IT sustainability

ManageEngine's green shift: Embracing sustainability in enterprise IT



ManageEngine

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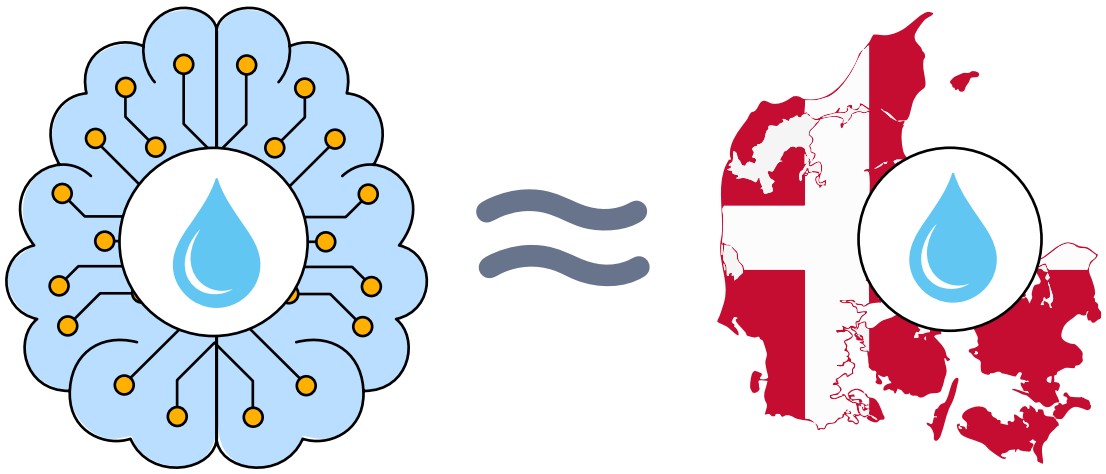
PART 01
Sustainable IT practices



Chapter 1:
Understanding the environmental impact of IT

GenAI has a notable environmental impact.

This sentiment is widely expressed online, but it remains broad and doesn't explain how GenAI tools contribute to climate change or the associated environmental costs. Here's the deal: large language models (LLMs) operate on data centers, i.e., energy-intensive servers that consume vast amounts of electricity and emit high levels of carbon dioxide (CO2). These data centers also need water to cool the servers. An average GenAI session with 10-50 responses can effectively use up to half a liter of fresh water.



Studies reveal the global AI demand is projected to account for 4.2-6.6 billion cubic meters of water withdrawal in 2027, which is more than the total annual water withdrawal of Denmark. (Source: University of California Riverside)

This isn't just a technical concern. As the hidden environmental costs of AI come to light, stakeholders are beginning to question not just what a tool can do, but what it takes to do it. The conversation is shifting from focusing solely on performance to embracing performance with responsibility.

The modern customer isn't just looking for cutting-edge technology. They're also evaluating the environmental impact of their choices. Businesses investing in software solutions are increasingly conscious of sustainability, expecting providers to take responsibility for their environmental, social, and governance (ESG) practices. Buyers now ask tough questions: **What are your sustainability initiatives? How energy-efficient is your cloud infrastructure? What steps are you taking to reduce carbon emissions?** The answers to these questions directly influence their purchasing decisions.

Transparency is no longer optional. Solution providers must be clear about their sustainability commitments, whether it's using renewable energy, optimizing data centers for efficiency, or reducing e-waste. A lack of effort, or even misleading by greenwashing, can push potential customers toward competitors who align better with their values. As awareness grows, so does responsibility. Not only is taking real action on sustainability great for the planet, it's also essential for staying competitive in an increasingly conscious market.

The environmental footprint of IT

The carbon footprint of the IT industry contributes significantly to overall global emissions, making it one of the fastest-growing sources of environmental impact. As more people and businesses rely on digital services, the energy demand from data centers, networks, and electronic devices continues to rise. This digital infrastructure, while often invisible to end users, depends on a vast amount of electricity, much of which still comes from fossil fuels. When combined, the emissions from production, operation, and disposal of IT hardware and services add to a meaningful share of global greenhouse gas output. The rapid expansion of digital technology is shaping a future where IT plays a central role not only in economic growth but also in the planet's climate trajectory.



1. Data centers

- **Energy consumption:** Data centers require electricity to power servers, storage, and cooling systems. A large percentage of this energy still comes from non-renewable sources like coal and natural gas.
- **Cooling systems:** High energy used for cooling infrastructure to maintain optimal server temperatures contributes heavily to global emissions.
- **Idle resources:** Inefficient server utilization and always-on systems increase energy consumption unnecessarily.



2. Hardware manufacturing and disposal

- **Resource extraction:** The production of IT hardware, such as servers, networking equipment, and user devices, involves mining rare earth metals and other resources, leading to damaged ecosystems, unfair labor practices, and high carbon emissions.
- **Supply chain emissions:** Factories manufacturing parts like semiconductors, circuit boards, and casings create carbon emissions. Transportation and distribution of hardware further add to the carbon footprint.



3. E-waste

- **Rapid hardware turnover:** Hardware lifespans are reduced due to planned obsolescence or compatibility issues, leading to an increase in e-waste.
- **Improper disposal:** A significant portion of e-waste is improperly disposed of, leading to toxic chemicals leaching into the environment. Recycling rates for IT equipment are low, and much of it ends up in landfills.
- **Energy-intensive recycling:** Even when recycled, breaking down and reprocessing materials can consume large amounts of energy, especially if facilities are inefficient.



4. Operational inefficiencies

- **Poorly optimized code:** Software requiring excessive computational resources increases the energy demand of hardware.
- **Redundant systems:** Duplicate data processing or lack of streamlined workflows leads to energy waste.

Leadership in sustainability

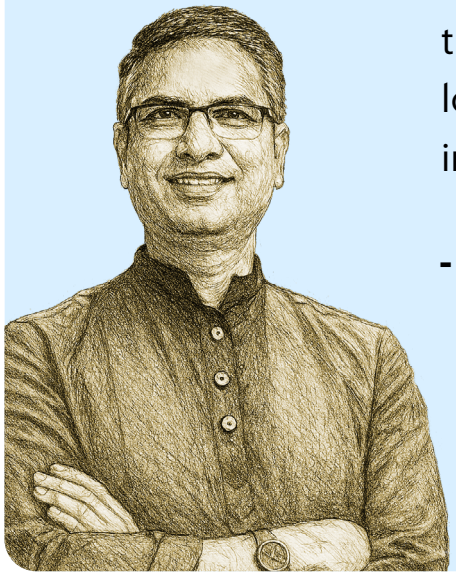
When leaders prioritize sustainability, they set the tone for the entire organization, influencing decisions across operations, supply chains, and corporate strategy. Their involvement ensures that sustainability is not treated as a side project but embedded into the core of business strategy. They create alignment across teams, allocate the right resources, and hold the organization accountable to measurable goals.



At Zoho, sustainability is built into the work environment and the ways in which we conduct business. Energy consumption is a key focus area, leading to the adoption of renewable energy for our data centers and offices to minimize our environmental impact. Some noteworthy sustainability initiatives include a 100% water recycling system, substantial CAPEX towards improved energy efficiency, and a focus on e-mobility, all at Zoho's Chennai hub.

- Sridhar Vembu
Chief scientist, Zoho Corp.

Leaders should be hands-on with their sustainability efforts because their influence directly impacts how seriously the organization approaches environmental responsibility. Their role goes beyond setting vision and endorsements. They should be deeply involved in reviewing progress, making informed trade-offs, and ensuring teams have the authority and resources to act. A visible and committed leadership presence signals to employees, partners, and stakeholders that sustainability is a long-term priority.



> Business leaders need to have a mindset shift regarding how sustainability will impact their bottom line and competitiveness in the long run, aside from focusing on short-term investments in costs and resources.
>
> **- Rajesh Ganesan**
> CEO, ManageEngine

Investors now factor ESG performance into decision-making, while customers expect greater transparency and accountability. As climate risks intensify and regulations tighten across regions, businesses are embedding sustainability into everything from supply chain management and product design to energy sourcing and data center operations. This shift is not limited to large corporations; even mid-sized and emerging companies are trying to align with global frameworks.

Zoho's Vision

Sustainability is not just about goals or reports, it is a guiding principle that informs every decision we make. At Zoho, we are driven by the belief that true progress isn't only measured by our achievements, but by how we ensure a thriving planet for future generations. Our commitment to sustainability is not just a responsibility—it's an opportunity to make a lasting, positive impact. We did not set out with the intention of gaining certifications; we simply recognized the need for harmony between technology and our ecosystem. Every step we take and every solution we create is centered around our desire to build a sustainable working environment for our community.

- Lydiance R
Environmental specialist, Zoho Corp.

A cultural shift of this magnitude cannot happen overnight. Lydiance, who spearheads the sustainability movement at Zoho Corp., talks about the challenges their team face—particularly in employee awareness. The problem is, people often expect immediate gratification or instant results from their sustainability efforts. Without it, it can become significantly more challenging to adhere to established guidelines or responsible practices. Integrating sustainability requires a top-down approach combined with the understanding that this is an ongoing process.

"If we start today, can we see results in a week or a month? Certainly not. It takes time to sow the seeds and reap its benefits. Most companies are not willing to invest in this because it's not a revenue-generating initiative. Thankfully, Zoho's senior leadership has always been about the big picture. In the long run, not only do we save money, we also set an example for other businesses in the tech industry. It can be done, and we are proof. We hope to inspire others and establish ourselves as change-makers for sustainability," Lydiance said.

For organizations starting from the ground up with a new sustainability team, the first step should be to hire a chief sustainability officer (CSO). Now you may think, if all of these initiatives can be done without a dedicated CSO, why do we need one? What sets a CSO apart is focus, accountability, and influence at the executive level. With access to the boardroom, a CSO can influence high-impact decisions like procurement, product design, and stakeholder relations.

Here's a quick look at the structure of a corporate sustainability team with a CSO at its helm:

Role	Responsibilities
Chief sustainability officer (CSO)	**Sets the sustainability vision and long-term strategy and aligns goals with the corporate mission. Reports to the C-suite or board.**
Sustainability program manager / specialist	Oversees day-to-day implementation, manages timelines and budgets, and ensures compliance. Reports to the CSO.

