



# IT sustainability at a crossroads

*Choosing a future of responsible computing*

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## Key takeaways

*Mature organizations differentiate themselves by integrating sustainability assessments during the design and planning stages of IT projects.*

### ■ IT's carbon footprint is growing.

Information technology brings efficiency, but also environmental impact. Gen AI can contribute to the problem but also offers potential solutions, helping technical architectures and infrastructure be more sustainable.

### ■ 57% of organizations struggle to quantify their green IT efforts.

Yet, accurate measurement is crucial for both sustainability and economic benefits. Organizations that take a holistic greener IT approach see not just greater carbon emission reductions, but also significant energy cost savings, 51% more than others.

### ■ Server virtualization and cloud computing are at the front line in the push to make IT more sustainable.

A quarter of businesses (25%) are already leveraging hybrid cloud solutions to significantly boost the sustainability and energy efficiency of their IT operations. Nearly half (46%) report a substantial positive impact on their overall IT sustainability.

# Sustainable IT

## A pressing challenge and a promising opportunity

Climate change is the existential threat of our time, and businesses are under increasing pressure to minimize their environmental impact. Information technology (IT) is a double-edged sword in this fight. While IT empowers businesses to operate more efficiently and sustainably, IT energy consumption and related carbon footprint mean it is not impact-free.

A recent IBM Institute for Business Value (IBM IBV) survey<sup>1</sup> of 1,100 executives paints a concerning picture. Organizations, on average, attribute as much as 20% of their overall energy costs to IT operations, and only 26% say their organizations are highly effective at executing initiatives to make their IT more environmentally sustainable (“green IT”). This sluggish progress is further hampered by a lack of visibility, with 99% of executives unable to accurately quantify their IT operations’ carbon footprint.

Only approximately one in four organizations demonstrate substantial engagement in transforming their IT systems and procedures to become genuinely environmentally responsible. And as few as 21% of executives said implementing initiatives for more sustainable IT had a significant positive impact on overall operational efficiency. This, despite organizations attributing an average 30% reduction in overall IT energy costs and a 19% reduction in their IT carbon footprint in the last year from the implementation of environmentally responsible IT initiatives.

What can explain these mixed findings? Lack of visibility is definitely a piece of the puzzle. In addition, more than half (57%) reported difficulty in measuring impact as the top challenge faced when they implement green IT initiatives.

# 99%

*of executives are unable to accurately quantify their IT operations’ carbon footprint.*





If organizations could measure more often and accurately, it would be both enlightening and likely motivating—not only from a sustainability perspective but also from an economic one. IT operations of companies that apply a holistic approach to green IT attribute greater reductions in IT energy usage and costs to these initiatives. On average, they see a 51% greater energy cost reduction than others.

With the ongoing explosion in AI adoption, the green IT challenge is set to become more pronounced. Generative AI, a powerful technology with the potential to revolutionize various industries, presents a unique challenge for green IT. While it offers opportunities to optimize processes, reduce waste, and accelerate innovation, its own computational demands can significantly expand IT's environmental footprint.

Finding effective and efficient ways to make your IT more sustainable is more urgent than ever, particularly given the potential impact of gen AI. Developing a comprehensive baseline of your organization's current state—encompassing all forms of IT—is a good first step. In fact, tools now exist to help quantify the environmental impact of IT, down to the level of individual applications. But just quantifying is not enough; you also must develop ways of tracking progress and show the impact to stakeholders. And then—what approaches and initiatives can help you move forward and reduce the environmental impact of your IT? Let's explore.

# The holistic approach

## A path to more environmentally responsible IT

The answer to a more sustainable future lies in a comprehensive green IT strategy that goes beyond energy efficiency. Greener IT has many facets and requires action across different parts of your IT estate. To help determine smart moves for organizations, we identified four levels of maturity among the organizations in our survey. (See “Four maturity levels but one winning approach.”). Based on approach and initiatives across five core capabilities—strategy, governance, IT operations, IT application development and maintenance, and employee involvement—a clear correlation emerged between strategic commitment and environmental outcomes.

Organizations with a holistic approach, characterized by enterprise-wide green IT integration, achieve a remarkable two times greater reduction in IT carbon footprint compared to their less mature counterparts. They leverage automation, cloud computing, and sustainable design principles to optimize their IT infrastructure from the ground up.

To better understand what drives these differences in outcomes, we identified areas where the more mature organizations stand out.

