — let alone optimize for it.

1.4 Flying Blind: The Visibility Gap in IT Carbon Accounting

Despite growing pressure to reduce emissions, most IT teams operate without the data needed to take meaningful action. There's a critical disconnect between teams' current visibility and what's actually required to align with sustainability goals.

Team	What They Know Today	What They Actually Need
ESG	Annual or quarterly vendor estimates	Auditable, real-time, granular data across cloud, datacenter, and edge infrastructure
FinOps	Cloud costs by account or project	Integrated view of cost and carbon to enable joint optimization
DevOps	Uptime, latency, reliability metrics	Real-time carbon signals to inform infrastructure and deployment trade-offs

Chapter 1: Why IT Needs GreenOps Now

From compliance pressure to operational clarity — the case for immediate action

Common Misconception
"Optimizing for cost also optimizes for emissions."

■ In reality, cost efficiency and carbon efficiency often diverge.

Illustrative Examples:

A cheaper cloud region might rely on a carbon-intensive energy grid (e.g., coal-heavy zones in the U.S. Midwest or certain APAC locations), leading to higher emissions per compute hour.

Cold storage tiers, while cost-effective, may operate on older, less energy-efficient infrastructure compared to live storage in green data centers.

Overprovisioned VMs or GPU-heavy inference setups can improve performance but dramatically increase power consumption and carbon footprint, especially if auto-scaling isn't tuned with emissions data.

Without granular, real-time carbon insights, teams are flying blind — assuming that cost, performance, and sustainability align by default, when in fact they often conflict.

1.5 The Window for Leadership Is Now

Organizations that adopt GreenOps practices early are doing more than cutting emissions — they're establishing themselves as:

- Technologically forward-thinking: Embedding sustainability into architecture, workflows, and tools.
- Financially strategic: Aligning carbon optimization with cost efficiency and operational resilience.
- ESG-aligned and compliant: Ready to meet rising disclosure mandates with auditable, high-resolution data.

These early movers gain a competitive edge by:

- Meeting emerging reporting standards (e.g., CSRD, SEC climate rules) without scrambling.
- Attracting sustainability-conscious clients, partners, and employees.
- Building resilient operations less exposed to energy volatility, carbon pricing, and reputational risks.

By contrast, organizations that delay action risk:

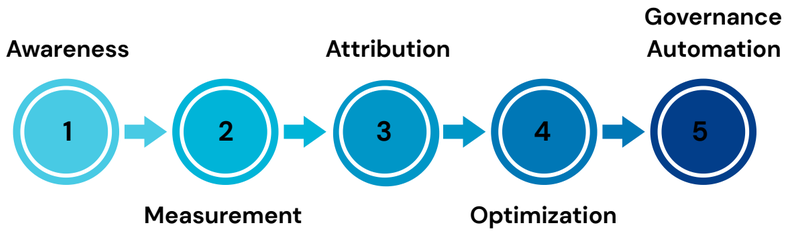
- Having to retrofit systems under regulatory or investor scrutiny, often without sufficient data.
- Facing higher audit and compliance costs due to incomplete visibility.
- Falling behind competitors that treat GreenOps not as an obligation, but as a strategic differentiator.
- Leaders are starting to lose credibility when they play ostrich on their CO2 emissions

Chapter 2: Understanding the GreenOps Concept and Maturity Journey

A step-by-step progression from awareness to action and governance

To effectively reduce IT carbon emissions, organizations must treat GreenOps as a capability, not a one-off project or dashboard. This requires cross-team alignment, reliable data, and a mindset shift — from reactive reporting to proactive operations.
Based on research, industry interviews, and field observations, most teams follow a 5-stage maturity model as they operationalize sustainability in IT.

GreenOps Maturity Model



Stage 1 — Awareness

"We know emissions exist, but we don't know where they are or how to act."

At the earliest stage of the GreenOps journey, organizations begin to acknowledge that IT systems contribute meaningfully to their overall carbon footprint — yet they lack the tools, visibility, and strategy to take informed action. ESG and sustainability teams often request IT-related emissions data for the first time, prompting initial internal investigations. The prevailing assumption at this stage is that hyperscale cloud providers are inherently "green enough," leading many teams to rely on vendor dashboards or lifecycle model estimates without further scrutiny.

However, the data available at this stage is typically high-level, incomplete, and not independently verified or auditable. Reports are often generated manually, consolidated annually, and fail to reflect the dynamic nature of modern IT infrastructure. The resulting emissions estimates are insufficient for compliance with upcoming regulatory standards or for informing any meaningful operational decisions.

This phase is also marked by critical structural challenges: a lack of alignment between IT and sustainability goals, a widespread belief that "optimization" simply means automating workloads, and a tendency to treat emissions analysis as a one-time reporting task rather than an ongoing operational process. Without reliable, granular data or dedicated GreenOps tooling, most teams remain stalled in a state of low visibility — aware of the problem, but unable to act.

Stage 2 — Measurement

"We can estimate emissions — but they're broad, slow, and not trusted."

In this phase, organizations transition from general awareness to an initial attempt at quantifying IT-related emissions. Most begin by using built-in sustainability dashboards from cloud providers — such as AWS's Customer Carbon Footprint Tool (CCF) or Azure's Emissions Impact Dashboard (EID). These tools offer rough emissions estimates, typically delivered in quarterly or annual reports and exported as static files or PDFs. While helpful for high-level ESG disclosures, these reports often lack the granularity required to drive change within

Chapter 2: Understanding the GreenOps Concept and Maturity Journey

A step-by-step progression from awareness to action and governance

engineering or operations teams.

At this stage, Scope 3 emissions, which include the indirect impacts from cloud usage and digital infrastructure, start appearing in ESG disclosures. However, they are usually based on vendor-provided data and remain broad, delayed, and untrusted by technical stakeholders. There is little to no integration of these metrics into CI/CD pipelines, infrastructure-as-code (IaC) workflows, or performance dashboards — limiting their usefulness beyond compliance reporting.

A key challenge lies in the architecture of the carbon data itself. Many organizations lack a modern data foundation for emissions — one that reflects the complexity of modern cloud environments. This is where Medallion data architecture becomes relevant. Commonly used in advanced data platforms, a Medallion architecture divides data processing into three structured layers:

- Bronze (raw data)
- Silver (cleaned and enriched)
- Gold (aggregated, business-ready insights)

Applying this paradigm to carbon intelligence allows teams to ingest raw telemetry (e.g., resource usage, instance types, regions), enrich it with emissions factors and energy mix metadata, and then aggregate it into trustworthy, actionable carbon metrics — by service, region, project, or team.

Unfortunately, most enterprises in Stage 2 do not yet operate on a structured carbon data lakehouse or Medallion-like pipeline, and as a result:

- Carbon insights are disconnected from workloads — teams can't tie emissions to specific compute jobs, storage types, or deployments.
- Accuracy is limited — vendor dashboards often omit key IaaS/PaaS layers or default to generic emissions factors.
- Engineering teams lack operational visibility, making it impossible to adjust architecture decisions based on carbon impact.