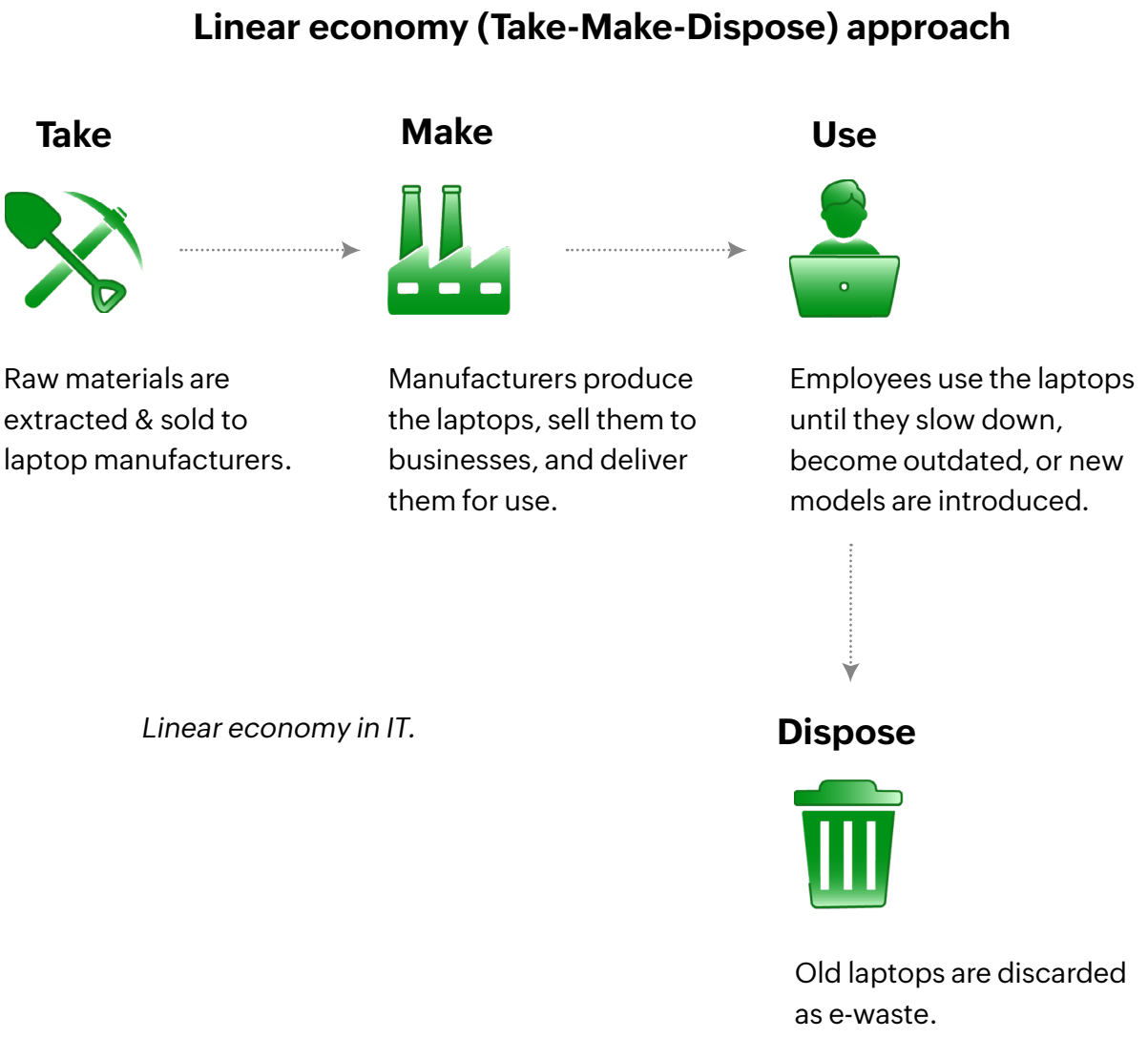
Role	Responsibilities
Subject matter lead	Vertical expert who collaborates with operational departments to identify opportunities and ensure adherence to regulations. **Examples:** Environmental compliance lead, energy and resource efficiency analyst, facility liaison
Green supply chain coordinator	Works with procurement to source sustainable materials and evaluate vendor practices.
Data & reporting analyst	Tracks KPIs, builds dashboards, and handles sustainability metrics and external disclosures.
Stakeholder engagement/ communications lead	Develops internal and external campaigns, manages reports, and drives sustainability awareness.

The role of leadership is predominantly to balance environmental goals with operational efficiency. If environmental goals are pursued without considering operational realities, they risk becoming unsustainable themselves—too costly, disruptive, or difficult to scale. On the other hand, if efficiency is prioritized without environmental accountability, the company may face long-term risks like regulatory penalties, resource scarcity, or reputational damage. Leaders who strike this balance can ensure that sustainability efforts are both impactful and practical.

Chapter 2:
Operational excellence for sustainability

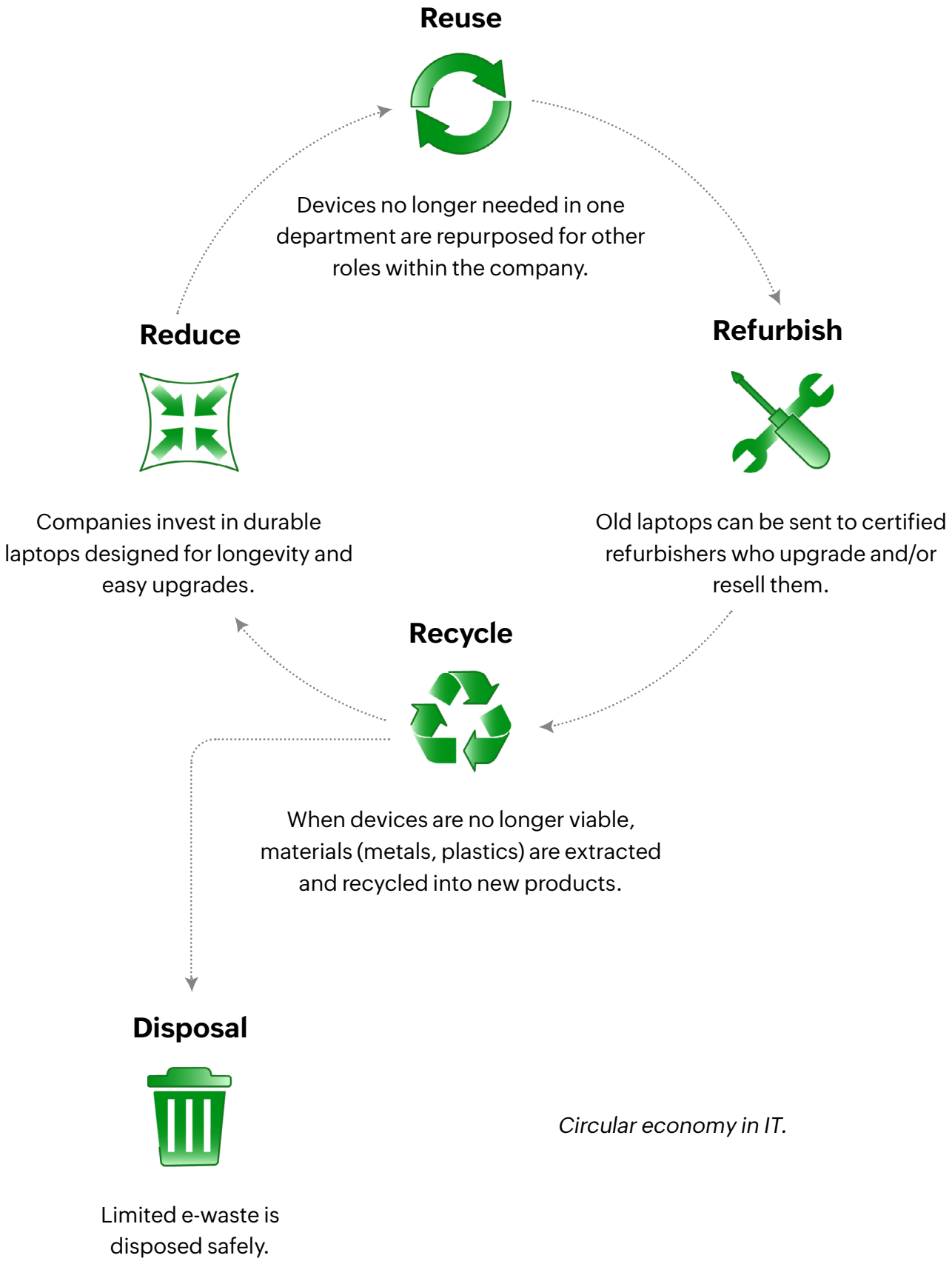
The role of a circular economy

A circular economy focuses on minimizing waste and maximizing the life cycle of resources by reusing, refurbishing, recycling, and sharing IT assets. Unlike the traditional "take-make-dispose" model, a circular economy aims to keep products and materials in use for as long as possible, reducing environmental impact and fostering sustainability.



Linear economy in IT.

Circular economy (Reduce-Reuse-Refurbish-Recycle) approach



Circular economy in IT.



Core principles of a circular economy

Fundamentally, a circular economy is a restorative system. Despite the variations in approach, the core principles are the same. In IT, they revolve around three factors: limiting consumption through efficient design and process, maintaining a closed-loop system, and creating an ecosystem that enables this movement.

Design for longevity:

IT hardware and software should be designed to last longer, with durability, upgradability, and repairability in mind. Software updates, for instance, can be designed to extend product usability instead of forcing obsolescence.

Reduce consumption:

Organizations should encourage employees to use IT equipment for longer by maintaining devices in optimal condition. Businesses can procure modular laptops and desktops that allow for easy upgrades and repairs. **Zoho Corp. introduced a wallet-based gadget policy in 2022.** Employees are provided with phones, laptops, and other accessories to meet the requirements of their role. Based on their (notional) wallet credits, they can opt for an upgrade every three to four years. This allows the IT team to monitor asset usage accurately and eliminate unnecessary consumption.

Extend product life cycle:

Organizations often discard IT equipment prematurely, leading to significant e-waste. By adopting practices like refurbishing and repurposing old hardware, businesses can minimize waste and the environmental hazards associated with disposal. For instance, instead of disposing of outdated laptops, companies can refurbish and redeploy them for less demanding tasks or donate them to educational institutions.

Responsible disposal:

Gadgets over five years old that have reached the end of their life are sent to an e-waste recycling unit. With nearly 20,000 employees at Zoho Corp. (and each having at least one or two devices), it is crucial to ensure accurate monitoring of device age. The IT team documents details such as the purchase date, serial numbers, and device specifications and sends the information to the e-waste team. These details are communicated to the e-waste vendors, who then collect the devices and provide a confirmation bill. Since the introduction of the wallet-based gadget policy, the number of devices sent for recycling has dropped considerably.

How a circular economy helps with sustainability:

- Promotes resource efficiency.
- Extends product lifespan.
- Lowers carbon footprint.
- Encourages IT asset sharing.
- Reduces e-waste.
- Creates cost savings.



Sustainable procurement practices

Sustainable procurement is crucial for corporate companies because it directly impacts environmental, social, and economic sustainability. Large organizations, in particular, have extensive supply chains, and their purchasing decisions can drive significant environmental and ethical consequences. Integrating sustainability into procurement strengthens brand reputation, attracts eco-conscious customers, and aligns businesses with global sustainability goals.

Establish clear sustainability goals:

Define specific sustainability goals that align with your organization's values and corporate social responsibility (CSR) strategy. For example, set a goal to source 50% of office supplies from recycled or eco-friendly materials within two years.

Collaborate with sustainable suppliers:

Create a supplier evaluation process that includes sustainability criteria such as environmental impact, labor practices, and ethical sourcing. Prefer suppliers with certifications like ISO 14001.

Review life cycle costing (LCC) and total cost of ownership (TCO):

Factor in maintenance, disposal, and energy usage when evaluating products or services. For example, choose a more energy-efficient machine, even if it has a higher upfront cost, because it reduces long-term energy expenses and environmental impact.

Engage in local sourcing:

Source products locally or regionally to reduce transportation emissions, support local economies, and decrease supply chain risks. Build relationships with local vendors or manufacturers and assess the carbon footprint of shipping and logistics.

Adopt circular procurement practices:

Select products designed for reuse, recycling, or remanufacturing. Choose suppliers offering take-back programs or reusable components and ensure the products can be easily disassembled for recycling.