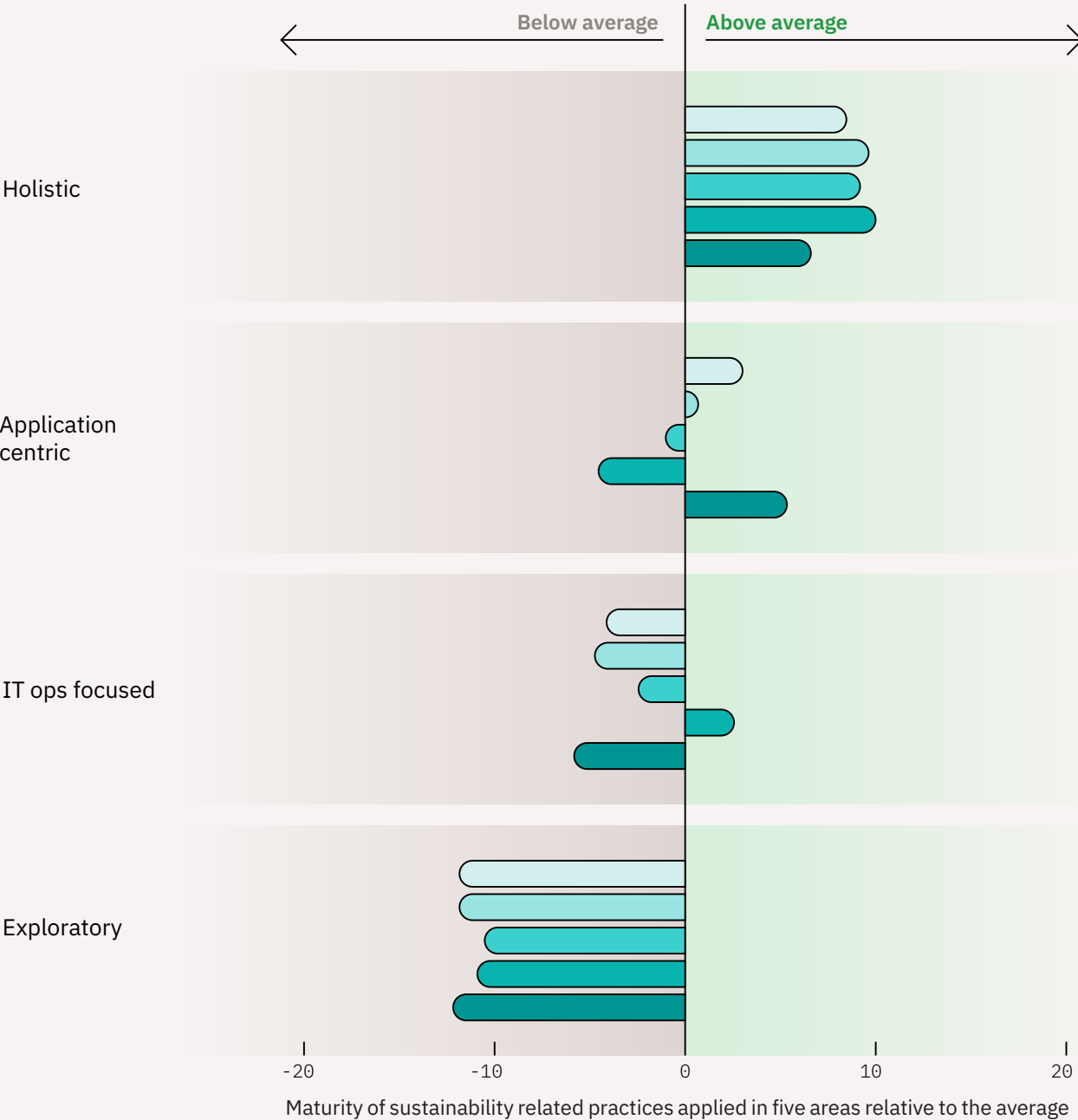
*The answer to a more sustainable future lies in a comprehensive green IT strategy that goes beyond energy efficiency.*





Perspective

Organizations take different paths.  
But there's one clear winner.



- Sustainability incorporated into IT ADM.
- Sustainability incorporated into IT operations
- Employees using IT more sustainably
- Enterprise-wide governance for more sustainable IT
- Green IT and IT strategies aligned



**Based on their approaches, the surveyed organizations fall into four distinct groups:**

**1. Holistic.** The most mature leading-edge green IT organizations have deeply integrated sustainable practices across their entire operations. From data centers to supply chains, and networks to products, they're driving industry-wide change through innovation and collaboration. They are more mature than their peers across all five capabilities.

**2. Application centric.** With a focus on software, lifecycle and strategy, and alignment, these enterprises are incorporating green IT principles to minimize environmental impact and potentially reap financial benefits. They're conscious of the broader implications of their IT choices, aiming to minimize indirect environmental consequences from product design choices and user behavior.

**3. IT ops focused.** These organizations prioritize energy efficiency in their IT infrastructure, aiming to reduce electricity consumption through server optimization and efficient cooling systems. While cost savings are a primary driver, environmental impact is a secondary consideration.