To progress, organizations must go beyond static dashboards and move toward granular, real-time emissions observability — supported by robust data infrastructure and independent measurement tooling.

Reality check:

According to IDC, 72% of IT leaders want to reduce their carbon footprint, but only 14% have the measurement capabilities to support decision-making.
Source: IDC – IT Sustainability Survey (2023)

Stage 3 — Attribution

"We know which systems, regions, teams, or apps drive emissions."

By Stage 3, organizations have moved beyond surface-level reporting and into a phase where emissions data is granular, attributed, and operationalized. Instead of relying on high-level cloud provider estimates, teams now access carbon metrics broken down by region, service, instance type, container, or even individual application. This level of

Chapter 2: Understanding the GreenOps Concept and Maturity Journey

A step-by-step progression from awareness to action and governance

detail makes it possible to correlate emissions with specific business units, client environments, and workload types — a foundational capability for any meaningful GreenOps practice.

At this stage, carbon impact becomes a measurable variable, integrated alongside traditional metrics like cost, performance, and latency. Infrastructure and operations teams can assess trade-offs between sustainability and engineering priorities. For example, decisions around workload placement can now account for the carbon intensity of different cloud regions or the efficiency of instance families, not just financial cost or uptime guarantees.

This attribution capability empowers a range of stakeholders:

- DevOps teams can deploy carbon-aware infrastructure and make emissions a visible part of CI/CD pipelines and deployment decisions.
- FinOps leaders gain a dual-lens into optimization: cost per service and grams of CO_2e per compute hour.
- ESG teams receive richer, auditable insights aligned with regulatory expectations and sustainability goals.
- Product owners can know how much carbon is emitted by their product, predict carbon impacts for future products, identify precisely where progress is needed and they can attribute carbon to department stakeholders.

In essence, Attribution unlocks cross-functional collaboration: engineering can design carbon-efficient infrastructure, finance can align sustainability with cost, and ESG teams gain transparent, auditable data. It also enables benchmarking across teams, geographies, or applications, allowing leaders to identify carbon hotspots and track progress over time.

Did you know?

Cloud computing across different regions can vary 10x in carbon intensity depending on the local grid energy mix. For example:

- GCP Belgium (europe-west1): ~50g CO_2e/kWh
- GCP Iowa (us-central1): ~450g CO_2e/kWh

Source: ElectricityMap, GCP Carbon Data (2024)

With this foundation, organizations are ready to move into the next phase: integrating carbon KPIs into day-to-day operations as a driver of decision-making and innovation.

Stage 4 — Optimization

"We use carbon-aware practices to drive architectural and operational choices."

In Stage 4, organizations begin to operationalize emissions data by actively optimizing infrastructure and architecture based on carbon impact, not just cost or performance. With granular attribution in place, engineering teams gain the confidence to make carbon-aware decisions across environments — from rethinking instance types to redesigning system architectures.

Workloads are intelligently shifted to cleaner cloud regions, run on more efficient hardware, or scheduled during periods of lower grid carbon intensity. Idle compute is minimized, overprovisioning is addressed, and serverless or containerized models are adopted to scale infrastructure with precision.

Chapter 2: Understanding the GreenOps Concept and Maturity Journey

A step-by-step progression from awareness to action and governance

Common GreenOps levers at this stage include:

- Geographic optimization — migrating services to cloud regions powered by low-carbon grids
- Vertical right-sizing — selecting smaller, more efficient instance families
- Temporal shifting — scheduling jobs (e.g., training, batch compute, stopping VMs in off-hours) to align with renewable energy availability
- Architectural refactoring — breaking down monoliths into modular, carbon-efficient microservices, remove unnecessary auto-updating and carry out eco-design initatives.
- Predict and optimize future infrastructure carbon impacts before purchasing, ie cloud cost avoidance

At this stage, carbon efficiency becomes a design and operational standard — embedded in engineering sprints, cost reviews, and deployment pipelines. It's not just about visibility anymore; it's about using emissions data to build better systems by design.

Real Impact: Shifting from Frankfurt to Sweden (same provider) can cut emissions by 80% — without changing code (Cloud Carbon Footprint community benchmarks 2023)

Stage 5 — Governance & Automation

"Sustainability is built into how we operate and scale IT."

In the final stage of the GreenOps journey, sustainability becomes an integrated part of how IT teams plan, operate, and scale systems. Carbon budgets are embedded into infrastructure decisions, and sustainability is treated as a first-class metric alongside cost, latency, and availability. FinOps, DevOps, and ESG teams align around shared KPIs, enabling a unified strategy for sustainable operations.

Real-time dashboards, alerts, and CI/CD pipeline integrations ensure that emissions data is actionable during development and deployment, not just during annual reporting cycles. GreenOps practices are codified into the software development lifecycle (SDLC), with automation reducing manual overhead and ensuring consistency.

Key outcomes at this stage include:

- Engineering teams optimize for carbon by default, without added friction
- Emissions reductions are measurable, trackable, and auditable in real time
- ESG disclosures become proactive and data-rich, rather than last-minute fire drills
- Every team and every product can own and act on their IT carbon in a fully empowered manner

This is where sustainability shifts from a goal to a system-level capability — powering resilient, responsible, and future-proof IT operations.

Case example:

A top-tier European fintech adopted continuous GreenOps monitoring and achieved:

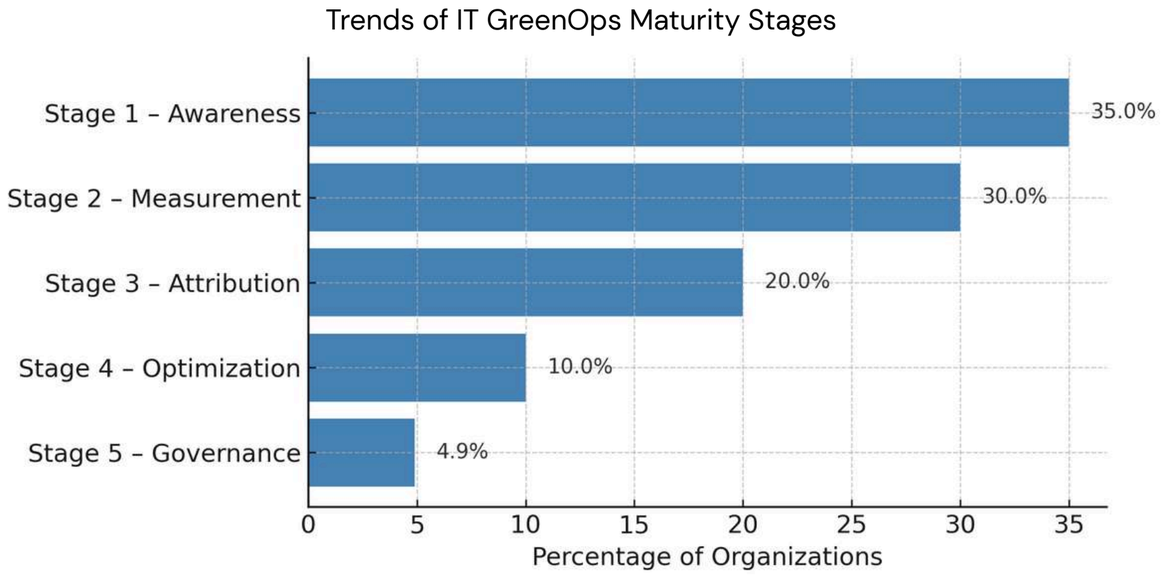
- 32% drop in cloud-related emissions
- 22% cost savings in compute-heavy environments

