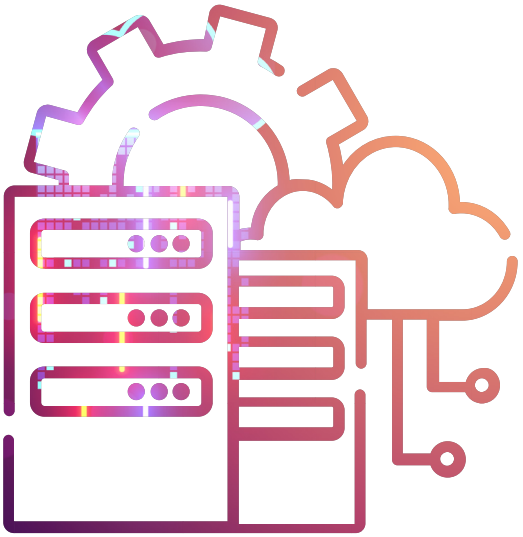
MIT Technology Review
Insights

Produced in partnership with

Hitachi Vantara

Modern storage solutions support decarbonization—while improving performance and lowering costs.

Sustainability starts with the data center



Key takeaways

1. **Data center decarbonization initiatives can tackle a key source of emissions while also creating a modern platform for business innovation.**
2. **Components of a decarbonization plan could include replacing aged hardware, modernizing and automating workflows, compressing and deduplicating data, and transitioning to longer-lasting infrastructure.**
3. **Though measuring sustainability impacts can be challenging, particularly when it comes to Scope 3 emissions, this type of analysis is essential to an impactful decarbonization project.**

When asked why he targeted banks, notorious criminal Willie Sutton reportedly answered, "Because that's where the money is." Similarly, when thoughtful organizations target sustainability, they look to their data centers – because that's where the carbon emissions are.

The **International Energy Agency (IEA) attributes** about 1.5% of total global electricity use to data centers and data transmission networks. This figure is much higher, however, in countries with booming data storage sectors: in Ireland, 18% of electricity consumption was attributable to data centers in 2022, and in Denmark, it is projected to reach 15% by 2030. And while there have been encouraging shifts toward green-energy sources and increased deployment of energy-efficient hardware and software, organizations need to accelerate their data center sustainability efforts to meet ambitious net-zero targets.

For data center operators, options for boosting sustainability include shifting energy sources, upgrading physical infrastructure and hardware, improving and automating workflows, and updating the software that manages data center storage. **Hitachi Vantara estimates** that emissions attributable to data storage infrastructure can be reduced as much as 96% by using a combination of these approaches.

Critics might counter that, though data center decarbonization is a worthy social goal, it also imposes expenses that a company focused on its bottom line can ill afford. This, however, is a shortsighted view.

> "Decarbonization and the more efficient energy utilization of the data center are supported by the same technologies that support data center modernization. Modernization has sustainability goals, but obviously it provides all kinds of business benefits, including enabling data analytics and better business processes."
>
> Dave Pearson,
> Research Vice President, IDC

Data center decarbonization initiatives can provide an impetus that enables organizations to modernize, optimize, and automate their data centers. This leads directly to improved performance of mission-critical applications, as well as a smaller, denser, more efficient data center footprint – which then creates savings via reduced energy costs. And modern data storage and management solutions, beyond supporting sustainability, also create a unified platform for innovation and new business models through advanced data analytics, machine learning, and AI.

Dave Pearson, research vice president at IDC, says, "Decarbonization and the more efficient energy utilization of the data center are supported by the same technologies that support data center modernization. Modernization has sustainability goals, but obviously it provides all kinds of business benefits, including enabling data analytics and better business processes."

How to decarbonize a data center

Organizations should apply a variety of interrelated approaches to data center decarbonization. These include eco-friendly replacements for hardware and infrastructure, workflow modernization tools, data management improvements, and better use of tools for tracking and monitoring energy consumption.