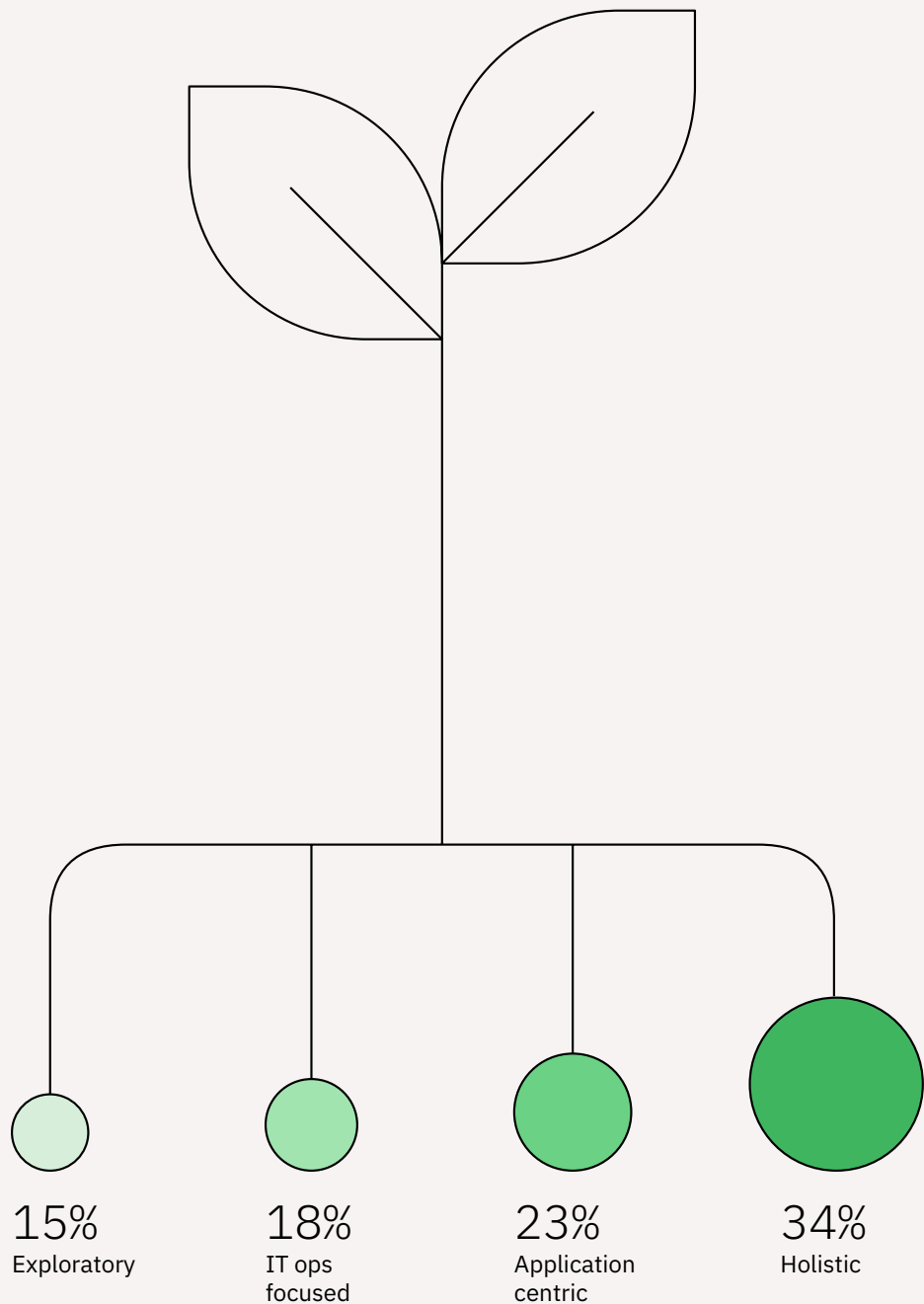
**4. Exploratory.** These organizations are still developing their approach, taking initial steps in green IT but primarily driven by regulatory compliance. Cost reduction is the main focus, with limited attention to overall environmental sustainability. They are less mature than their peers across all five capabilities.

The different approaches to green IT are associated with markedly different outcomes. Not only do the more mature organizations achieve better environmental outcomes, they are also far more likely to attribute a positive impact from their green IT efforts on overall operational efficiency (98% versus 50%), and they attribute greater reductions in IT energy usage and costs to their green IT initiatives.

*The different approaches to green IT are associated with markedly different outcomes.*

## Greener IT means full-cycle sustainability

Energy efficiency and carbon reductions are not the only areas where holistic organizations perform better. They look at the entire green IT lifecycle—design, development, implementation, use, and disposal—to achieve greater impact. For example, they achieve a significantly higher rate of electronic waste recycling.



*Percentage of IT-generated electronic waste that is recycled*

## Where do more mature organizations stand out?

Holistic, mature organizations stand out in two main areas: sustainability by design and cloud and automation.

### **Making IT more sustainable by design**

Mature organizations differentiate themselves by integrating sustainability assessments during the design and planning stages of IT projects. This proactive approach, adopted by only 23% of organizations but demonstrably impactful, ensures that environmental considerations are embedded into the very fabric of IT systems. More than half (52%) of those who do report taking this approach say it had a significant positive impact on the overall sustainability of their IT operations.

Moreover, making use of the latest technologies such as AI creates new opportunities for more sustainable IT design. For example, 49% of companies have fully implemented AI for sustainable design, and of these, 57% say it had a significantly positive impact on the overall sustainability of IT operations. Unsurprisingly, thinking ahead and dealing with the challenge proactively seems to be more effective than trying to address the problem retroactively.

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### **Capitalizing on cloud and automation**

Server virtualization and cloud computing are at the front line in the push to make IT more sustainable; they're the top actions taken to reduce IT operations' carbon footprints across all organizations surveyed.

#### ***Server virtualization***

More than one-third (35%) of servers now reside in virtualized environments.

This digital transformation has yielded impressive results: companies have trimmed physical hardware needs by 30%. And holistic organizations have fully embraced this shift, having virtualized 45% of their servers, resulting in an impressive 40% reduction in hardware. 'Exploratory organizations, on the other hand, are struggling to keep pace, with virtualization rates and hardware savings at less than half those figures, 23% and 17%, respectively.

#### ***Hybrid cloud***

The data is clear: hybrid cloud, when paired with automation, is a potent catalyst for a greener IT footprint. Both help businesses navigate the intersection of business performance and environmental responsibility. For example, with hybrid cloud you can optimize your use of infrastructure by selecting nearby processing locations with access to renewable power. In fact, your hybrid cloud platform can serve as a green IT control tower, providing the visibility needed to run data, workloads, and applications in the clouds and systems with the lowest environmental impact. Plus, running workloads in a container platform instead of in a classically deployed virtual machine environment lets you cut annual infrastructure costs by as much as 75% thanks, in part, to increased energy efficiency.<sup>2</sup>

An opportunity exists at the intersection of FinOps and GreenOps. When users can see operational costs and infrastructure choices alongside emissions and energy data, they can make more informed decisions and trade-offs for their organizations.

A quarter of businesses are already leveraging hybrid cloud solutions to significantly boost the sustainability and energy efficiency of their IT operations. Nearly half (46%) report a substantial positive impact on their overall IT sustainability.

Mature organizations, however, also are harnessing automation to dynamically adjust IT environments based on demand. Many organizations overprovision how much compute power is at the ready. They can reduce excess standby processing power through greater optimization and demand management, which should lower energy usage significantly without compromising performance (while also freeing up high-demand processing power for other purposes). This level of agility not only enhances operational efficiency but also minimizes resource waste. A stark contrast emerges when comparing these leaders to their less mature counterparts: 83% of the former employ high levels of automation, while a mere 3% of the latter do the same.