<3 hours/month spent on sustainability reporting (vs. >20 before)

Chapter 2: Understanding the GreenOps Concept and Maturity Journey

A step-by-step progression from awareness to action and governance

Where Most Teams Are Today



Source: Capgemini, Sustainable IT Report (2021)

Despite mounting pressure from regulators, investors, and ESG mandates, most organizations remain in the early stages of IT sustainability. Capgemini's Sustainable IT Report (2021) shows over 65% are still at Stage 1 (Awareness) or Stage 2 (Measurement), facing limited visibility, outdated reporting, and siloed data. Just 20% have reached Stage 3 (Attribution), where emissions are traceable to systems or workloads, and fewer than 15% have implemented active optimization or governance — revealing a clear gap between ambition and action.

This lag is both a risk and an opportunity. Organizations that invest early in attribution, automation, and GreenOps governance can leap ahead — gaining compliance, reputation, and a more scalable IT foundation.

How OxygenIT Supports Your GreenOps Journey

OxygenIT provides purpose-built APIs that help teams progress across all stages of GreenOps maturity:

- Leaders can have confidence that they are communicating reliable and science based IT emissions numbers, team leaders can rally everyone around clear KPIs.
- Carbon Measurement & Attribution APIs: Deliver granular, up-to-date emissions data at the service, region, and workload level.
- Optimization APIs: Recommend low-emission alternatives based on usage patterns, cost, and infrastructure goals.
- Seamless Integration: Designed for use in CI/CD pipelines, dashboards, and ESG reporting systems—so sustainability becomes part of your day-to-day IT operations.

Whether you're starting from scratch or scaling carbon-aware infrastructure, OxygenIT enables fast, verifiable, and automated progress.

Chapter 3: What Makes IT Carbon Emissions Complex?

Understanding the blind spots, limitations, and why precision matters

Most organizations assume that measuring IT emissions is as simple as tagging costs or pulling a report from their cloud provider. In reality, accurate carbon measurement in IT is technically complex, operationally fragmented, and often misunderstood.

Let's break down why it's hard — and how modern platforms like OxygenIT overcome these barriers.

3.1 The Technical Challenge: Navigating Shared, Elastic, and Opaque Cloud Infrastructure

Modern cloud computing fundamentally relies on multi-tenant, distributed infrastructures that enable unparalleled scalability and cost efficiency. However, these very characteristics also introduce significant complexity in accurately measuring associated carbon emissions.

Several factors contribute to this challenge:

- Shared resources: Cloud users do not own the physical hardware; instead, they lease segmented portions of computing capacity shared among multiple tenants. This obscures direct attribution of resource use.
- Ephemeral workloads: Dynamic compute instances such as containers, serverless functions, and auto-scaling groups frequently instantiate and terminate within short timeframes, complicating consistent monitoring.
- Elastic storage and network utilization: Data continuously moves across various services and geographic regions, often without transparent tracking or detailed visibility into the underlying infrastructure paths.
- Abstracted energy consumption: Users lack access to granular data on the electricity consumption of their workloads, including when and where compute resources draw power.

Together, these factors render the carbon footprint of cloud workloads effectively invisible to the teams responsible for them, unless supported by advanced telemetry systems and sophisticated emissions modeling.

3.2 The Reporting Challenge: Inconsistent, Incomplete, Inaccurate

Current sustainability reporting tools provided by cloud vendors were primarily designed for high-level overview rather than detailed operational decision-making. These tools typically offer carbon emissions estimates rather than precise measurements, which introduces several critical limitations:

- Dependence on regional averages: Many dashboards rely on generalized regional carbon intensity data instead of reflecting real-time energy consumption specific to the workload or data center.
- Exclusion of key service categories: Essential components such as networking traffic, backup storage, and auxiliary services are frequently omitted from emissions calculations.
- Reporting delays: Emissions data is often available only after significant time lags, sometimes extending to several months, impeding timely decision-making.
- Lack of workload-level granularity: Dashboards seldom provide the fine-grained visibility necessary to attribute emissions to individual applications, services, or business units.

Chapter 3: What Makes IT Carbon Emissions Complex?

Understanding the blind spots, limitations, and why precision matters

Cloud carbon data is often incomplete and inconsistent. For instance, AWS's Carbon Footprint Tool excludes networking and storage unless manually added. Estimates vary across providers, due to differing carbon factors and infrastructure assumptions.

Vendors also offset emissions with carbon credits, but offer no transparency on how or where. Many tools rely on worst-case emissions estimates instead of real-time data — undermining optimization efforts.

To drive real impact, teams need independent, real-time, and standardized data, not oversimplified dashboards.

3.3 The Organizational Challenge: Siloed Teams, Misaligned Goals

Even when accurate emissions data is available, it often remains underutilized due to organizational fragmentation and differing priorities across teams. The following illustrates how various groups operate with distinct metrics and tools, leading to misalignment in addressing carbon reduction:

Team	Key Metrics Tracked	Primary Tools Used
ESG	Scope 1, 2, and 3 emissions; CO_2e per ton	ESG reporting platforms, spreadsheets (e.g., Excel)
FinOps	Cost per service, cost per team, cost per region	Cloud billing dashboards, financial management tools
DevOps	Latency, CPU utilization, resource usage, cost	Monitoring and observability tools such as Grafana, Prometheus, CI/CD pipelines

Each team focuses on optimizing its own key performance indicators, which typically do not include carbon emissions unless those metrics are made explicitly visible, granular, and integrated into their workflows. This siloed approach prevents organizations from leveraging emissions data effectively to drive coordinated, actionable sustainability improvements.