Where you start matters. While cutting-edge technologies like liquid cooling are interesting and important, "you probably want to start with optimizing the IT infrastructure first, so that when you address air conditioning optimization, you've brought what you are cooling down to the minimum level possible," says Ian Clatworthy, director of data platform product marketing at Hitachi Vantara.

On the hardware front, solid-state flash arrays have emerged as an eco-friendly replacement for spinning disks. "If you look at the last 10 years," says Clatworthy, "the 2014 generation of storage produced 27 kilos of CO2 per terabyte, and we've reduced that year-on-year to the point now where we're down to four. It's a massive reduction."

Pearson notes the cost advantages of upgrading as well. "If we can replace multiple spinning disk arrays with fewer dense flash arrays," he says, "we're going to see savings. I get to amortize that against the cost of the flash and maybe I pay a bit more for it up front, but I justify the

Sustainable storage at Türk Telekom

Turkish telecommunications provider Türk Telekom has prioritized sustainability, with a goal of zero carbon emissions in all service buildings and data centers within the scope of the Paris Agreement goal to reach net-zero by 2050. The company, which offers mobile, internet, home phone, and corporate services, won the Low Carbon Hero award at the eighth Istanbul Carbon Summit for its smart energy management platform.

The company, which operates five data centers across Turkey, recognizes the clear link between digitalization and sustainability. "The increasing need for digitalization has made next-generation approaches mandatory," says Mehmet Fatih Bekin, data center and cloud services director at Türk Telekom.

For example, to both modernize its infrastructure and boost its sustainability, Türk Telekom recently deployed a cutting-edge virtual storage system. The change reduced the organization's data center footprint from 23 storage cabinets to nine. That alone cut power, cooling, and space costs by 60%.

The company has taken a multi-pronged approach to sustainability with substantial results. Space required to house compute and storage infrastructure has been reduced by a ratio of 8:1, while energy usage has achieved savings at a ratio of 2:1. Power usage efficiency is at the high end of industry standards, and water usage efficiency exceeds the industry average.

Türk Telekom plans to continue to modernize its data centers, introducing innovations such as liquid cooling technology. "We plan to build a data center filled with more modernized and advanced technologies in the future," says Bekin. "Building a data center that operates entirely on renewable energy sources will significantly increase sustainability and reduce carbon emissions."

Increasing global digital traffic and data center energy use

While energy use is growing, efficiency gains have moderated the increase, even as internet traffic soars

	2015	2022	CHANGE
Internet users	3 billion	5.3 billion	+78%
Internet traffic	0.6 zettabytes	4.4 zettabytes	+600%
Data center workloads	180 million	800 million	+340%
Data center energy use*	200 terawatt-hours	240-340 terawatt-hours	+20%-70%

*excluding crypto
Source: Compiled by MIT Technology Review Insights, based on data from "Data Centres and Data Transmission Networks," IEA, July 11, 2023

savings in smaller space, lower power charges, and less cooling."

IT infrastructure professionals might be convinced by the value of new storage infrastructure, but still be concerned about how to manage the migration of data from legacy to current-generation technologies. The good news is that modern solutions have that covered with storage virtualization technology. Clatworthy says, "Not only is the current generation of storage that much more power-efficient than the old ones, but also for each generation, we provide the capability to migrate the data non-disruptively. If you can do that, you can save the data migration overhead. Increasing the amount of power you're saving by not undertaking that migration is huge. And it allows you to more easily move to the next more power-efficient generation."

An eco-friendly substitution like flash storage can also catalyze further sustainability changes across the organization. Pearson explains, "The same storage infrastructure that supports sustainability goals also happens to be very dense and high performing, and helps rationalize existing data center infrastructure and scale things down. So, it's taking up less footprint in the data center; it also increases the scale of what they

can consolidate within a storage array." Adopting these newer technologies can lead organizations to a next stage of sustainability, such as reducing and consolidating their physical infrastructure.