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## Case study

### Major fast-moving consumer goods company heads toward more sustainable IT by design

In the quest for a more sustainable future, a leading fast-moving consumer goods (FMCG) company has taken a significant step toward reducing its environmental footprint by embedding sustainability design principles into its IT architecture. This pioneering initiative demonstrates the power of green IT in action, showcasing the potential for technology to drive positive change.

#### **The opportunity**

The FMCG company, recognizing the urgent need to decarbonize its IT operations, planned to infuse sustainability into its application design and architecture. The goal was to reduce the energy consumption and carbon footprint of its conversational AI application on Microsoft Azure, while promoting a cultural shift that prioritizes sustainability as a non-functional requirement (NFR) in application design and architecture.

#### **The solution**

The company conducted a comprehensive assessment of the conversational AI application architecture, leveraging a specialized framework to identify sustainability risks and gaps. This analysis revealed opportunities for improvement in various areas, including compute selection, build and deployment practices, logging and monitoring processes, and language and framework selection.

Based on these findings, the company made a series of enhancements to the application architecture, focusing on sustainability-driven design principles. It anticipates a respectable reduction in compute resource consumption (20%), CO2 emissions (30%), and cloud operating costs (28%). This achievement not only supports the FMCG company's commitment to sustainability but also sets a new standard for the industry.

This project exemplifies the concept of "sustainability by design," where environmental considerations are integrated into the earliest stages of application development. By adopting this approach, organizations can create more efficient, eco-friendly systems that minimize their carbon footprint while promoting business growth and innovation.

# Gen AI to the green IT rescue?

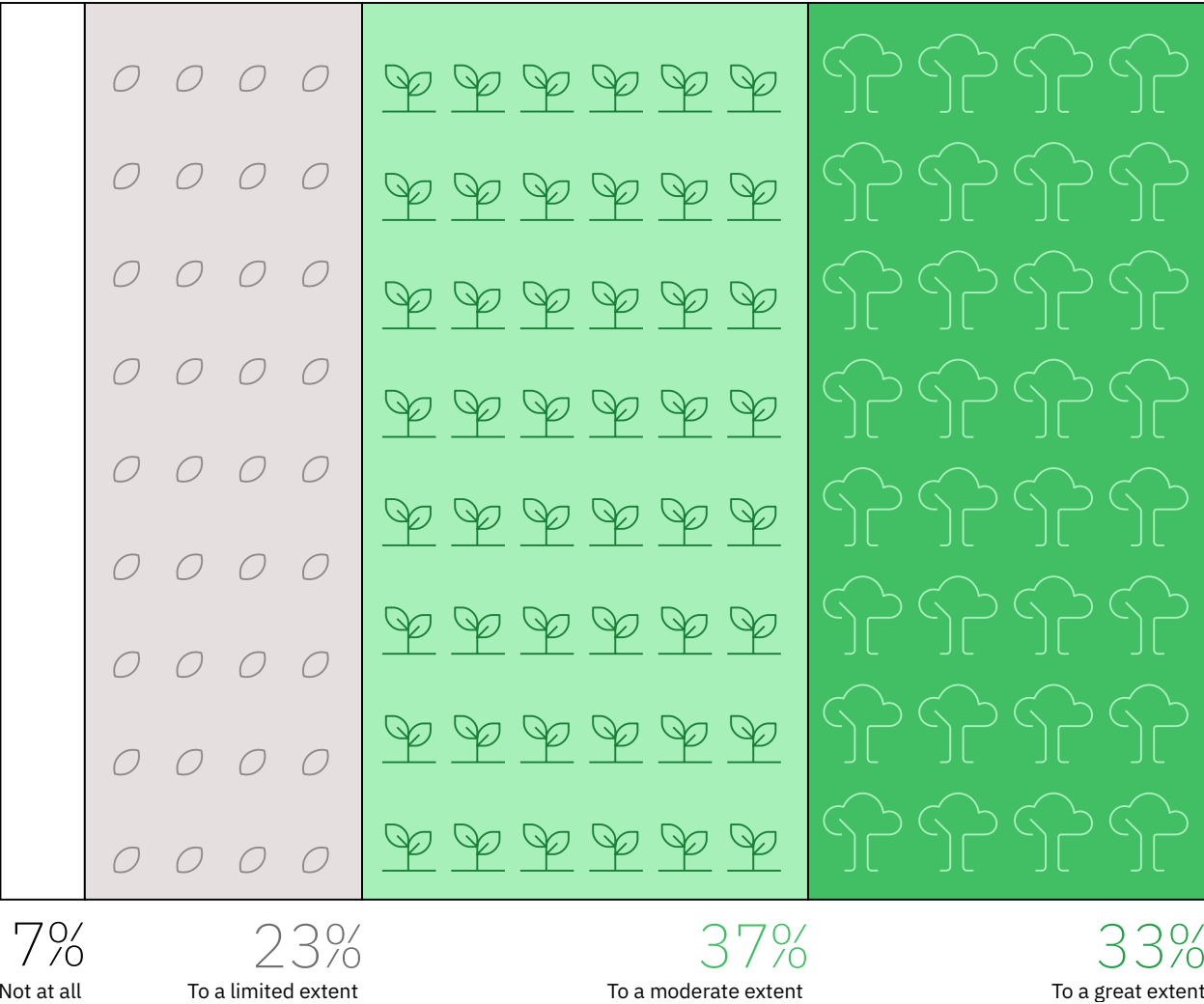
Generative AI is a game changer for more sustainable IT. How it changes the game, though, is up to every organization that uses it.