3.4 Why "Guesstimates" Are Not Enough

Carbon emissions models that rely primarily on financial spend or simplistic energy multipliers may offer a superficial sense of insight but fall short in several critical areas:

- Auditability: Emerging regulatory frameworks—such as CSRD and IFRS S2 — demand transparent, verifiable methodologies. Approximate models lack the traceability necessary to satisfy these compliance requirements.
- Engineering utility: Developers and engineers require precise, actionable feedback to implement effective emissions reductions. Vague estimates do not provide the granularity needed to guide operational improvements or inform architectural decisions.
- Optimization effectiveness: Decisions based on inaccurate or overly generalized data increase the risk of inefficient resource allocation. Poor-quality emissions data can misdirect optimization efforts, potentially leading to unintended consequences or missed reduction opportunities.

Robust, data-driven approaches are essential to move

Chapter 3: What Makes IT Carbon Emissions Complex?

Understanding the blind spots, limitations, and why precision matters

beyond guesswork and enable credible, impactful carbon management in cloud operations.

Danger of underestimating emissions:

Organizations relying on low-quality estimators could under-report by 30–70%, leaving them exposed to accusations of greenwashing or even legal non-compliance.

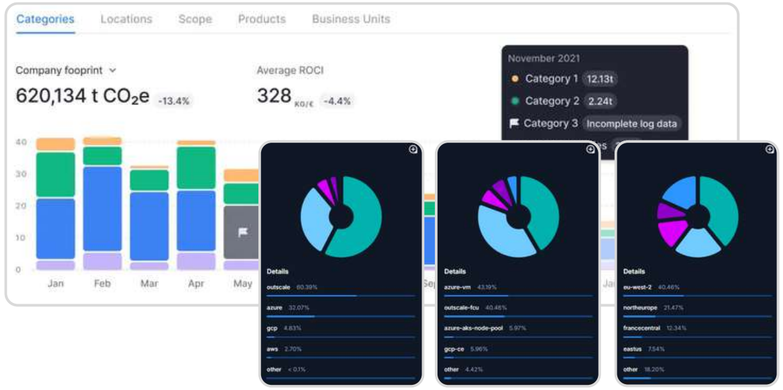
Source: CDP – "The Emissions Gap in Tech" (2023)

3.5 What Accurate IT Carbon Data Looks Like

Accurate IT carbon data provides emissions at a granular level, measuring carbon output for each individual workload such as virtual machines, containers, and storage buckets. This data is updated in real-time or near real-time—ideally daily or more frequently—to reflect current conditions. It incorporates regional carbon intensity, representing the actual electricity mix of specific cloud or datacenter locations. Emissions are attributed by tags or accounts, allowing breakdowns by team, project, customer, or environment. Furthermore, this data is accessible through integratable APIs, enabling seamless connection with dashboards, CI/CD pipelines, and reporting tools.

With these capabilities, teams gain the ability to compare carbon profiles across different architectures, choose cleaner deployment regions, validate the environmental impact of cloud optimizations, and feed verified emissions figures directly into ESG disclosures.

Exemple of workload-level granularity



Source: OxygenIT

3.6 The Ownership Gap

One of the most persistent challenges in reducing IT-related emissions is the lack of clear ownership. Engineering teams are typically measured on performance, uptime, cybersecurity, and innovation, not carbon. As a result, sustainability often remains siloed within ESG or compliance departments, disconnected from day-to-day infrastructure decisions.

GreenOps helps close this gap by embedding carbon awareness into the workflows of DevOps, Product owners, and FinOps teams. By giving engineers access to granular, science-based emissions data tied to their applications and infrastructure choices, GreenOps creates a sense of agency, enabling teams to reduce emissions proactively, without compromising reliability or speed.

This shift in ownership yields additional benefits: ESG leaders gain access to transparent, verifiable data; cross-functional collaboration improves; and emissions reduction becomes a continuous, integrated part of IT operations rather than a reactive reporting exercise.

Chapter 4: Embedding GreenOps Into Infrastructure Practices

How to make sustainability actionable for developers, architects, and infrastructure teams

GreenOps becomes real when carbon data meets engineering workflow. This chapter shows how to embed sustainability into the day-to-day decisions of DevOps, FinOps, and SRE teams — turning insights into action, and action into emissions reductions.

4.1 Shift-Left for Carbon Awareness

Similar to established practices for security and cost management, carbon visibility must shift left—integrated early in the development and deployment lifecycle. This proactive approach enables teams to identify and address emissions impact before workloads reach production.

Key methods include:

- CI/CD Pipelines: Embed carbon impact alerts or enforce blockers to prevent deployment of high-emission or misconfigured infrastructure.
- Terraform and Infrastructure-as-Code (IaC): Enable emissions previews for different cloud configurations during the planning phase to guide sustainable choices.
- Pre-commit Hooks: Automatically flag architectural decisions that could lead to elevated carbon costs, empowering developers to optimize designs upfront.

Example use case:

A DevOps team commits a change to deploy a batch workload in **us-east-1**. The pipeline flags that running this job in **us-west-2** would reduce emissions by 40% based on current grid data.

With tools like OxygenIT's Optimization API, this feedback is instant, actionable, and tied to real infrastructure specs.

4.2 Cloud Cost Optimization with Carbon as a Variable

Many organizations already rely on FinOps teams to monitor cloud spending. However, cost and carbon optimizations frequently align, presenting an opportunity to achieve savings on both fronts. Integrating carbon metrics into FinOps practices enables teams to unlock these dual benefits.

A carbon-aware FinOps approach includes:

- Combining financial cost per region with carbon emissions (CO_2e) per region to inform deployment decisions
- Prioritizing more efficient compute options such as ARM-based processors and spot instances
- Identifying and eliminating unused or idle resources that contribute unnecessarily to both cost and emissions
- For a given cost savings, there can be several carbon savings possibilities, help teams make the best choice.

By considering carbon, organizations can optimize cloud usage for both financial and environmental impact.

Example opportunity:

An ML team cut GPU idle time by 60%, saving $12K/month and 5 tCO_2e by tagging jobs with emissions data.

Chapter 4: Embedding GreenOps Into Infrastructure Practices

How to make sustainability actionable for developers, architects, and infrastructure teams

4.3 Carbon-Aware Observability

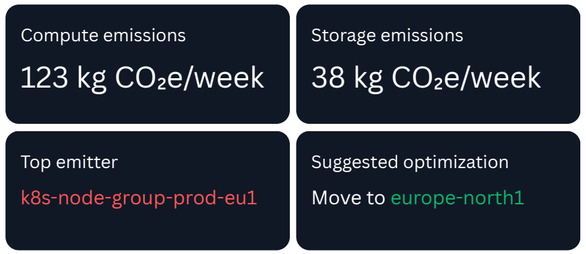
Modern observability tools provide real-time insights into performance metrics like CPU usage, latency, and availability. Yet, carbon emissions remain largely invisible within these stacks.

With API-level access to accurate emissions data, organizations can make carbon a first-class metric:

- Visualize emissions per service, region, or team directly in dashboards
- Trigger alerts when carbon thresholds are exceeded
- Extend SLAs and SLOs to include environmental KPIs

By integrating carbon into observability workflows, teams gain the visibility needed to monitor, respond to, and reduce their environmental impact in real time.