Workflow modernization opportunities

Migrating from legacy to next-generation storage infrastructure also provides opportunities for workflow modernization. In a legacy storage system, "if I have to introduce a new piece of hardware for every workflow I have because I need to match certain capacity requirements or performance requirements, whether that's latency or I/O or throughput, then that's a problem," says Pearson. "I wind up with lots of heterogeneous infrastructure, and lots of overprovisioning of infrastructure to support all these workloads."

With modernized storage systems, however, "something that has great performance characteristics can atone for a lot of sins when it comes to application development," says Pearson. "I can run more applications and more disparate applications that have different workload requirements because the speed of the flash covers for a lot of the flaws in development or the differences in application needs."

A small business might be able to run all of its apps on a single array, breaking down silos between data sources. And a large enterprise can run more workloads on the same infrastructure. "When I'm able to break down those silos and bring the application and the data into a single or at least fewer arrays, that changes everything for me," says Pearson. "That means data is accessible to more applications and more users at a single time. I no longer have these disparate arrays and media types and applications that are all separate and require different management and different security."

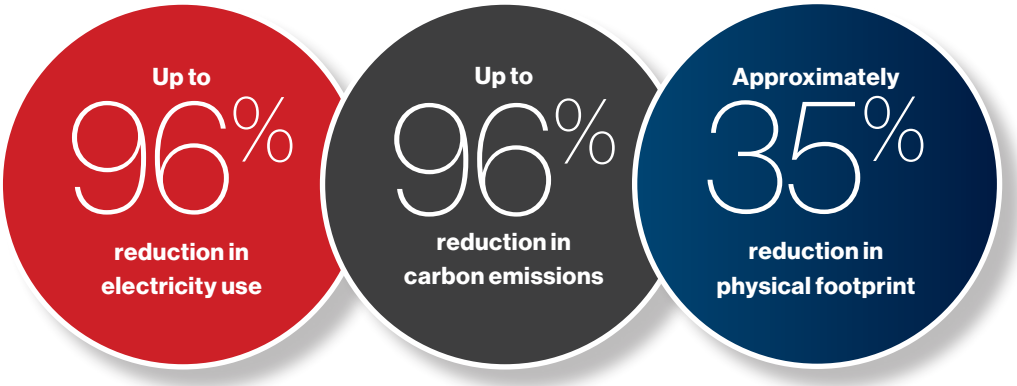
Consolidating data on a high-performance storage array also enables the deployment of automation technologies that place workloads on the appropriate hardware for maximum utilization of data center resources. Storage management, monitoring and automation toolsets can "make sure that I don't have particular arrays running too hot, using too much capacity, too much throughput based on the workloads that are on them," says Pearson. "If I'm able to move them around in a non-disruptive way, and prevent human interaction from being required to do that, then I wind up with a more efficient data center."

Data compression and data deduplication

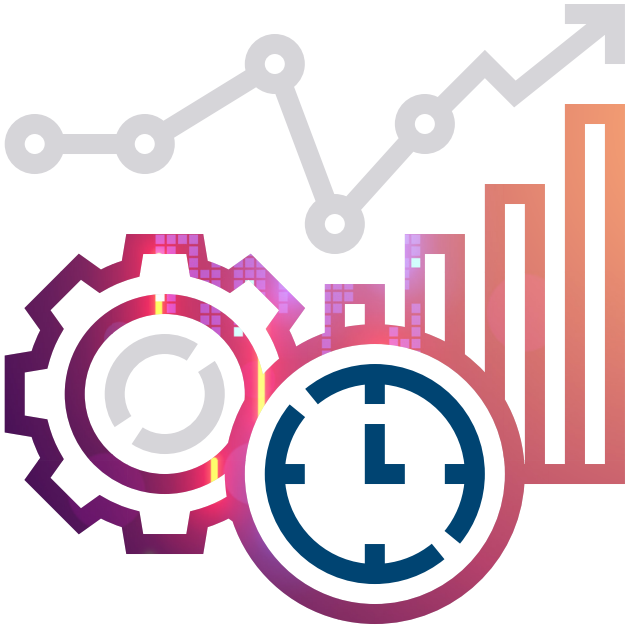
Two additional tools in the sustainability toolbox, says Clatworthy, are data deduplication and data compression. Data compression technology encodes repeatable bits into smaller files. "The greater the data compression," says Pearson, "the more efficient and, really, the smaller the data center footprint is going to be."