Of the surveyed organizations, 64% are using generative AI and large language models. But thus far, only one-third of these organizations have made great progress in addressing its environmental impact. That must change for gen AI’s benefits to outweigh its potential negative impact on carbon footprints.

The good news: generative AI can help solve the very problem it may contribute to over time. It is creating new opportunities to transform IT and make it more

sustainable. For example, teams can use generative AI to quickly translate code into more energy-efficient languages, and develop more sustainable algorithms and software by analyzing code performance. In this way, employing generative AI can make developing new applications and modernizing existing applications more environmentally sustainable. Generative AI can also identify which workloads can be most efficiently containerized; it can rethink the entire data center, designing and optimizing layouts, cooling systems, and server configurations to minimize energy consumption.

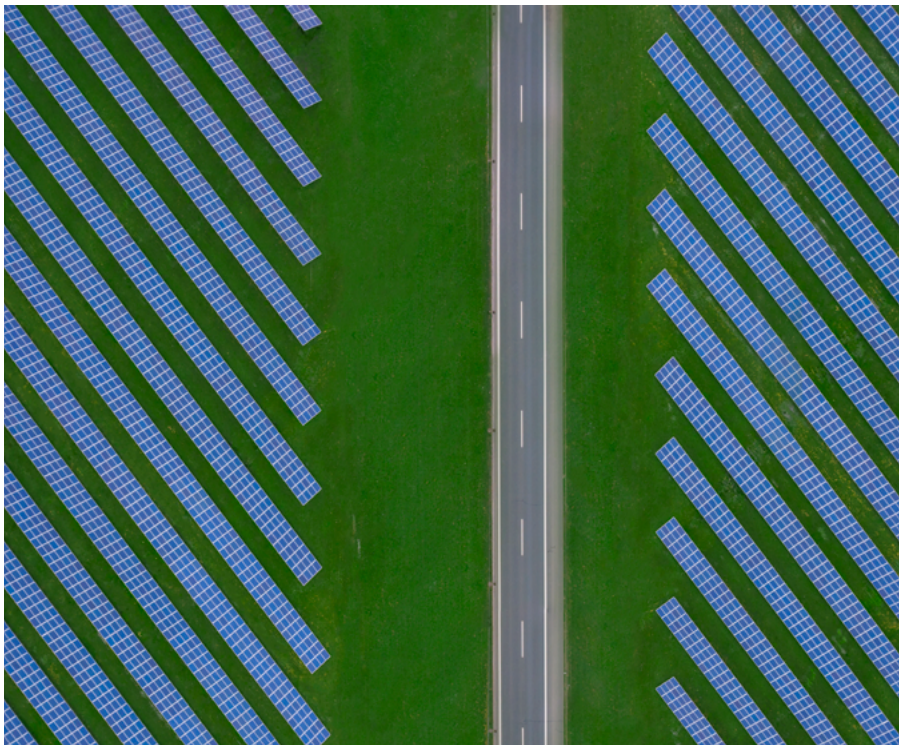
**FIGURE 1**  
**Enterprises are taking steps to reduce the environmental impact of generative AI and large language models**





With increasing numbers of firms recognizing the value associated with reducing carbon footprints through innovative approaches, incorporating generative AI into these efforts appears increasingly promising. Organizations have taken note, and 27% were already applying (post pilot) generative AI in green IT initiatives and operations in 2023. Sixty-three percent plan to apply it by the end of 2024 and 89% say they will by the end of 2027.

Holistic organizations are embracing the opportunities of gen AI for more sustainable IT to a greater extent than others. On average, almost half (49%) of the organizations taking a holistic approach were already deploying generative AI for green IT in 2023 compared to only 8% for the less mature. In terms of specific generative AI use cases for green IT initiatives, energy consumption optimization ranks first (see Figure 2).



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FIGURE 2

Top generative AI implementations in green IT initiatives and IT operations (2023).



# Harnessing the power of people and visibility

More sustainable IT is not just about technology; it's about people too. Educating employees on the environmental impact of their IT habits and fostering a culture of responsible use are crucial. The study finds that organizations with a more holistic approach dedicate nearly three times more training hours to green IT initiatives for their employees.

Finally, successfully reducing the environmental impact of IT hinges on accurate measurement and visibility—yet only one in five companies monitors and reports energy consumption related to IT operations daily. Organizations must establish baselines and implement effective tracking mechanisms to quantify their progress. This data-driven approach empowers informed decision-making and continuous improvement.

FIGURE 3

## Greener IT people initiatives



*Only 1 in 5 companies monitors and reports energy consumption related to IT operations daily.*

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## Perspective

### Regulations driving more sustainable IT

#### Regulations driving more sustainable IT

The regulatory landscape for green IT is rapidly evolving, with specific initiatives being implemented across various regions. For instance, the European Union's Energy Efficiency Directive (EED) mandates minimum energy efficiency requirements for data centers, including the use of energy-efficient equipment and cooling technologies. In the United States, the US Environmental Protection Agency (EPA) has established energy efficiency guidelines for data centers, encouraging the adoption of sustainable practices.

In Asia, China and Japan are implementing stringent energy efficiency standards for data centers and promoting the use of renewable energy sources. Additionally, the Singapore Green Data Center Code provides voluntary guidelines for data centers to adopt energy-efficient and environmentally sustainable practices.