Example dashboard:



4.4 Empowering Developers Without Slowing Them Down

A common concern among engineering leaders is: “If we introduce carbon as a KPI, will it slow down innovation?” The answer is no, provided it's implemented thoughtfully. The objective is not to enforce rigid controls, but to empower teams with the right data and options, enabling them to take ownership of their environmental impact without disrupting velocity.

Key principles for carbon-aware development:

- Provide clean defaults—such as pre-selected green regions—without restricting flexibility.
- Present emissions alongside latency and cost, allowing developers to make informed decisions.
- Guide teams with optimization recommendations rather than hard constraints.
- Give development teams a means to predict and optimize infrastructure before purchasing, they will do the rest.

When integrated in this way, carbon awareness enhances engineering autonomy while aligning day-to-day choices with sustainability goals.

Pro tip:

Carbon-aware tools work best when integrated into familiar workflows — VS Code, Slack, Jira, CI tools — not introduced as yet another platform.

4.5 Aligning Governance with Sustainability Goals

Scaling GreenOps requires more than just developer engagement—it demands clear governance structures that align sustainability with business priorities. Policy, process, and accountability are essential to embed carbon considerations into everyday operations. Key governance mechanisms include:

- Tagging and attribution policies: Enforce workload tagging to ensure emissions are traceable by team, project, or environment.
- Carbon budgets: Set CO_2e limits for teams, regions, or

Chapter 4: Embedding GreenOps Into Infrastructure Practices

How to make sustainability actionable for developers, architects, and infrastructure teams

business units, as you would with financial budgets.

- Procurement standards: Incorporate carbon performance criteria into vendor evaluation and cloud service selection.
- Executive reporting: Provide tailored dashboards and reports that translate technical emissions data into insights for CxOs and ESG leaders.

By embedding these controls, organizations can turn sustainability goals into measurable outcomes—and make carbon accountability a shared responsibility.

ESG readiness advantage:

Organizations with integrated GreenOps practices are 4x more likely to report Scope 3 IT emissions confidently and defensibly.
Source: Forrester — "ESG Data Confidence Gap" (2023)

OxygenIT: Enabling Engineering-Grade Carbon Intelligence

OxygenIT provides engineering-grade carbon data through two powerful APIs:

- Carbon API – Real-time, workload-level emissions data for cloud and datacenter usage
- Optimization API – Emissions-based recommendations aligned with cost and performance

These APIs integrate into CI/CD pipelines, cloud monitoring tools, and ESG/FinOps platforms—making carbon visible, actionable, and embedded in everyday workflows.

With OxygenIT, organizations move from carbon guesswork to data-driven decisions—without slowing down innovation.

Chapter 5: The Business Case for GreenOps

Why IT sustainability is now a strategic, financial, and operational imperative

GreenOps is not just an ESG initiative or a moral decision. It's increasingly a business-critical strategy with measurable ROI, regulatory alignment, and competitive edge. In this chapter, we'll lay out the hard numbers and risk-based rationale behind taking action now.

5.1 Sustainability Is Becoming a Procurement Requirement

Sustainability is no longer a "nice to have" — it's becoming a key criterion in enterprise procurement, particularly across Europe and North America. 72% of large enterprises now consider carbon disclosures when selecting suppliers (1).

Organizations that cannot provide detailed, credible Scope 3 emissions data risk exclusion from RFPs and preferred vendor lists.

Implication: If you provide IT services, operate infrastructure, or sell SaaS, carbon transparency is no longer optional—it's a competitive necessity.

5.2 Regulatory Pressure Is Rising — Fast

Environmental disclosure mandates are rapidly expanding worldwide, requiring organizations to report on carbon emissions with increasing detail and rigor. Key regulations include:

- CSRD (EU): Mandatory Scope 1–3 disclosures for 50,000+ EU companies, effective 2024 for large firms, with SMEs following in 2026.
- IFRS S2: Climate-related risk reporting adopted by 140+ countries starting in 2025.
- SEC Climate Rule (US): Scope 1 and 2, potentially Scope 3 reporting for US-listed companies.
- UK SECR: Energy use and carbon reporting for large UK firms.

Why it matters for IT: Scope 3 emissions often encompass data centers, cloud consumption, and IT services—categories notoriously difficult to quantify without precise data. GreenOps solutions provide the traceability, auditability, and defensibility necessary for compliance.

5.3 Operational Efficiency: Cost Savings & Resilience

Optimizing for carbon often drives greater operational efficiency, delivering simultaneous financial savings and emissions reductions. Key benefits include:

- Migrating workloads to cleaner, more efficient regions reduces both cost and carbon footprint.
- Rightsizing instances minimizes waste from overprovisioning.
- Eliminating idle or "zombie" resources produces immediate cost and environmental gains.

28% of cloud resources are underutilized, and 45% of companies could cut emissions by 20–40% through optimization(2).

5.4 Talent, Brand, and Stakeholder Pressure

Sustainability is increasingly important to employees and external stakeholders alike. 65% of developers consider sustainability when choosing an employer (3). Companies with strong environmental commitments attract 25% more

(1) Capgemini Research Institute – "Sustainable IT" (2022)
(2) Uptime Institute Global Data Center Survey 2023
(3) 2023 Stack Overflow Developer Survey

Chapter 5: The Business Case for GreenOps

Why IT sustainability is now a strategic, financial, and operational imperative

job applicants according to LinkedIn Global Talent Trends, 2023).

Beyond recruitment, sustainability efforts boost brand reputation, improve ESG ratings valued by investors and buyers, and foster alignment between engineering and sustainability teams, strengthening organizational cohesion and market position.

5.5 Future-Proofing IT Strategy

GreenOps sets the stage for emerging innovations such as sustainable AI—tracking the carbon footprint of training and deployment—digital twins for sustainability modeling, and carbon-aware autoscaling and scheduling, already adopted by leading SRE teams like Google's.

Adopting these practices signals readiness for a future economy that prices carbon, penalizes waste, and rewards transparency, giving your IT strategy a lasting competitive edge.

Real-World Case Study: Driving GreenOps Success

Company: A French beauty product manufacturer
Challenge: Faced increasing procurement pressure to disclose accurate carbon emissions and optimize cloud costs amid rising regulatory demands.

Solution:

- Integrated OxygenIT's Carbon and Optimization APIs into their CI/CD pipelines and FinOps dashboards.
- Implemented tagging policies to attribute emissions by project and team.
- Shifted workloads to regions with lower carbon intensity and rightsized compute resources.