Deduplication looks across data silos, identifying and removing duplicates of identical data sets. Data silos, by definition, create duplicated infrastructure. "Each silo is the result of an IT project that built its own stack of infrastructure," says Clatworthy. "Not only is breaking

Potential impacts of decarbonization projects



Source: Compiled by MIT Technology Review Insights, based on data from "**7 Ways to Reduce Your CO2 Footprint and Save Money**," Hitachi Vantara, February 22, 2023



> "Times have changed. People want access to all their data, and they want it to be available, and often at high performance."
>
> Ian Clatworthy, Director of Data Platform Product Marketing, Hitachi Vantara

down the silos useful from a data correlation point of view, but it also allows you to get rid of a whole bunch of unnecessary infrastructure because you no longer need to have five or six duplicated sets of data."

This provides a pathway for introducing efficiency-boosting automation. Once you've done away with silos, says Clatworthy, "now you've got a much more optimized, much more efficient, but bigger set of infrastructure. Now you need automation tools to manage it."

And data center storage requirements are not static. New applications are constantly being created, and the amount of data that needs to be stored and processed continues to grow. Companies that once archived data for regulatory reasons now understand that they need to be able to access all of that data to power AI-based tools such as large language models (LLMs.)

"Times have changed," says Clatworthy. "People want access to all their data, and they want it to be available, and often at high performance." Through sustainability efforts that reduce the data center footprint, as well as optimize and automate processes, organizations are able to offset that growth and avoid disruptive and expensive forklift upgrades.

The benefit to the business is a consolidated, well-managed data lake that enables advanced data analytics using machine learning and AI.

Increasing asset longevity

Longer-lasting business assets improve the bottom line while also contributing to sustainability. "If I can increase the lifespan of my infrastructure, I'm no longer causing carbon creation when I'm manufacturing these devices or when someone else is manufacturing them on my behalf. It looks really good not just from an operation standpoint, but from an entire lifecycle standpoint," says Pearson.

An additional benefit of the transition to flash storage is that it extends the life of data center infrastructure. Flash storage not only consumes less power than disk, but flash storage can also last longer. "A big concern with flash early on was that people didn't really know how many write cycles they would get," says Pearson. "They were concerned about its lifespan." Today, however, "longevity guarantees being provided by enterprise array manufacturers go beyond what you'll get from spinning disk arrays," he adds, noting that the lifespan of a spinning disk tops out at four to five years, while flash arrays can last up to 10.

In addition, advances in chip technology, as well as techniques like server virtualization and containerization, have enabled organizations to get more out of their server assets. Three-year refresh cycles have been extended to five or even seven years.

Measuring sustainability

There's little point in setting sustainability goals unless the organization has a way to measure progress and

to report success to stakeholders, including employees, customers, investors, and regulatory agencies. Sustainability measurement, however, can be extremely complex.