While these regulations are significant, several other factors are influencing the adoption of green IT practices:

- **Carbon pricing.** Many countries and regions are implementing carbon pricing mechanisms, such as carbon taxes or emissions trading schemes. These initiatives incentivize organizations to reduce their carbon footprint, including IT-related emissions.
- **Corporate social responsibility (CSR).** Companies are increasingly expected to demonstrate their commitment to sustainability through their CSR programs. This often includes initiatives to reduce the environmental impact of their IT operations.
- **Supplier and partner pressure.** Organizations are facing pressure from their suppliers and partners to adopt more sustainable practices. This can include demands for IT sustainability certifications or commitments to reduce emissions.
- **Industry standards.** Organizations in certain industries may be subject to specific industry standards or certifications related to more sustainable IT.

As the global focus on sustainability continues to grow, even more regulations and initiatives are expected to emerge in the coming years.

# Understanding industry disparities

The environmental impact of IT varies significantly across industries (see Figure 4). Sectors such as insurance and finance, where IT plays a central role, tend to prioritize green IT initiatives. Conversely, heavy manufacturing industries with entrenched legacy systems may lag behind.

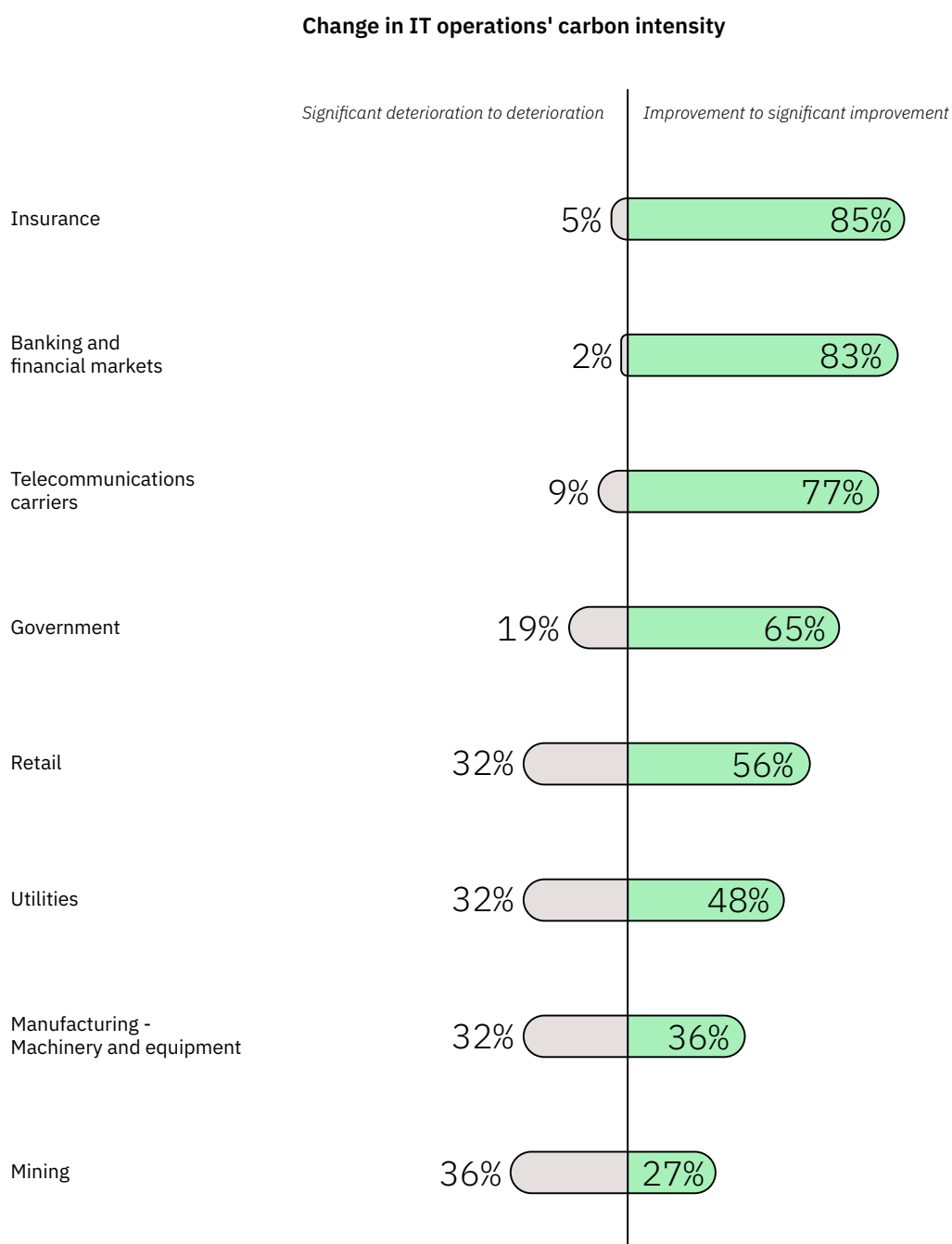
Understanding these industry-specific nuances is essential for crafting effective strategies for more sustainable IT. Businesses must prioritize green IT efforts based on their IT's relative contribution to their overall environmental footprint.





FIGURE 4

Significant variation across industries



*The solution enabled a what-if analysis of the future-state carbon footprint for different technology options under consideration by the bank.*

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## Case study

### A greener path forward

#### Large bank's IT transformation journey begins

As the world grapples with the challenges of climate change, one large bank is taking a proactive approach to reducing its carbon footprint. With a commitment to achieving net-zero emissions, the bank recognized that its IT estate was a significant contributor to its overall carbon emissions, accounting for roughly 40% of its total carbon footprint.

#### The opportunity

The bank's IT transformation journey was already underway, aimed at reducing technical debt and modernizing its infrastructure. However, leaders struggled to create a strong business case for the transformation, backed by a positive environmental impact. The challenge lay in measuring the carbon footprint of its current IT estate at a granular level and estimating the future-state carbon footprint for different technology choices.