Results:

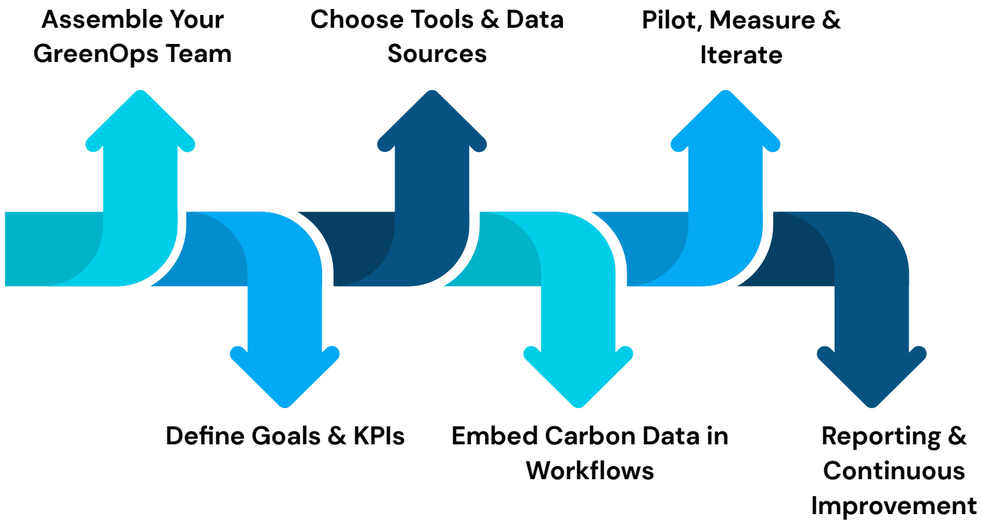
- Achieved 30% reduction in cloud emissions within 6 months.
- Reduced cloud costs by 15% through optimized resource usage.
- Met procurement requirements with detailed, auditable carbon reports—securing preferred vendor status with key enterprise clients.

Chapter 6: Implementing GreenOps in Your Organization

From theory to practice — how to start and scale GreenOps effectively

This chapter provides a pragmatic roadmap for IT leaders, DevOps teams, and sustainability professionals ready to start or mature their GreenOps journey. It covers key roles, workflows, tools, and milestones — empowering you to embed sustainability into your IT operations step by step.

Overview / Roadmap to implement GreenOps in your organization



Note: Smaller teams can start with hybrid roles — for example, a DevOps engineer taking on FinOps and GreenOps responsibilities — and evolve the team structure as the program matures.

6.1 Assemble Your GreenOps Team

GreenOps is not a solo effort — it requires collaboration across technical, financial, and sustainability domains. Building the right team ensures carbon data is not only visible, but actionable across workflows. Core roles in a GreenOps team typically include:

- GreenOps Sponsor: An executive-level champion who drives the initiative, secures funding, and aligns sustainability with business goals.
- Cloud Architect: Designs infrastructure with carbon efficiency in mind — selecting cleaner regions, right-sizing resources, and recommending sustainable architectures.
- DevOps/SRE: Implements carbon-aware practices directly into CI/CD pipelines, observability tools, and runtime monitoring.
- FinOps Analyst: Brings financial accountability to sustainability by integrating cost and carbon metrics for smarter optimization.
- Sustainability Lead: Bridges IT and ESG functions — ensuring GreenOps data supports regulatory reporting and broader climate goals.
- Data Engineer: Maintains data quality, enforces tagging standards, and ensures accurate attribution of emissions across teams and services.
- Product owner: a key player to ensure ownership and action on CO2 emissions at the application/solution level.

Chapter 6: Implementing GreenOps in Your Organization

From theory to practice — how to start and scale GreenOps effectively

6.2 Define Your GreenOps Goals and KPIs

To drive meaningful impact, GreenOps initiatives must be tied to clear business objectives and measurable outcomes. Establishing the right goals early helps teams stay focused, prioritize resources, and demonstrate value to stakeholders.

Typical GreenOps objectives include:

- Carbon reduction targets – e.g., reduce cloud emissions by 30% within 12 months
- Cost efficiency goals – e.g., decrease monthly cloud spend by 10% through smarter provisioning
- Compliance and reporting readiness – e.g., deliver audit-ready Scope 3 IT data by next quarter
- Developer engagement – e.g., ensure carbon impact is visible in 100% of CI/CD pipelines
- Present GreenOps approach to 100% new customer prospects, increase new customer acquisition by 15%
- Present GreenOps approach to 25% of existing customers per quarter, reduce customer loss-rate (churn) by 10% over the year

Suggested KPIs to track progress:

- CO_2e per application or service
- % of workloads running in low-carbon ("green") regions
- Number of optimization recommendations
- Carbon savings relative to baseline infrastructure usage

These metrics not only support continuous improvement but also provide traceable data for internal stakeholders, ESG reports, and regulatory disclosures.

6.3 Choose the Right Tools and Data Sources

Implementing GreenOps requires integrating the right technology stack — tools that provide visibility, automation, and governance across your IT environment. Prioritize solutions that offer real-time, independent, science-based, granular, and region-specific carbon data, as these are essential for actionable insights.

Core capabilities and tool examples include:

- Carbon data collection: OxygenIT Carbon API for high-resolution data across cloud & datacenter workloads
- Optimization insights: OxygenIT Optimization API or built-in tools from cloud providers
- CI/CD integration: Custom scripts or plugins for Jenkins, GitHub Actions, or other pipelines
- Dashboards & alerts: Grafana, Datadog, or similar platforms with carbon data plugins
- Governance & policy management: Cloud tagging standards, FinOps platforms, and ticketing systems for traceability

Pro tip:

Use API-based tools that integrate with DevOps, FinOps, and observability workflows, enabling data-driven sustainability without disrupting operations.

6.4 Embed Carbon Data Into Daily Workflows

For GreenOps to succeed, carbon awareness must be integrated into the everyday routines of engineering and operations teams. Rather than treating sustainability as a separate initiative, organizations should weave emissions data directly into development, deployment, and infrastructure decisions.

Chapter 6: Implementing GreenOps in Your Organization

From theory to practice — how to start and scale GreenOps effectively

Practical ways to embed carbon into workflows:

- Pull request reviews & approvals: Surface estimated carbon impact alongside other quality checks
- Cloud cost comparisons: Automate side-by-side visibility of cost and carbon when evaluating infrastructure options
- Developer enablement: Provide tools or defaults that prioritize low-carbon regions and resource types
- Intelligent scheduling: Align batch or flexible workloads with periods of cleaner grid electricity
- Include granular metrics in eco-design initiatives to measure progress

By integrating carbon data into daily touchpoints, teams can act on sustainability insights without disrupting velocity or innovation.

6.5 Pilot, Measure, Iterate

GreenOps doesn't require a large-scale rollout from day one. The most effective approach is to start small, learn fast, and scale gradually. Begin by selecting one application, workload, or team as a pilot to validate your GreenOps approach and tooling.