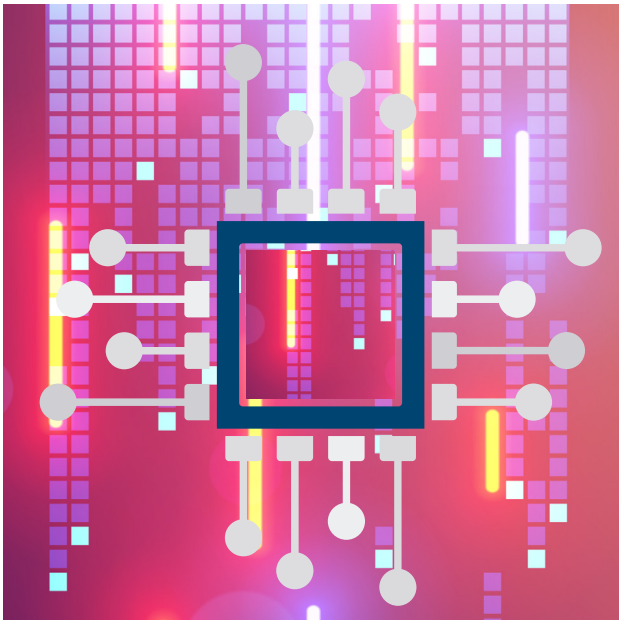
Carbon emissions, for example, are classified into three types. Scope 1 emissions are emissions that are completely under your control – those produced by your data center, for example. Scope 2 emissions are those generated on your behalf by an energy producer; in other words, a measure of the extent to which your electricity provider is using clean energy sources versus burning coal. And Scope 3 emissions correspond to energy being consumed on your behalf, such as in the cloud.

"If you ship stuff out to a cloud provider, you need transparency about how much power they are consuming on your behalf," says Clatworthy. "You don't get a free ride just because you've moved something off premises. Measuring progress toward your ESG [environmental, social, and corporate governance] goal is now just that much more complicated."

Clatworthy adds that we currently lack standard tool sets for measuring energy consumption. "Right now, there's a lot of heavy lifting to get to the point of understanding everything," he says. For that reason, many organizations rely on third-party experts to help with the measurement of sustainability efforts.

With complexity a given, the key to data center decarbonization is assessing the existing data center environment and developing a cost/benefit analysis aimed at identifying which projects will deliver the most bang for the buck. Organizations can then take a multi-pronged approach to sustainability. This typically starts with eco-friendly hardware replacements, then moves on to applying techniques like storage virtualization, workflow automation, and advanced storage management tools.

Data center decarbonization doesn't need to be a tough sell. It provides numerous benefits to the organization, including more efficient data center operations, improved application performance, and lowered costs. In addition, a modern data-storage platform sets the stage for the technology future, providing the infrastructure necessary for advanced data analytics, machine learning, and generative AI.



"If you ship stuff out to a cloud provider, you need transparency about how much power they are consuming on your behalf. You don't get a free ride just because you've moved something off premises."

Ian Clatworthy, Director of Data Platform Product Marketing, Hitachi Vantara

"Sustainability starts with the data center" is an executive briefing paper by MIT Technology Review Insights. We would like to thank all participants as well as the sponsor, Hitachi Vantara. MIT Technology Review Insights has collected and reported on all findings contained in this paper independently, regardless of participation or sponsorship. Teresa Elsey was the editor of this report and Nicola Crepaldi was the publisher.

About MIT Technology Review Insights

MIT Technology Review Insights is the custom publishing division of MIT Technology Review, the world's longest-running technology magazine, backed by the world's foremost technology institution – producing live events and research on the leading technology and business challenges of the day. Insights conducts qualitative and quantitative research and analysis in the U.S. and abroad and publishes a wide variety of content, including articles, reports, infographics, videos, and podcasts. And through its growing MIT Technology Review Global Insights Panel, Insights has unparalleled access to senior-level executives, innovators, and entrepreneurs worldwide for surveys and in-depth interviews.

From the sponsor

Hitachi Vantara, a wholly-owned subsidiary of Hitachi Ltd., delivers the intelligent data platforms, infrastructure systems, and digital expertise that supports more than 80% of the Fortune 100. To learn how Hitachi Vantara turns businesses from data-rich to data-driven through agile digital processes, products, and experiences, visit **hitachivantara.com**.

Learn more about Hitachi Vantara sustainable data infrastructure solutions: **hitachivantara.com/en-us/solutions/sustainability/data-center-ecosystem.html**.

Hitachi Vantara

Illustrations
Cover art by Adobe Stock, spot illustrations created by Chandra Tallman Design LLC, compiled from The Noun Project and Adobe Stock.

MIT Technology Review Insights

www.technologyreview.com

insights@technologyreview.com