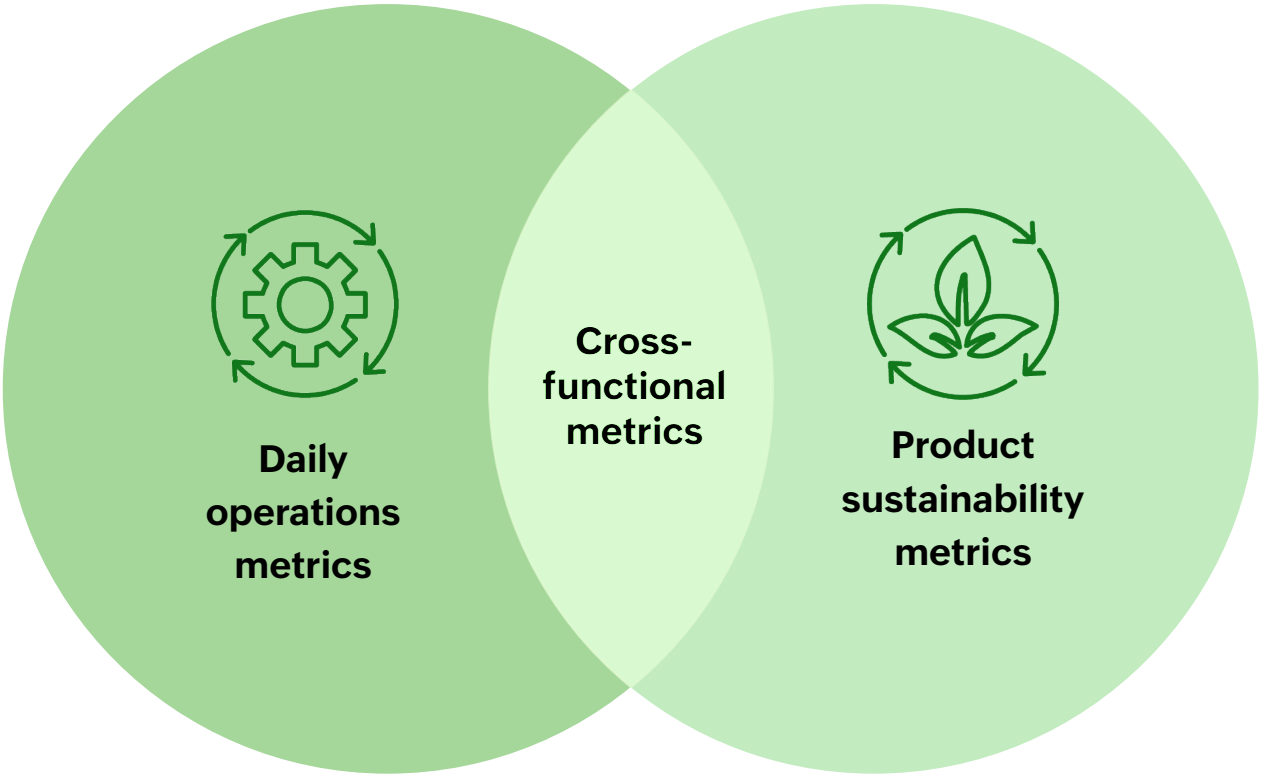
Integrate sustainability into contracts:

Develop supplier contracts that require regular reporting on sustainability metrics and compliance with environmental regulations. For instance, companies can include clauses that require suppliers to reduce plastic packaging or use sustainably sourced raw materials.

Chapter 3:
Measuring progress

Key sustainability metrics

For an enterprise, sustainability metrics should cover two primary areas: operations and product impact. These metrics help track environmental, social, and economic performance and align with sustainability goals. In this section, we'll go in greater detail about the metrics that can help monitor progress in an organization's sustainability efforts.



Daily operations metrics

1. Energy consumption

Tracks the total energy usage across offices, data centers, and operations. This helps assess the overall carbon footprint and effectiveness of energy efficiency programs. For instance, Zoho Corp. measures energy consumption (kWh) from renewable vs. non-renewable sources in global offices and data centers.

2. Carbon emissions

Measures the greenhouse gas emissions resulting from company operations, including energy use, business travel, and supply chain activities. This helps organizations set reduction targets and transition toward carbon neutrality.

It's important to measure scope 1, 2, and 3 emissions:

- Scope 1: Direct emissions from owned assets (e.g., company vehicles).
- Scope 2: Indirect emissions from energy purchases (e.g., electricity for data centers).
- Scope 3: Emissions from the supply chain and employee commuting.

3. Waste management

Monitors e-waste, general waste, and recycling rates. Good waste management practices help reduce landfill contributions and promote circular economy practices. For example, organizations can report the percentage of e-waste properly recycled through certified vendors.

4. Water usage

Tracks the amount of water consumed in facilities, manufacturing, and cooling systems for data centers. Organizations can use metrics like water usage per employee and compile reports on rainwater harvesting or greywater recycling capacity.

5. Employee commute and travel

Calculates the carbon footprint associated with employee commuting and business travel. Zoho Corp. actively monitors the percentage of employees using green commuting options (shuttle services) vs. private vehicles.

6. Renewable energy usage

Tracks the percentage of total energy sourced from renewable sources. For instance, Zoho Corp. evaluates the share of energy that comes from solar installations at the hub offices.



Product sustainability metrics

These metrics assess the environmental and social impact of products throughout their life cycle, from development to usage and disposal. They help ensure that products are designed, built, and maintained in a way that minimizes the environmental footprint while maximizing efficiency for customers.

1. Product energy efficiency

Measures the energy consumption of software and infrastructure to help minimize environmental impact and reduce operational costs. The primary goal is to introduce optimization efforts that can reduce the software's energy demands, especially during off-peak hours.

Examples:

- Power consumption of servers running cloud applications.
- Energy required to process transactions or user interactions i.e., energy consumed per user session or per 1,000 operations.

2. Carbon impact

Tracks the greenhouse gas emissions generated by hosting and delivering cloud-based products. Carbon emissions must be a part of sustainability plans for B2B enterprises like ManageEngine, because it allows customers to make eco-conscious decisions.

Examples:

- CO_2 emissions per customer or per data transaction.
- Percentage of cloud operations powered by renewable energy.

3. Sustainable product design

Evaluates how products are built to minimize resource consumption and support long-term usability on various devices. This helps users avoid unnecessary hardware replacements and reduces e-waste.

Examples:

- Software compatibility with older devices to extend their lifespan.
- Use of lightweight coding to minimize computing resource consumption.
- Compatibility with energy-saving hardware.

4. Customer impact metrics

Assesses how products help customers reduce their environmental footprint through digital transformation and efficiency improvements. This provides measurable value for customers looking to achieve their ESG goals.

Examples:

- Number of documents that were e-signed instead of printed.
- Energy and water saving metrics.

5. End of life (EOL) recycling and reusability

Monitors the ability to recycle, refurbish, or responsibly dispose of products after their life cycle ends. It encourages a circular economy and minimizes landfill contributions.

Examples:

- Customer engagement in take-back or recycling programs.
- Usage of eco-friendly packaging for physical products or accessories.



Cross-functional metrics

Cross-functional sustainability metrics span across departments and business functions to align the entire organization with sustainability goals. These metrics ensure sustainability efforts are integrated into company culture, decision-making, and external partnerships.

1. Sustainability awareness and engagement

Measures employee participation and understanding of sustainability initiatives within the organization. Awareness is crucial to build a sustainability-focused culture and encourage innovative solutions.

Examples:

- Employee participation in sustainability initiatives and training.
- Internal green campaigns and volunteer efforts.

2. Supplier sustainability compliance

Evaluates suppliers' adherence to environmental and ethical standards in their operations and supply chains. It allows businesses to ensure compliance with global environmental standards.

Examples:

- Supplier adherence to environmental and ethical standards (e.g., fair labor practices, use of sustainable materials).
- The proportion of purchases from certified green vendors.
- The percentage of IT hardware sourced from vendors with sustainability certifications like ENERGY STAR or EPEAT.

3. Sustainable event practices

Tracks the environmental impact of corporate events, including waste reduction and carbon offset efforts. As an enterprise pursuing sustainable operations, Zoho Corp.'s goal is to set an example for customers, partners, and other solution providers.

Examples:

- Sustainability efforts at corporate events, such as using eco-friendly materials and minimizing waste.
- Carbon offset initiatives tied to events.
- Usage of waste sorting and recycling stations at conferences.

4. Circular economy metrics

Assesses how well an organization incorporates reuse, refurbishment, and recycling into its supply chain and operations. This enhances the company's green credentials and supports a closed-loop system.

Examples:

- Participation in circular economy programs with vendors.
- Reduction in waste generated by operations.
- Implementation of internal IT asset refurbishment programs, allowing older laptops and devices to be redeployed instead of discarded.

5. CSR initiatives

Measures the organization's contribution to environmental and social welfare programs. CSR promotes employee participation in meaningful environmental efforts and boosts brand image.

Examples:

- The amount of funding allocated to environmental CSR projects.
- Volunteer hours contributed to sustainability-focused initiatives.
- Track the number of trees planted as part of CSR programs.

Zoho's commitment to social responsibility



Our focus on people and serving communities not only enriches our corporate culture but has also contributed to Zoho's bottom line. By aligning our business goals with social objectives, we have created a unique model that proves that profitability and social responsibility are two sides of the same coin.

- Sridhar Vembu
Chief scientist, Zoho Corp.

6. Sustainability reporting and transparency

Tracks the organization's commitment to regularly sharing progress and data on sustainability efforts with customers. This builds trust with customers and demonstrates a commitment to continuous improvement.

Examples:

- Frequency and depth of sustainability reporting.
- Customer feedback on sustainability efforts.
- Annual sustainability report showcasing progress in emissions reductions, energy savings, and social impact.



Key certifications for data centers

1. ISO 14001: Environmental management system (EMS)

ISO 14001 helps organizations implement an effective EMS, offering a structured approach to manage environmental responsibilities. The standard encourages continuous improvement in environmental performance, ensuring compliance with regulations and alignment with global sustainability goals.

For data centers, ISO 14001 ensures that service providers adopt processes to minimize environmental impact, such as reducing energy consumption, managing waste, and optimizing water usage. From construction to operation and decommissioning, it is crucial to follow sustainable practices to avoid penalties. An ISO 14001 certification demonstrates environmental responsibility, helping to build trust with customers.

Key principles:

1. **Environmental policy:** Establish an environmental policy that aligns with strategic organizational goals and commitments to sustainability.
2. **Planning:** Identify environmental risks, set objectives, and establish processes to achieve them. This includes assessing aspects like energy usage, waste generation, and emissions.
3. **Implementation and operation:** Develop action plans, allocate resources, and establish roles to ensure environmental objectives are met.

4. **Monitoring and evaluation:** Track environmental performance using key metrics and ensure compliance with legal requirements.
5. **Continuous improvement:** Use feedback from audits and evaluations to refine processes and improve environmental impact over time.

Examples:

Zoho Corp.'s data center in Dublin is certified for ISO 14001. This means we follow practices like energy-efficient cooling technologies, renewable energy sources to power operations, and recycling programs for e-waste.

2. ISO 50001: Energy management system

ISO 50001 is a standard that provides a framework for improving energy performance, including energy efficiency, use, and consumption. It focuses on helping organizations establish systems and processes to reduce energy consumption systematically and continuously.

For data centers, ISO 50001 supports methods to optimize energy-intensive processes like cooling, power distribution, and IT hardware operation. It focuses on reducing power usage effectiveness (PUE), a critical metric for data center energy efficiency. ISO 50001 encourages providers to identify inefficiencies and adopt emerging technologies that can achieve significant energy cost reductions.