A practical pilot plan:

- Choose a high-impact service to apply initial GreenOps practices
- Establish baseline metrics for carbon emissions and cloud costs
- Apply optimization insights using tools like OxygenIT or native cloud features
- Review results monthly, tracking reductions and identifying blockers
- Celebrate the IT CO2 reductions obtained with the team, identify best practices and lessons learned
- Expand scope gradually to more services, regions, or teams as capabilities mature

This iterative approach builds internal momentum, demonstrates value early, and lays the foundation for organization-wide adoption.

6.6 Reporting and Continuous Improvement

GreenOps is not a one-time initiative — it's a continuous, evolving process. As your organization scales its sustainability efforts, regular reporting and feedback loops become essential.

Key practices for long-term impact:

- Automate emissions reporting to meet ESG and regulatory requirements
- Use data insights to refine cloud architecture and inform procurement decisions
- Communicate progress across technical and leadership teams to foster alignment
- Ensure ownership and autonomy of action on CO2 emissions by the IT operational teams
- Stay current with emerging tools, regulations, and GreenOps best practices

By embedding these habits, GreenOps becomes part of your IT culture — driving transparency, resilience, and measurable impact over time.

GreenOps starts with clear data. OxygenIT makes it easier to cut emissions without compromising IT performance.

Chapter 7: Overcoming Common Challenges and Misconceptions

Addressing hurdles and myths to ensure a successful sustainability journey

Many organizations encounter obstacles on their GreenOps path, often rooted in misunderstandings or operational challenges. This chapter unpacks the most common ones, offering solutions to keep your program on track.

7.1 Misconception: We Can't Measure IT Emissions Accurately

A common barrier to GreenOps adoption is the belief that IT-related emissions are too complex or imprecise to quantify. While this may have been true in the past, today's technology offers a far more accurate picture.

Platforms like OxygenIT provide near real-time, workload-level carbon data based on actual usage — with granularity across regions, services, and instance types. This enables precise, actionable insights.

Pro tip: Avoid relying on static or averaged data from vendors. Accurate GreenOps starts with high-resolution, current emissions data.

7.2 Challenge: Lack of Visibility Leads to "Flying Blind"

Many teams optimize for cost alone, overlooking emissions due to missing or siloed data.

Solution: Integrate carbon metrics into existing monitoring and FinOps dashboards. Add carbon-aware alerts and reports to flag high-impact workloads.

Outcome: With clear visibility, teams can make informed decisions and prioritize optimizations that cut both cost and carbon.

7.3 Misconception: GreenOps Slows Down Development

A frequent concern among engineering leaders is that incorporating carbon metrics into workflows will introduce delays or hinder innovation.

In reality, when carbon awareness is thoughtfully integrated, it becomes a seamless, non-intrusive part of existing development processes.

Rather than enforcing hard blockers, effective GreenOps provides developers with clear, actionable insights and optimization recommendations.

Automation plays a key role by surfacing opportunities for reducing emissions with minimal manual effort, allowing teams to maintain agility while advancing sustainability goals.

7.4 Challenge: Organizational Silos

Sustainability initiatives often reside within ESG or corporate responsibility teams, while IT operations, finance, and development groups operate independently.

This siloed structure limits collaboration and slows progress on GreenOps adoption. The solution lies in building cross-functional teams that unite IT, finance, and sustainability professionals around shared goals and KPIs.

Encouraging regular communication and knowledge sharing between these groups is critical. Leveraging tools that provide accessible, transparent carbon data helps break down barriers and fosters a collaborative culture focused on reducing IT's environmental impact.

Chapter 7: Overcoming Common Challenges and Misconceptions

Addressing hurdles and myths to ensure a successful sustainability journey

7.5 Misconception: Optimizing for Carbon Means Higher Costs

A common concern is that reducing carbon emissions comes at a premium. However, many carbon optimization strategies actually reduce operational costs.

Actions such as rightsizing cloud instances, eliminating idle or unused resources, and migrating workloads to more energy-efficient regions often result in both lower emissions and reduced expenses.

By integrating carbon and cost optimization efforts, organizations can achieve synergistic “win-win” outcomes —advancing sustainability goals without sacrificing financial performance.

7.6 Challenge: Staying Updated With Evolving Standards

Sustainability regulations, reporting frameworks, and best practices are evolving rapidly, making compliance a moving target. To keep pace, organizations must adopt flexible tools that continuously update their data and provide compliance-ready reporting aligned with current standards. Additionally, appointing a dedicated sustainability governance role helps ensure policies and procedures are regularly reviewed and adapted, enabling the organization to stay ahead of regulatory changes and maintain credible environmental disclosures.

Chapter 8: The Future of GreenOps and IT Sustainability

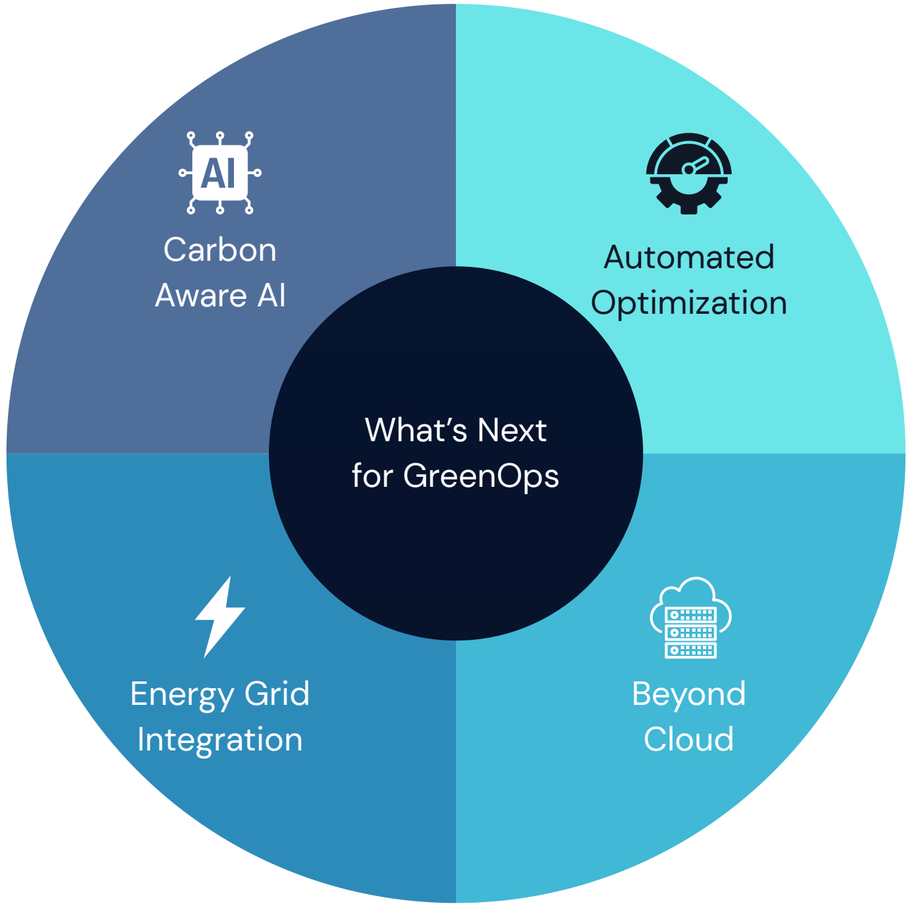
The GreenOps landscape is rapidly evolving. Here's what's coming next:

8.1 Carbon-Aware AI and Machine Learning

AI training and inference workloads consume significant amounts of energy, contributing substantially to IT carbon footprints. Implementing carbon-aware scheduling strategies can reduce the environmental impact of these workloads by up to 30%, according to recent findings from Google Research (2023). This approach optimizes compute timing and location to minimize emissions without compromising performance.