#### The solution

The solution leveraged the Green IT Analyzer (GiTA) platform hosted on Amazon Web Services (AWS). The GiTA platform provided a detailed analysis of the bank's energy and carbon footprint, covering 1,500 instances of physical servers, virtual machines, and AWS EC2 instances. The solution went beyond mere measurement, offering insights into the distribution of carbon emissions and identifying carbon hotspots.

But that was just the beginning. The solution also enabled a what-if analysis of the future-state carbon footprint for different technology options under consideration by the bank. This allowed the bank to make informed, energy/carbon-aware decisions about its technology choices, helping ensure that its IT transformation journey was not only modernizing its infrastructure but also reducing its environmental impact.

The results were impressive. By implementing this solution, the bank expects to achieve a 30% reduction in energy consumption, a 30% reduction in total CPU consumption, and a 25% reduction in infrastructure management costs. But the most significant impact could be on the bank's carbon footprint, with a staggering potential 70% reduction.

The bank's commitment to reducing its carbon footprint has not only contributed to a more sustainable future but has also demonstrated the business case for green IT. By leveraging the power of technology to measure and reduce its environmental impact, the bank has set a new standard for responsible business practices.

The bank's story demonstrates that even the largest and most complex organizations can make a significant impact by embracing green IT and reducing their carbon footprint.

# A more sustainable future beckons

The call to action is clear: executives must prioritize reducing the environmental impact of IT. By adopting a holistic approach, empowering employees, and leveraging data-driven insights, businesses can navigate the more sustainable IT crossroads and emerge as leaders in a sustainable future. The need will only become more pressing as enterprises seek to transform themselves with the power of generative AI.

As organizations start to scale generative AI across their enterprises, they must do so responsibly. Generative AI is not inherently unsustainable. When harnessed responsibly, it can be a powerful tool for greener IT. Imagine AI-powered systems that optimize data center cooling, predict equipment failures for preventive maintenance, or design energy-efficient products.



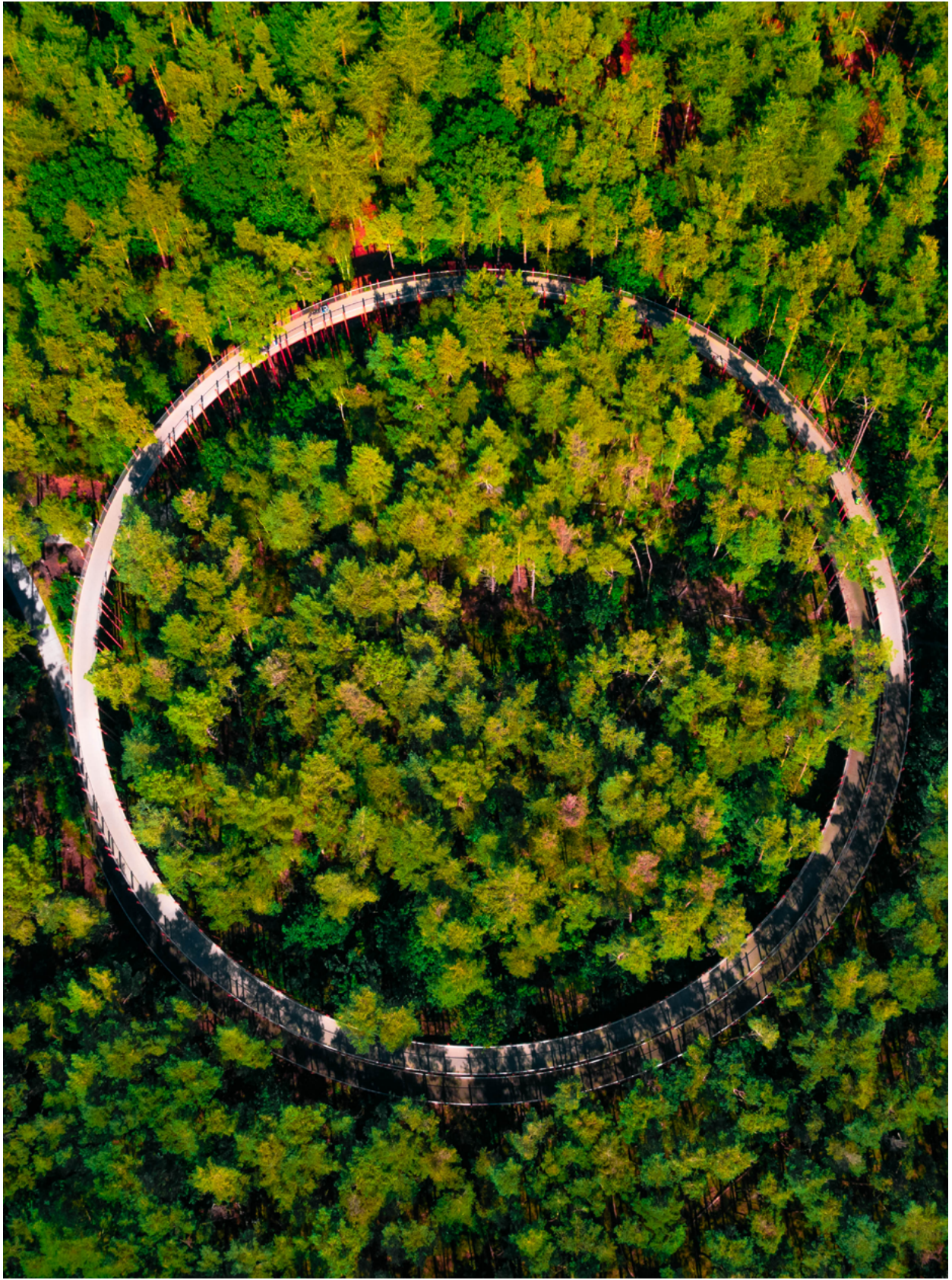
*Generative AI is not inherently unsustainable. When harnessed responsibly, it can be a powerful tool for greener IT. Imagine AI-powered systems that optimize data center cooling, predict equipment failures for preventive maintenance, or design energy-efficient products.*