Key principles:

1. **Energy policy:** Develop an energy policy outlining commitments to improving energy performance.
2. **Planning:** Identify significant energy uses, establish energy baselines, and set measurable objectives for improvement.
3. **Implementation and operation:** Integrate energy management practices into daily operations, including the procurement of energy-efficient equipment and training employees.
4. **Performance monitoring:** Measure and analyze energy performance metrics against established baselines.
5. **Review and improvement:** Regularly audit the energy management system and make necessary adjustments to enhance performance.

Examples:

Zoho Corp.'s data center in Amsterdam is certified for ISO 50001. This means we follow practices like real-time energy monitoring, predictive scaling for servers and workloads, use high-efficiency power supplies, and sustainable building designs.

Combining ISO 14001 and ISO 50001 ensures that data centers address their environmental impact holistically, covering both energy and other resources. Certification also demonstrates leadership in sustainability, which can help attract environmentally conscious customers. Finally, it ensures adherence to environmental laws and standards, reducing the risk of fines or operational disruptions.

Leadership in Energy and Environmental Design (LEED)

LEED is a globally recognized green building certification system developed by the United States Green Building Council (USGBC). It provides a framework for designing, constructing, and operating energy-efficient and environmentally friendly buildings, including data centers. LEED certification is awarded based on points earned across different sustainability categories, with four levels of certification:

Certification	Points
Certified	40–49 points
Silver	50–59 points
Gold	60–79 points
Platinum	80+ points

Key principles:

1. **Energy and atmosphere:** PUE, renewable energy, & efficient power distribution.
2. **Water efficiency:** Water usage effectiveness, alternative cooling methods, and on-site water recycling.
3. **Sustainable sites:** Location, storm water management, urban heat island effect reduction.
4. **Materials and resources:** Sustainable construction materials, e-waste management, and adaptive reuse.
5. **Indoor environmental quality:** Low-emission equipment and materials, advanced ventilation systems, lighting optimization.
6. **Innovation:** Cutting-edge green technologies and additional compliance strategies.

Examples:

Facebook's US data center in Oregon is certified LEED Gold. It uses 100% renewable energy (i.e., solar and wind) and an advanced water-efficient cooling system, reducing water usage by 80%. It also utilizes custom-built, high-efficiency servers. Data center certifications ensure compliance, reduce inefficiencies, and build trust with customers and partners. Pursuing these certifications also positions data centers as future-ready in a market that increasingly values sustainability and transparency.

PART 02
Sustainable IT technologies



Chapter 4:
Sustainable infrastructure design

In the 1940s, the world's first data center, ENIAC, consumed about 150 kilowatts of power. For comparison, that's enough power to run about 100–150 modern desktop computers continuously, making ENIAC not only groundbreaking but also one of the earliest examples of high-energy computing infrastructure. We've come a long way since then, but infrastructure design continues to be one of the key determinants in how environmentally responsible technology can be.

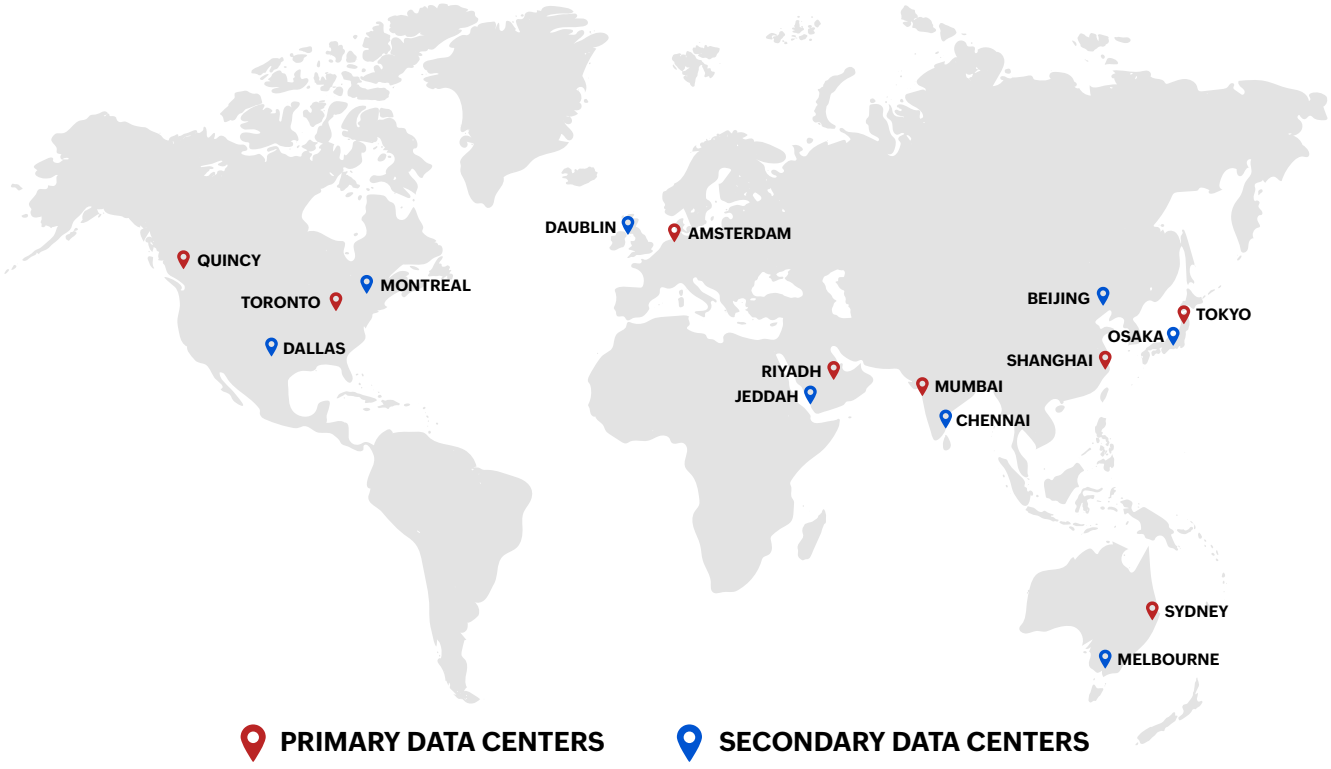


Sustainable data center management

A green data center is one that minimizes its environmental impact by reducing energy consumption, lowering carbon emissions, and optimizing resource use. The goal is to ensure efficient operation while being environmentally responsible.

Data centers are an environmental concern due to their substantial energy consumption and associated greenhouse gas emissions. Recent estimates from the World Economic Forum indicate that data centers account for approximately 2% of global electricity use and nearly 1% of worldwide greenhouse gas emissions. To put that in perspective, these numbers are comparable to the emissions of the global aviation industry, which uses 3% of global electricity.

This rising consumption, exacerbated by AI advancements, poses a serious challenge to global sustainability efforts. As organizations prioritize and work towards carbon neutrality, investing in green data centers becomes a critical piece of the puzzle. This means following practices outlined above, like using energy-efficient cooling systems, running on renewable energy, utilizing a closed loop for water consumption, and using recycled or sustainable materials to build the data center.



Locations of Zoho Corp.'s data centers worldwide

As of September 2024, Zoho Corp. operates over 18 data centers worldwide, with plans to establish data centers in almost every country by 2030. These data centers are certified with various international standards, including ISO 27001, HIPAA, and SOC Type II, ensuring high levels of security and compliance for our customers.

Energy efficiency in data centers is primarily measured using power usage effectiveness (PUE), which is calculated as:

$$\textbf{PUE} = \frac{\text{Total facility energy}}{\text{IT equipment energy}}$$

- **Total facility energy consumption** includes all energy used in the data center, including cooling, power distribution, and lighting.
- **IT equipment energy consumption** refers to the energy consumed by servers, storage devices, and networking equipment.

A perfectly efficient data center would have a PUE of 1.0, meaning all energy is used solely by the IT equipment. However, in reality, this number is nearly impossible to achieve. Highly efficient data centers have a PUE close to 1.1–1.4. Traditional data centers typically range from 1.8–2.5, meaning a significant portion of energy is lost to cooling and infrastructure inefficiencies.

PUE	1.2	1.5	2	2.5	3
Efficiency level	Very efficient	Efficient	Average	Inefficient	Very inefficient

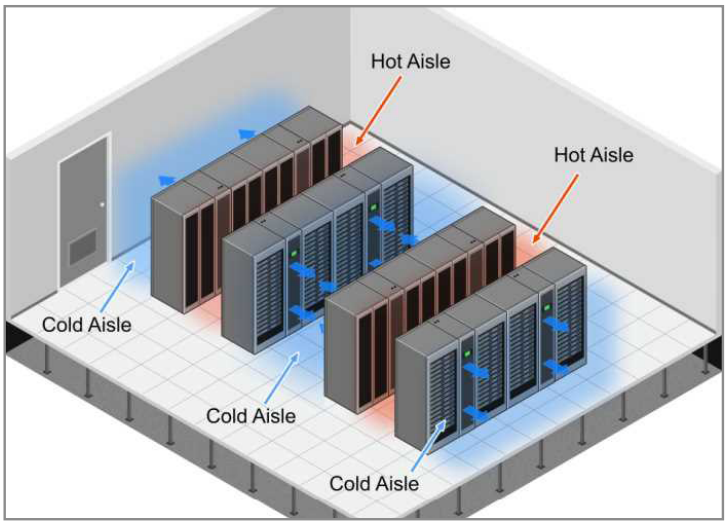
Zoho Corp.'s data centers are managed between 1.2-1.5 PUE consistently.

Energy-efficient cooling techniques for data center management

Sustainably managed or green data centers implement energy-efficient cooling techniques to reduce power consumption and minimize environmental impact. Let's take a quick look at some of these systems.

- **Hot/cold aisle containment**

This system separates hot and cold airflows within the data center by aligning racks to direct cool air to the equipment intake and hot air to exhausts. It prevents hot air from recirculating, improving cooling efficiency.



Example: Zoho Corp.'s data center in Chennai uses hot/cold aisle containment.

- **Free cooling**

This system uses cool outside air or cold water sources (such as lakes or underground aquifers) to cool the data center without running traditional cooling systems. It reduces reliance on energy-intensive air conditioning (i.e., HVAC) systems.

Example: Google's data centers in Finland use seawater for cooling.

- **Evaporative cooling (Adiabatic cooling)**

This system uses water evaporation to absorb heat and cool the air before it enters the data center. It requires significantly less energy than traditional air conditioning.