8.2 Real-Time Energy Grid Integration

Future GreenOps practices will increasingly leverage real-time data on renewable energy availability from local grids. By aligning workload scheduling with periods of high renewable energy supply, organizations can further reduce carbon emissions. Major cloud providers are investing in regional renewable energy infrastructure, making greener computing options more accessible and reliable.



8.3 Automated Optimization Powered by AI

Advancements in AI-driven tools are enabling automated recommendations and even autonomous execution of optimization strategies. These capabilities significantly reduce the manual effort required to maintain and enhance green infrastructure, allowing teams to focus on innovation while sustaining environmental performance.

8.4 Expanding GreenOps Beyond the Cloud

While cloud environments are the current focus, GreenOps principles are extending to on-premises, edge, and hybrid infrastructures. Integration with Internet of Things (IoT) devices and smart building systems will provide holistic sustainability management across the entire IT ecosystem, ensuring comprehensive carbon visibility and control.

Conclusion

The journey to GreenOps is urgent, strategic, and entirely achievable. As digital infrastructure continues to scale, so does its environmental footprint—yet the ability to measure, understand, and reduce IT-related emissions has lagged far behind. GreenOps bridges that gap, turning sustainability from a vague ideal into a precise, operational discipline embedded in the daily decisions of engineering, product owners, DevOps, cloud, and procurement teams.

By making IT emissions visible, granular, and actionable, organizations gain far more than just environmental benefits. They unlock real opportunities for cost optimization, regulatory compliance, and operational resilience. They signal to investors, employees, and customers that sustainability is not a bolt-on initiative but a core pillar of innovation and long-term strategy.

What's needed now is leadership—technical and cultural—to move from passive measurement to active optimization. The path may begin with awareness and simple reporting, but it quickly evolves into system-wide impact as GreenOps practices are integrated into automation pipelines, architectural decisions, and cloud governance models.

With platforms like OxygenIT, IT teams finally have the granular APIs, real-time insights, and automation-ready tools they need to make sustainability a competitive advantage, not just a reporting obligation.

The question is no longer if your organization will adopt GreenOps, but when—and how quickly you can turn your IT infrastructure into a lever for sustainability, efficiency, and transformation.

References and further reading

1. Andrae, A. S. G., & Edler, T. (2015). On global electricity usage of communication technology: Trends to 2030. Challenges, 6(1), 117–157. https://www.sciencedirect.com/science/article/pii/S2214629620303823
2. International Energy Agency. (2021). Data centres and data transmission networks. https://www.iea.org/reports/data-centres-and-data-transmission-networks
3. Capgemini Research Institute. (2022). Sustainable IT: Why it's time for a green revolution for your IT estate. https://www.capgemini.com/research/sustainable-it/
4. Uptime Institute. (2023). Global data center survey 2023. https://uptimeinstitute.com/research
5. Stack Overflow. (2023). Developer survey 2023: Key insights. https://survey.stackoverflow.co/2023
6. Google AI Blog. (2023, April). Carbon-aware computing: Reducing emissions for AI workloads. https://ai.googleblog.com/2023/04/carbon-aware-ai.html
7. Gartner. (2023). Market guide for IT sustainability solutions. https://www.gartner.com/en/documents/4001317
8. International Energy Agency. (2022). Electricity information: World electricity data. https://www.iea.org/reports/electricity-information-overview
9. Organisation for Economic Co-operation and Development. (2022). Measuring the environmental impacts of digital technologies. https://www.oecd.org/environment/measuring-the-environmental-impacts-of-digital-technologies-b1f81b00-en.htm
10. European Commission. (2023). Corporate Sustainability Reporting Directive (CSRD). https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en
11. IFRS Foundation. (2023). IFRS S1 and IFRS S2 issued: International sustainability disclosure standards. https://www.ifrs.org/news-and-events/news/2023/06/ifrs-s1-and-ifrs-s2-issued/
12. U.S. Securities and Exchange Commission. (2024). Final rule: The enhancement and standardization of climate-related disclosures. https://www.sec.gov/news/press-release/2024-31
13. Science Based Targets initiative. (2023). ICT sector guidance. https://sciencebasedtargets.org/sectors/ict
14. Amazon Web Services. (2023). Customer carbon footprint tool. https://aws.amazon.com/blogs/aws/new-customer-carbon-footprint-tool/
15. Microsoft. (2023). Cloud for sustainability overview. https://www.microsoft.com/en-us/sustainability/cloud

References and further reading

Green Native for IT

> DOWNLOAD

How CIOs can leverage sustainability for more business

> DOWNLOAD

OxygenIT recognized in the 2024 Gartner® Cool Vendors™

> READ MORE

About

Methodology

The information analyzed and presented in this report is derived from a comprehensive review of internal OxygenIT documents, including technical documentation, use case studies, internal notes, and ongoing project work. This core data is further enriched by insights gathered from widely recognized external public sources, as well as relevant information extracted from internal databases and analytical tools. Together, these sources provide a robust foundation for the findings and conclusions outlined in this report.

About OxygenIT

OxygenIT is a leading provider of cloud carbon intelligence solutions, empowering organizations to measure, monitor, and optimize the environmental impact of their IT operations.

Through advanced APIs and real-time dashboards, OxygenIT delivers granular, workload-level carbon data across major cloud providers and datacenters. By integrating seamlessly with DevOps, FinOps, and sustainability workflows, OxygenIT helps businesses achieve meaningful carbon reductions while maintaining cost efficiency and operational performance.

Committed to enabling the transition to sustainable IT, OxygenIT supports companies in meeting regulatory requirements, driving green innovation, and advancing their environmental, social, and governance (ESG) goals.

OxygenIT

TRUSTED GREENOPS API

The most impactful platform to bring GreenOps into your IT operations

For cloud and on-premise

Explore how OxygenIT can support your GreenOps journey at oxygenit.io

For tailored solutions or enterprise inquiries, contact us!

Darin Beach
Director Business Development
dbeach@oxygenit.io