To optimize the value of generative AI while minimizing its environmental footprint, organizations must adopt a lifecycle approach. This means actively managing energy consumption from development to deployment. Key strategies include:

- **Strong governance.** Ensure clear oversight of AI models to prevent duplication and unnecessary energy use. Document all models, code, and training data for transparency and reuse.
- **Efficient architecture.** Choose AI models that are designed for speed and energy efficiency. For example, models that can process information more effectively and require less computational power.
- **Smart training.** Upgrade and fine-tune existing models to new tasks without needing to retrain them from scratch, saving energy. Use open-source resources to make existing AI models better instead of building new ones for every need.
- **Optimized processors.** Invest in specialized processors optimized for machine learning training, such as GPUs. This can improve energy efficiency significantly compared to general-purpose processors.

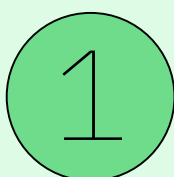
By prioritizing sustainable practices and fostering collaboration between IT and sustainability teams, businesses can unlock the full potential of generative AI for a greener future. Progress is occurring—about seven out of 10 (73%) have a designated team or individual responsible for implementing and tracking green IT initiatives. Almost one-quarter (23%) say communication and collaboration between IT and other departments regarding green IT initiatives is highly effective.





# Action guide

Here are a few first steps to make your IT operations greener:



**Identify your environmental impact drivers.** Discover how different elements of your IT estate influence environmental impacts and how these drivers can change as you scale new IT efforts. Set clear environmental control parameters to guide every IT decision and give your teams the tools they need to assess and monitor the environmental impact of IT use in the organization.



**Embrace sustainable-by-design principles.** Be proactive, embedding sustainability in IT design, including data centers, architecture, application development and modernization, and day-to-day IT maintenance. Making your IT more sustainable up-front is more effective than retrofitting and adjusting it after implementation.



**Create a sustainable IT supply chain.** Develop a sustainable supply chain strategy for IT products and services. This includes working with suppliers who adhere to environmentally responsible practices, such as responsible sourcing, recycling, and waste reduction. Establish clear sustainability standards and guidelines for suppliers and monitor their progress.



**Set up a green IT nerve center.** Gain visibility to orchestrate IT efforts for greater sustainability across your cloud and on-prem estate, using a hybrid-cloud platform as a green IT control tower. Establish green IT governance principles and guidelines to facilitate enterprise-wide standards.



# Action guide



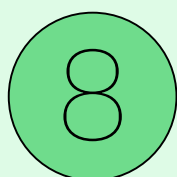
**Develop a circular economy approach to IT.** Implement a circular economy mindset by designing digital products and services that are restorative and regenerative by design. This includes developing products that are recyclable, reusable, or biodegradable. Work with suppliers to develop sustainable product design principles and encourage the use of recycled materials in IT products.



**Optimize with hybrid cloud, virtualization, edge computing, and the Internet of Things (IoT).** We covered how hybrid cloud and virtualization can help green your IT. And, as the Internet of Things (IoT) continues to grow, consider deploying edge-computing solutions to process data closer to where it's generated. This reduces the need for data to be transmitted to centralized data centers, resulting in lower energy consumption and latency.



**Earmark some of your gen AI investments specifically for sustainability.** Then leverage gen AI and machine learning to optimize IT operations and reduce environmental impact. AI can help predict and prevent energy waste, optimize data center cooling systems, and identify opportunities for reducing energy consumption.



**Actively manage the energy consumption associated with AI.** Select the right AI model architecture, use specialized processors optimized for machine learning training, and choose suitable model training techniques, all of which have varying energy usage implications. Establish robust enterprise governance over AI models to prevent duplication and unnecessary energy use and enhance model lifecycle management.

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## Methodology

To better understand organizations' progress towards greener IT operations, the IBV worked with Oxford Economics to survey 1100 organizations from 22 countries and 19 industries. Respondents are executives or hands-on stakeholders that have in depth knowledge of their organizations' data center, infrastructure, cloud, development, and maintenance capabilities and associated performance metrics at enterprise level. In addition, respondents have an understanding of their organizations' progress in making their IT more environmentally sustainable and how they are measuring success in Green IT. The data obtained from the survey was analyzed to identify Green IT practices most prevalent amongst organizations, highlighting industry differences where applicable. The data from the survey was further analyzed to determine patterns in implementation approaches, with respondents answering in similar patterns grouped together into 4 distinct segments. The relationship between implementation approaches and performance on Green IT metrics was then analyzed.



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## Related reports

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IBM Institute for Business Value. February 2024.  
<https://ibm.co/sustainability-business-value>

### **IT sustainability beyond the data center.**

IBM Institute for Business Value. May 2022.  
<https://ibm.co/it-sustainability>

### **CEO's guide to generative AI for sustainability.**

IBM Institute for Business Value. 2023.  
<https://ibm.co/ceo-ai-sustainability>

## Notes and sources

- 1 Green IT survey. IBM Institute for Business Value. n = 1100. April 2024. All data in this report is from this survey unless otherwise noted.
- 2 Roy, Sreejit, Diptiman Dasgupta, Charbak Roy, and Nalini Manuru Dixit. *IT sustainability beyond the data center: Decarbonizing with hybrid cloud*. IBM Institute for Business Value. May 2022. <https://www.ibm.com/thought-leadership/institute-business-value/en-us/report/it-sustainability>

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