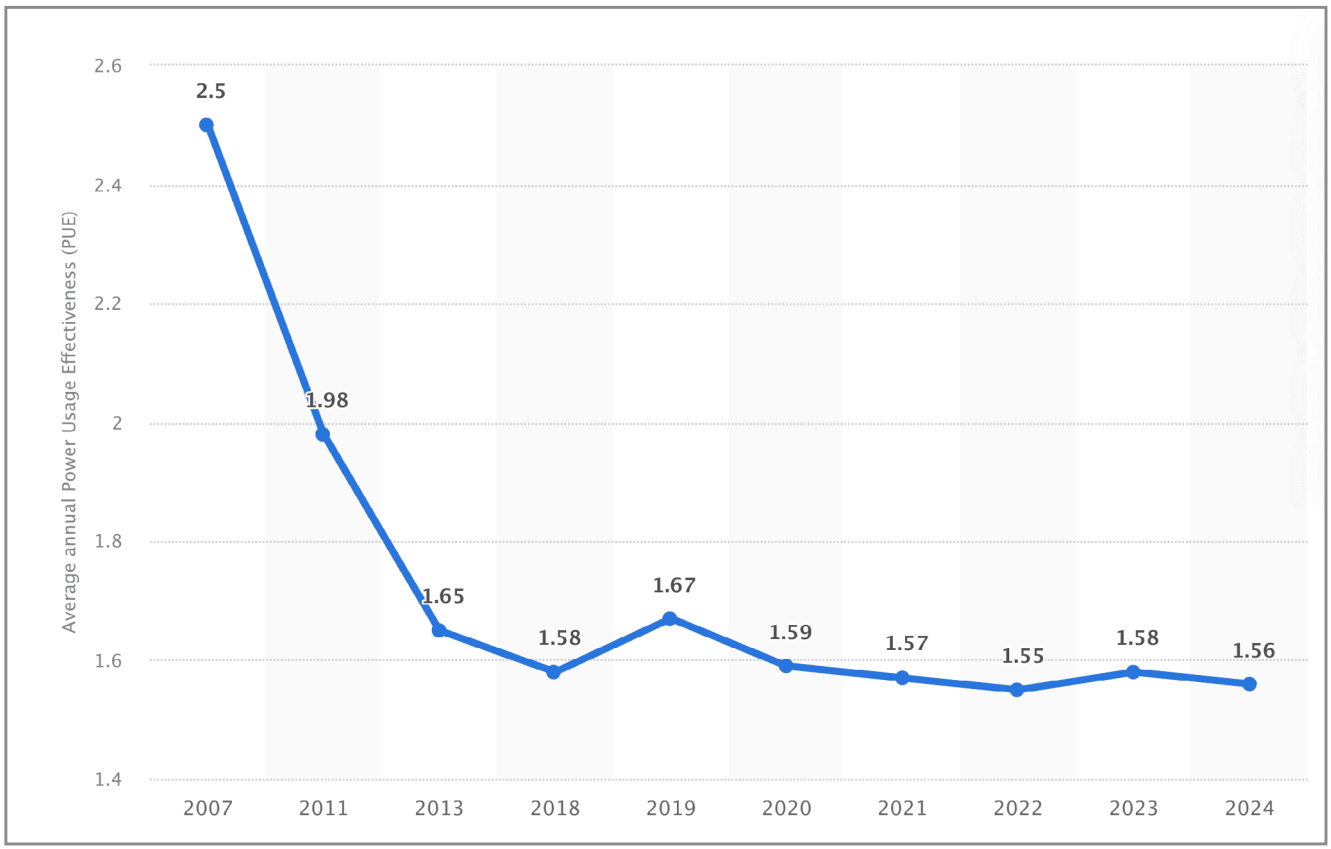
Example: Facebook's data center in Sweden uses evaporative cooling in combination with free cooling.

Some other notable techniques, such as solar cooling, geothermal cooling, and AI-driven cooling optimization, are also used by companies to manage data centers sustainably.



Green data center practices

The good news? Businesses worldwide are actively taking efforts to boost their data center efficiency. A 2024 survey for data center owners and operators showed a significant improvement in the average annual PUE, which means a smaller share of total power is being used to run secondary functions like cooling.



Source: Global data center average annual PUE 2007-2024, Statista

Businesses that build their own data centers have the opportunity to prioritize sustainability for long-term gains. This means an increased focus on factors like:

- **Maximized infrastructural potential:** The first step is to select a location that is suitable in terms of temperature and access to energy sources. Proximity to users can further help reduce energy consumption in data transmission. Construction using LEED-certified materials (which we'll discuss in the next section) and optimizing floor space to ensure better airflow and reduce excess cooling needs makes a big impact.
- **Energy efficiency:** A PUE between 1.2-1.5 is considered ideal. Businesses can optimize cooling systems, upgrade to energy-efficient hardware, and use AI-driven power management to reduce waste.

- **Renewable energy:** Businesses should consider a transition to solar, wind, or hydroelectric power instead of fossil fuels, especially if on-site energy generation is an option. Some businesses also choose to offset carbon emissions by investing in carbon credits or green power purchase agreements (PPAs).
- **Operational modifications:** Implementing suitable cooling system techniques, using smart sensors to adjust cooling, and setting up closed-loop water usage systems can limit the consumption of unnecessary resources. Data centers can also use energy-efficient lighting, insulation, and building automation to lower energy use.

For businesses that opt for colocation services, i.e., renting space and power from third parties, it is important to set high sustainability standards and seek vendors who adhere to them. In India, the Ministry of Electronics and Information Technology (MeitY) is working on setting benchmarks for energy efficiency in data centers. For instance, the ministry has proposed a PUE benchmark of less than 1.35 for data centers.

At a global level, the Uptime Institute sets industry standards for data center design, reliability, and efficiency. It established the tier classification system that is now followed in many regions such as the US, Europe, and Asia.

Tier level	Uptime (%)	Max downtime (annually)	Infrastructure	Redundancy	Suitability
Tier I (Basic)	99.671%	~28.8 hours	Single path for power and cooling	No redundancy	Small businesses with minimal IT needs

Tier level	Uptime (%)	Max downtime (annually)	Infrastructure	Redundancy	Suitability
Tier II (Redundant components)	99.741 %	~22 hours	Single path with some backup components	Partial redundancy	Mid-sized businesses needing improved reliability
Tier III (Concurrently maintainable)	99.982 %	~1.6 hours	Multiple power and cooling paths (only one active at a time)	Full redundancy for maintenance	Enterprises, SaaS providers, financial institutions
Tier IV (Fault-tolerant)	99.995 %	~26.3 minutes	Multiple active power and cooling paths	Fully fault-tolerant; no single point of failure	Banks, stock exchanges, healthcare

Each tier builds upon the previous one, enhancing redundancy and reducing potential downtime. Higher tiers mean greater uptime but increased costs. Tier III is the ideal space for most enterprises, balancing uptime and cost. Tier IV data centers offer the added advantage of using an N+N model, which is a fully redundant infrastructure where all critical systems are duplicated. N represents the exact number of components (like power supplies or cooling units) required to support operations. With this model, service providers can ensure that if one system fails, an identical backup system takes over immediately without affecting operations.



Use case: Managing energy consumption in IT infrastructure

A London-based financial services company operates a large IT infrastructure, including network devices, servers, and a Tier III data center. With energy prices in the United Kingdom hitting record highs and stringent environmental regulations, the organization seeks a solution to monitor, manage, and optimize energy consumption while maintaining compliance and operational efficiency.



Challenges

With the UK experiencing volatile energy prices, the organization's monthly electricity bill for the data center alone exceeds £50,000. The IT team suspects inefficiencies in server utilization and cooling systems but is unable to identify specific problem areas. The excessive energy costs reduce profitability and strain the organization's IT budget, limiting its investment in other critical areas.

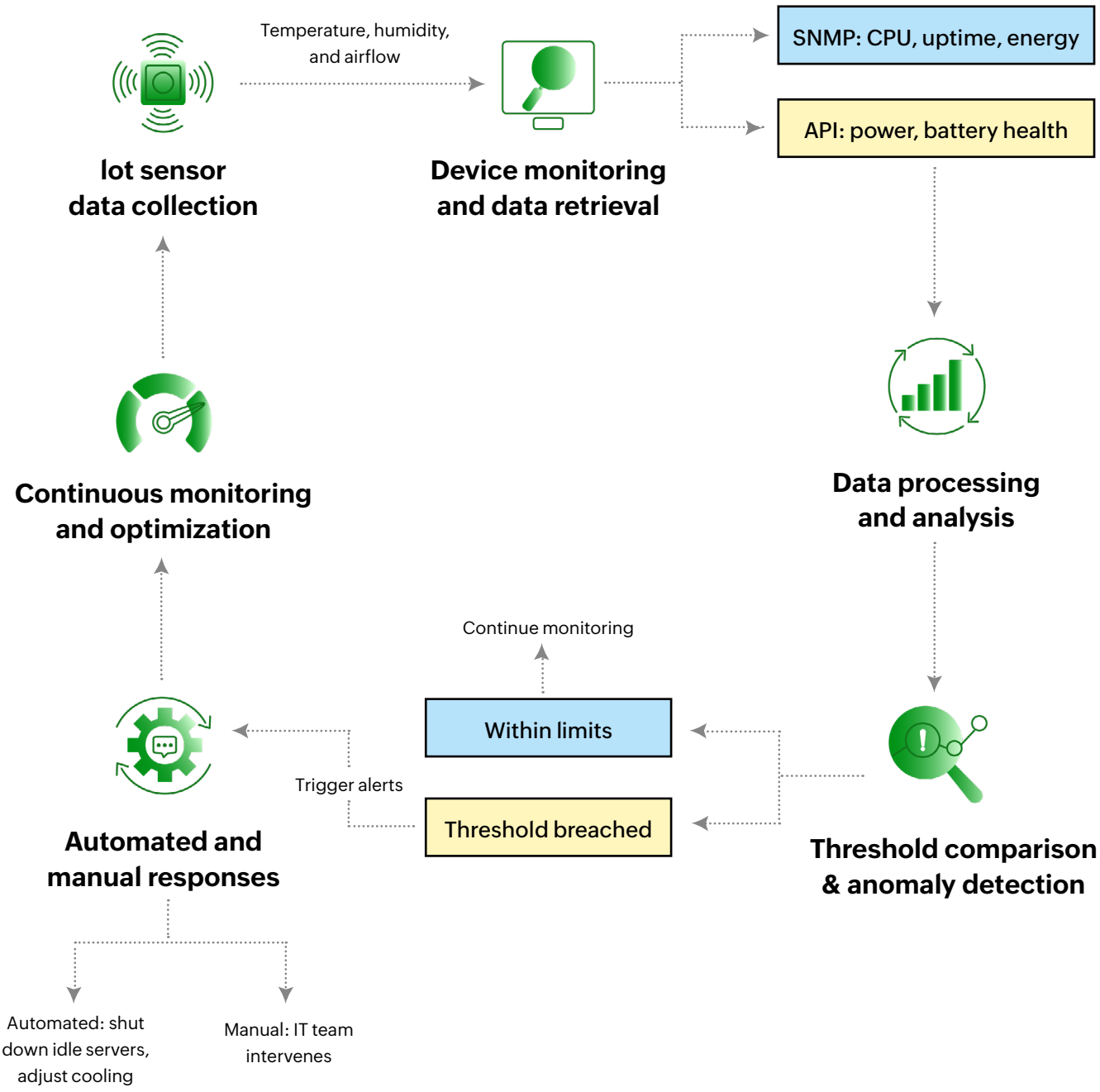
During non-peak hours (e.g., late nights and weekends), servers and network devices continue operating at full capacity. These systems run idle workloads, consuming power unnecessarily. This means the organization wastes significant energy, with the estimated idle power consumption accounting for 30% of the total energy bill.

The core issue is the lack of centralized visibility. The organization operates branch offices across Europe. Energy consumption data is siloed across multiple systems, making it difficult to gain a unified view of the IT infrastructure. Additionally, the UK government's commitment to achieving net-zero emissions by 2050 imposes regulatory pressure on the organization to adopt green IT practices. Without proper means to assess its energy usage and emissions, the company could face penalties, reputational damage, and missed opportunities to attract eco-conscious clients.



Implementation

Action 1: The first issue the company must tackle is energy inefficiencies in the data centers through real-time monitoring. A network and server monitoring tool is crucial for this process. The tool is integrated with IoT sensors installed across racks to monitor temperature, humidity, and airflow. Devices are equipped with SNMP agents to provide data about their operational parameters, including energy usage, CPU load, and device uptime. The tool then queries these devices using SNMP to collect energy-related metrics. APIs allow the tool to pull real-time energy consumption data, such as power draw, temperature, and battery health. Ultimately, the tool identifies uneven cooling contributing to inefficiencies.



A proactive approach is also a must-have to stay ahead of inefficiencies. The IT team configures custom thresholds for acceptable temperature and energy usage levels and sets up alerts to notify the team of any breaches. Idle servers are automatically scheduled to shut down during low-demand hours. To optimize the workload further, underutilized servers are identified and consolidated, reducing the number of active machines. Server virtualization is implemented, reallocating workloads to fewer, more energy-efficient servers during non-peak hours.

Action 2: The company relies on independent energy monitoring systems across branches, hindering decision-makers from getting a high-level view of the overall consumption. Having a single tool implemented across all branches would allow leadership to gain unified visibility on a centralized dashboard and make decisions accordingly.

The greatest advantage to this approach is the cross-location comparison. Historical data from each location can be analyzed to identify variances in energy usage. Let's say a branch office in central London is flagged for excessive energy use due to outdated cooling systems. The IT team can prioritize an upgrade, leveraging insights from energy-efficient branches to implement best practices.

Lastly, the tool can also assist with sustainability reporting and compliance. ManageEngine's server management tool has a reporting module that allows the company to map energy consumption to carbon emissions. Reports generated monthly help the organization demonstrate compliance with UK environmental standards and track progress toward its net-zero goals. With this strategy, the firm addresses three crucial concepts that can save their business millions in expenses: **insights, automation, and scalability.**

Chapter 5:
Cloud & virtualization for sustainability

As organizations strive to align with sustainability goals, the role of technology in reducing environmental impact has come into sharper focus. Cloud adoption, in particular, has emerged as a powerful catalyst for minimizing an organization's carbon footprint.



How cloud adoption minimizes carbon footprint

One of the most significant contributions of cloud adoption to sustainability is the reduction in the need for on-premises hardware. Running local data centers often requires substantial investment in servers, networking equipment, and cooling systems. Cloud migration eliminates much of this demand.

Cloud providers operate hyper-scale data centers designed for exceptional energy efficiency. These facilities employ advanced technologies such as optimized cooling systems, energy-efficient servers, and automated energy management. Leading cloud providers invest heavily in renewable energy sources to power their operations.

Compared to on-premises setups, cloud data centers achieve higher utilization rates, meaning fewer resources are wasted. This consolidation of computing power significantly reduces the energy required to run equivalent workloads.

Another key approach is virtualization, where cloud providers consolidate workloads onto fewer physical machines, reducing the overall energy requirement for IT operations. This is especially beneficial for organizations looking to scale without expanding their hardware footprint. Cloud providers also maximize the life cycle of their hardware, ensuring servers are used to their full capacity before being decommissioned. Organizations that migrate to the cloud benefit from these practices, as their IT operations generate less waste. By offloading workloads to cloud providers, they also avoid the high energy consumption associated with cooling on-site data centers.



Supporting green IT through intelligent management

Traditional IT setups often lack the visibility and automation needed to monitor and control energy-intensive processes, leading to inefficiencies and higher carbon footprints. This is where intelligent management comes into picture, helping organizations transform their tech operations and become sustainability champions. Intelligent management tools leverage advanced analytics, automation, and real-time monitoring to identify underutilized resources, implement energy-saving measures, and track environmental impacts.



Use case: Sustainability with cloud cost management tools

A media company with its headquarters in London relies heavily on cloud platforms to support its operations, including video streaming, content management, and internal collaboration. While the cloud enables scalability and performance, the organization faced multiple challenges that ultimately made a huge dent in their monthly bills.



Challenge 1: Identifying cost and energy inefficiencies

The IT team notices that many cloud resources, such as virtual machines and storage systems, are over-provisioned or idle during non-peak hours, unnecessarily consuming energy and driving up costs. However, with no consolidated view of their cloud usage, they are essentially blind to where these leaks are occurring.

To resolve this, they invest in a cloud cost management tool that provides granular visibility into resource usage and costs. The IT team begins by peeling back the layers. They identify dozens of virtual machines running 24/7 for old development projects that were already completed. Storage buckets housing archived content that no one has accessed for years are incurring monthly costs. Even worse, their fragmented tagging system means they can't easily attribute costs to departments, leaving them unable to hold teams accountable for their consumption.



Insights:

1. **Idle instances:** Nearly 15% of their virtual machines were sitting idle, burning energy without delivering value.
2. **Over-provisioning:** Some workloads were assigned more CPU and memory than they realistically needed, leading to wasteful spending and energy use.
3. **Lack of tagging:** Untracked resources meant no one truly owned the costs, creating a culture where waste went unnoticed.



Action:

The first plan of action is to consolidate cloud usage and spending data from AWS and Azure into a single dashboard, providing the IT team with a clear view of all resources. The intelligent management tool highlights idle or underutilized resources, such as EC2 instances running overnight and over-provisioned storage volumes. Based on those insights, they shut down unused instances, resize over-provisioned machines, and clean up old storage.

At this stage, the team also recognizes the need for cultural-level changes that would prevent the repetition of untracked resource usage. A company-wide tagging policy is issued and made mandatory across all branches of the office. Resources are tagged by department, project, and workload, enabling cost allocation and accountability across teams. This further allows teams to set budgets for cloud usage and receive real-time alerts when spending approaches thresholds.



Outcome:

Within months, the results are clear:

- The company saved £20,000 annually in cloud costs by optimizing resource usage.
- Their energy consumption dropped significantly, contributing to a measurable reduction in their carbon footprint as part of their ESG guidelines.

- For the first time, they could generate detailed reports linking cloud usage to business goals, assuring stakeholders of their commitment to sustainability.



Challenge 2: Choosing sustainable cloud providers

The organization has committed to achieving sustainability targets as part of its CSR goals. However, assessing the environmental impact of its cloud operations has proved challenging due to fragmented visibility, a lack of comparative analysis, and unoptimized resource allocation. The IT team and decision-makers do not have sufficient information to align their efforts with the company's sustainability goals. Once again, they turn to their newly implemented cloud management tool for answers.



Insights:

The tool's comparative analysis highlights that a competing cloud provider powered 85% of its European data centers with renewable energy, compared to the current provider's 60%. Migrating the company's video streaming workload to this greener provider will reduce carbon emissions by 30% for that workload.



Action:

In addition to migrating the workload, the IT team integrates sustainability metrics from AWS and Azure to measure the environmental footprint of individual workloads, such as video streaming. They study detailed reports from the tool that links financial costs with environmental impact. A complete breakdown of which services (e.g., compute, storage, networking) contribute the most to emissions allows them to make smarter choices towards their sustainability goals.

Leaning into automation further helps the IT team with cost optimization. They're able to scale down resource usage during off-peak hours and migrate specific workloads to energy-efficient or green-certified instances.



Outcome:

- Detailed sustainability reports combining financial and environmental data allowed the company to monitor its present progress toward their CSR targets.
- Idle resources in non-critical environments were automatically shut down during off-peak hours, lowering energy consumption by 40%.
- Optimizing resources and migrating to greener providers reduced cloud costs by 20% annually while meeting environmental objectives.

Chapter 6:
AI and sustainability

Investing in AI is a double-edged sword depending on how organizations implement it. While it offers powerful capabilities to optimize energy usage and enhance operational efficiency, it also comes with significant challenges. AI-driven systems require substantial computational power, which can increase energy consumption and carbon emissions if not managed responsibly. The key lies in balancing technological advancement with responsible implementation to ensure AI contributes to an organization's environmental goals instead of undermining them.



Positive impact:

1. **Optimizing cloud infrastructure:** AI helps optimize server workloads and energy consumption in cloud data centers. For instance, AI-driven workload management distributes computing tasks across servers more efficiently, reducing idle energy use and carbon emissions.
2. **Improved software efficiency:** AI can refine the design and operation of SaaS platforms, making them lighter and more efficient, which reduces computational demand. AI-powered code optimization tools streamline applications to use less processing power and memory.
3. **Enhancing collaboration:** AI can improve the efficiency of collaboration tools (e.g., video conferencing, cloud storage), enabling remote work and reducing the need for commuting and office space. For example, AI-powered video compression reduces data usage and energy consumption for remote meetings.

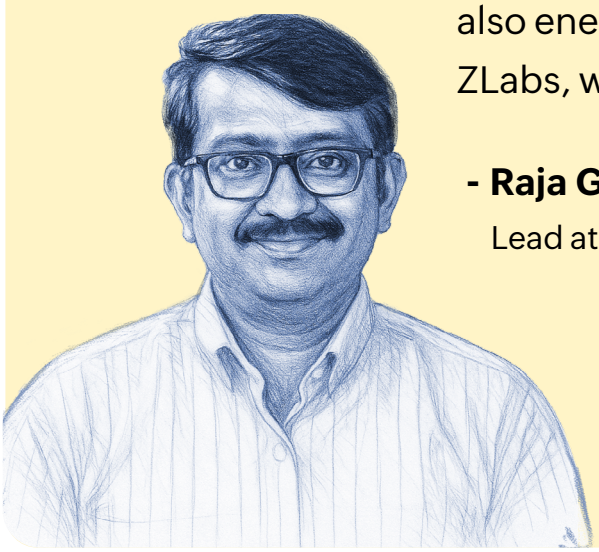
4. **Implementing sustainability solutions:** AI-powered platforms can help both organizations and their customers track and reduce their carbon footprint and improve sustainability metrics like supply chain emissions or environmental compliance.
5. **Facilitating smarter energy use:** AI models can predict energy needs and adapt infrastructure to use renewable energy sources. Organizations can utilize AI-driven energy management systems to predict peak loads and shift workloads to data centers powered by renewable energy.



Negative impact:

The most evident consequence of AI is the technology's high energy consumption. Training and deploying AI models require substantial computational resources, increasing energy demands. Furthermore, relying on AI can lead to shorter hardware cycles. AI workloads demand advanced hardware (e.g., GPUs, TPUs), which accelerates hardware obsolescence and contributes to e-waste. While businesses may want to adopt AI sustainably, the lack of transparent green energy options or clear regulations can make the efforts more challenging.

What is Zoho Corp. doing about it?



"When we're talking about AI and sustainability, there are two ways of looking at it. First, there's **AI for sustainability**, where we use AI to enable more efficient practices, such as turning off air conditioning automatically when the occupancy on a floor drops below a certain threshold. Then there's **sustainable AI**, which is building technology that is not only powerful and scalable but also energy-efficient in the long run. At ZLabs, we work on both aspects."

- Raja Gopal Hari Vijay
Lead at ZLabs, Zoho Corp. R&D

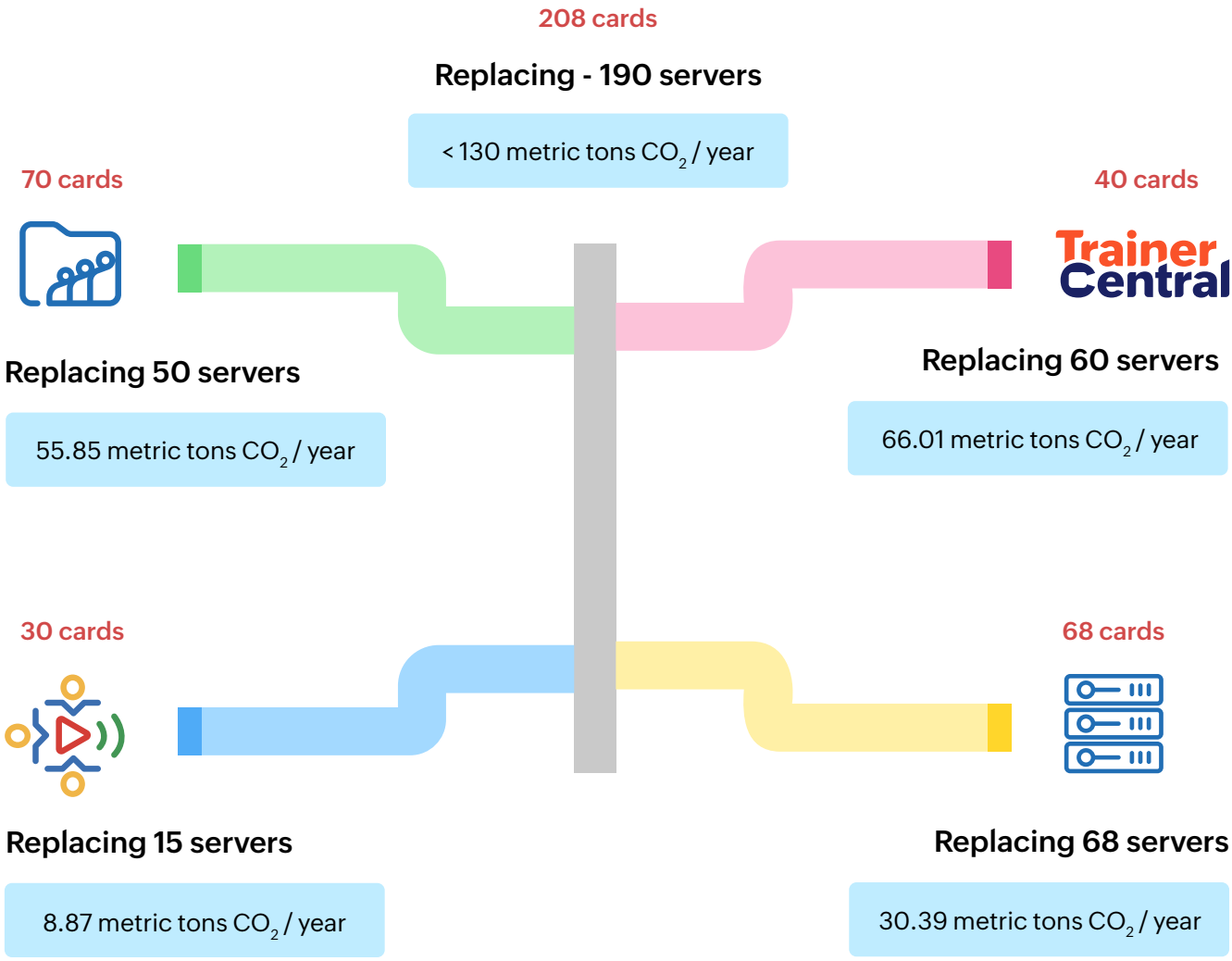
AI-driven video processing

Raja Gopal and his team work on accelerating complex workloads on hardware. As part of their sustainable AI initiatives, the team is working on AI-driven video processing, or optimizing video workflows with hardware acceleration.

The problem with using traditional servers for video processing is that they consume vast amounts of power. For Zoho and ManageEngine combined, the sheer number of servers that would be required for operations is economically unfeasible. To address this, the team is experimenting with field-programmable gate array (FPGA) cards designed for video transcoding solutions. Cards like MA35D and U30 are built for real-time, high-volume streaming, allowing service providers to reduce latency per card and reduce overall expenses.

What does this mean?

Typically, a server uses approximately 200-450W per hour. For a video to be captured, compressed, and sent over a network, we need four servers, i.e., 1kW per hour. A 3rd Gen CPU or card would only require 25W—a drastic change in workload. FPGA cards reduce energy consumption and server footprint in data centers, contributing to overall sustainability. To begin with, the cards have been adopted and integrated with select Zoho products, reducing carbon emissions by around 130 metric tons per year.

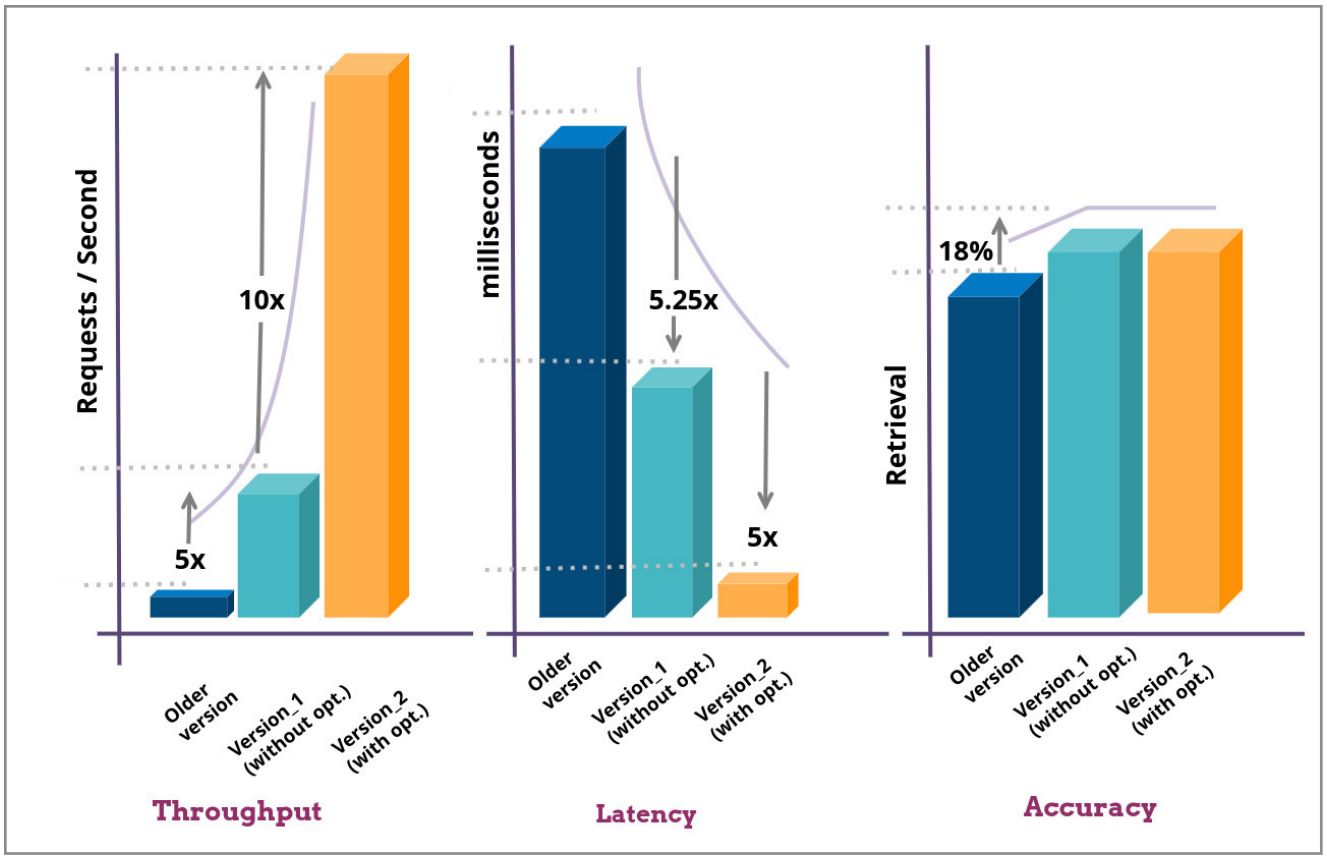


The results are encouraging, strongly indicating that the R&D team is headed in the right direction. They will continue phase-wise implementation across Zoho Corp.'s product suite and support sustainable AI. Additionally, the team is also working on running quantized models on CPUs instead of power-hungry GPUs. Quantization compresses models by reducing the precision of weights, making them faster to execute and easier to deploy on standard CPUs for lightweight tasks. Consequently, this reduces the need for power-intensive cooling equipment and lowers environmental impact.

Operational performance boost with embedding

When trying to find matching text, the most obvious method is pattern matching, i.e., looking for specific characters, words, or sentence structures. However, this can be inefficient when searching through large amounts of text. Just as images are made up of pixels and sounds are made up of digital signals, the ZLabs team uses a similar method to represent text, especially for advanced tasks like retrieval, classification, or semantic search. That's where text embedding comes in.

The ZLabs team used a tool known as Sentence Transformers with a small, English-language AI model to convert text into numbers called text embeddings. This makes searches smarter by understanding the meaning of the query and not just the exact words. The embedding functionality is then used to power other AI workloads.



Product teams (in beta testing) observed an 18% increase in accuracy, 5x increase in throughput (processing capacity), and 5.25x reduction in inference time. From a sustainability standpoint, this has allowed teams to switch from GPUs to CPUs, resulting in significant reduction in both cost and emissions.



Going green with low-code

The foundation of Zoho Corp.'s sustainability efforts at the HQ rests on our in-house low-code IoT platform. As with any large infrastructure, the only way to attain efficiency is by having complete visibility over operations. IoT devices are crucial for green operations because you can't optimize what you can't measure. Let's take a closer look at how we made this happen.

Pain points

1. High energy consumption

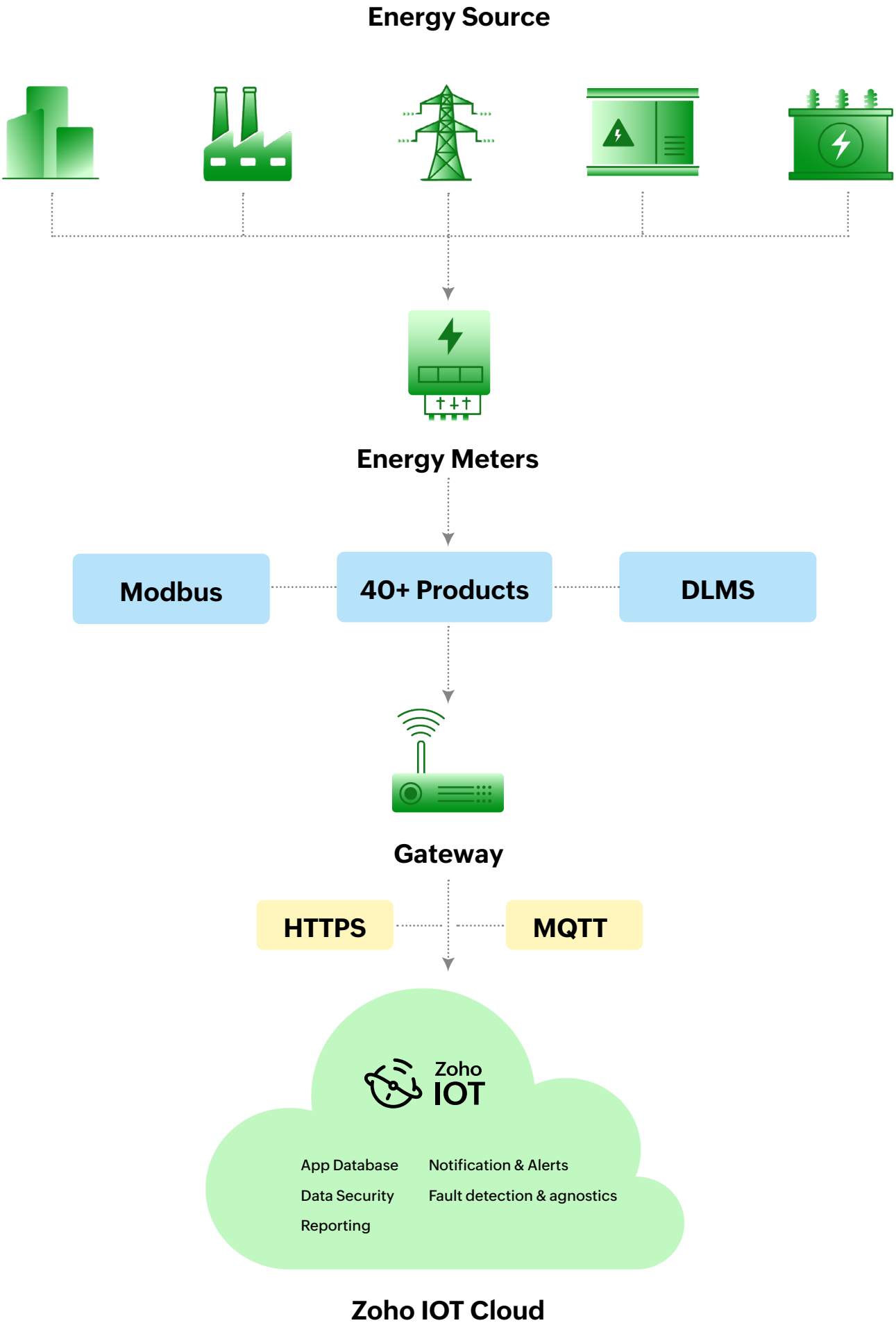
One of the biggest challenges we faced was unmonitored high energy consumption across the HQ campus. Lights, fans, and HVAC systems often ran even when unoccupied, either due to user negligence or the absence of automated controls, leading to unnecessary power usage. Similarly, air handling units (AHUs) and chillers continued to operate at high capacity regardless of occupancy or temperature conditions. Without real-time insights and automation, inefficient energy use became a major challenge for the admin team.

2. Lack of real-time monitoring

The lack of a centralized system to monitor utility consumption in real time led to delays in detecting overconsumption or waste. Electricity and water consumption data was collected manually, making it difficult to identify patterns or sudden anomalies. For instance, a minor water leak in a restroom or cooling tower could go unnoticed for a few days, resulting in water being wasted before it was noticed and corrected. Similarly, without real-time energy monitoring, facility managers couldn't determine when power usage spiked due to faulty equipment or unnecessary loads.

3. Limited data-driven decision making

The admin team relied on historical data and manual reporting to make critical decisions regarding energy and resource management. Without a unified system that consolidates and analyzes data from various sensors and equipment, decision-making was often reactive rather than proactive. For example, HVAC adjustments were typically based on predefined schedules rather than real-time occupancy data, leading to either under-utilization or excessive cooling or heating. Likewise, budgeting for utilities and maintenance was done based on past trends rather than predictive insights, which meant technicians could not anticipate potential spikes in energy demand or upcoming maintenance needs. The lack of AI-driven analytics further complicated forecasting, making it difficult to identify opportunities for cost savings and efficiency improvements.


Energy Source
Energy Meters
Modbus
40+ Products
DLMS
Gateway
HTTPS
MQTT
Zoho IOT
App Database
Data Security
Reporting
Notification & Alerts
Fault detection & agnostics
Zoho IOT Cloud

Implementation

To tackle high energy consumption and operational inefficiencies, we deployed our in-house IoT energy management solution across the entire campus, integrating a broad range of assets including ACs, lights, fans, AHUs, chillers, diesel generators (DGs), solar panels, water systems, electricity meters, and surveillance cameras.

Each energy-consuming and critical infrastructure component was connected to the platform using a layered hardware integration model. For instance, smart energy meters were installed at main distribution boards, sub-distribution panels, and critical load points to measure kWh, kVA, power factor, voltage, current, and harmonics. Temperature sensors were deployed in workspaces, server rooms, and AHU supply/return ducts to capture ambient conditions. Populated areas like lunch halls used occupancy sensors to detect human presence for conditional actuation of lights, fans, and HVAC loads. All sensors and equipment were connected to local IoT edge controllers and gateways that pre-processed data, buffered it in case of network failure, and pushed it to the cloud platform over MQTT/HTTPS.

With all sensors and assets connected, the IoT platform provided the facility team with a centralized cloud dashboard for real-time visibility into energy and resource usage across the campus. The dashboard offered multi-layered views—allowing monitoring at the campus, building, floor, and individual device levels. Teams could track key metrics such as energy consumption, power factor, water usage, and asset uptime from a single interface. The system also enabled real-time alerting through threshold-based rules. Any spike in power demand, abnormal diesel generator fuel consumption, or signs of a water leakage would trigger immediate notifications via email, SMS, or mobile push. Device health metrics were also tracked to ensure that sensors, gateways, and controllers were communicating reliably. This allowed the admin team to stay ahead of anomalies, prevent wastage, and maintain a high level of operational control across all zones.

Usage could be compared across time-of-day segments, helping teams detect inefficiencies during non-working hours when systems were expected to be idle.

Beyond monitoring, the platform empowered the admin team to automate energy usage through rule-based controls that responded to real-world conditions. Lights in common areas and meeting rooms were configured to turn off automatically if no movement was detected for a set duration. HVAC systems, including AHUs and chillers, were dynamically modulated based on real-time data from temperature and occupancy sensors. For example, variable frequency drives (VFDs) allowed the system to reduce airflow when fewer people were present or when cooling demand dropped. Diesel generators were also managed more efficiently—they only activated when both grid and solar power sources were insufficient, using real-time load and capacity data to avoid unnecessary runtime. In high-demand periods, the system could automatically disable non-critical loads to prevent peak penalties. All control rules could be configured, tested, and updated remotely from the platform, giving the operations team precise control over when and how energy was consumed across the campus.

The platform collected and stored time-series data which was analyzed through analytics and custom ML models to extract operational insights:

- **Electricity bill forecasting:** Historical consumption data was correlated with tariff slabs and seasonal patterns to project upcoming utility costs.
- **Load disaggregation:** Energy consumption was broken down by asset category (e.g., HVAC, lighting, DG, plug loads) to assess where energy-saving interventions were most effective.
- **Anomaly detection:** Algorithms flagged equipment that deviated from baseline behavior (e.g., a chiller running longer than normal or a DG showing excessive fuel burn at low loads).

- **Predictive maintenance:** Vibration and runtime data from HVAC systems and pumps were used to estimate maintenance windows before potential failures occurred.

With this implementation, the campus achieved a **20% reduction in energy consumption over 2.5 years**. Device lifespan improved, anomalies were detected and resolved faster than ever, and admin budgets were no longer a challenge. Ultimately, the increased visibility and accountability supported sustainable performance across departments.

Scenario: Water leak detection in cooling tower saves thousands of liters

A cooling tower responsible for regulating temperature in the server block was consuming significantly more water than usual, but the increase was gradual and didn't raise immediate flags. Since water meters were read manually once a week, the leak went undetected for nearly two weeks, resulting in excessive water usage and a risk of operational downtime due to the cooling system's reduced efficiency.

To automate the process, water flow sensors and leak detection sensors were installed on water pipelines and cooling towers to monitor the system in real time and detect microleaks or sudden pressure drops. With the sensors installed, the platform continuously monitored flow rate, pressure, and total water consumption. The platform detected a sustained increase in flow rate from the cooling tower's return line without a corresponding rise in ambient temperature or load demand. Simultaneously, pressure sensors registered a slight but consistent drop, suggesting a possible leak or line breach.

Once this anomaly was captured by the IoT platform, the data was pushed into the integrated analytics tool for correlation. The analytics team built a dashboard that overlaid cooling tower water consumption with temperature trends, occupancy levels, and equipment schedules. This data clearly showed that while demand remained stable, water usage spiked—pinpointing a likely leak that would not have been noticed without this multi-metric analysis.

With this information, the facilities team traced the leak to a hairline crack in one of the return pipes. Since it was not visible externally, traditional inspections would have taken much longer to find the issue. The pipe was repaired within 24 hours, and water consumption normalized immediately, saving an estimated 8,000+ liters of water per week. Water pressure returned to baseline, reducing stress on the cooling equipment. A custom alert was configured to notify teams of any similar flow-pressure mismatches in the future.

IoT tools empower organizations to improve their sustainability efforts by providing real-time visibility into energy, water, and resource usage across operations. This enables data-driven decisions that reduce consumption, lower emissions, and extend equipment life, making sustainability an actionable goal.

Tools for change

How does Zoho Corp. implement in-house tools to bolster its sustainability efforts?



Low-code

Enables the efficient development of custom applications for various operational needs. Facilitates digital transformation and reduces paper usage, contributing to environmental sustainability.



IoT

Supports real-time monitoring of energy consumption, power quality, and carbon footprint tracking. Aids in setting and measuring sustainability goals and achieving net-zero targets.



Remote monitoring and management (RMM)

Permits remote monitoring of energy consumption in buildings, devices, and cloud infrastructure. Helps MSPs implement green IT practices and comply with sustainability regulations.



IT asset management

Enables comprehensive management of IT assets, including hardware and software inventory, license compliance, and life cycle management. Promotes the efficient use of resources, reduces electronic waste, and supports sustainable procurement practices.



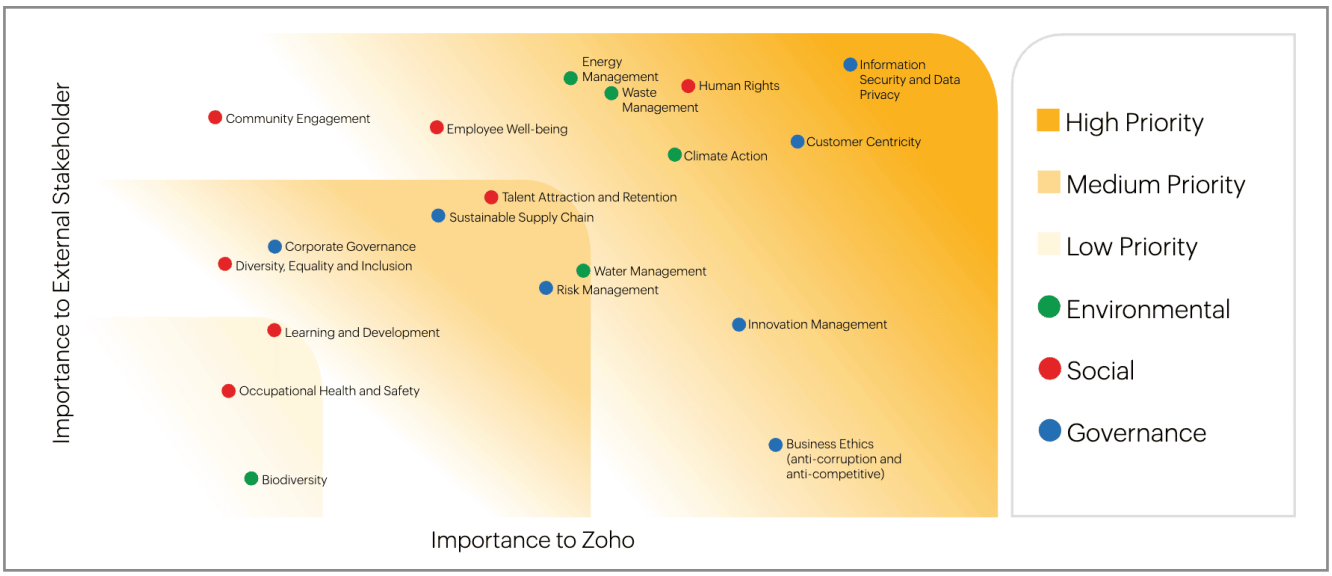
Remote support and access

Provides remote IT support and access to devices from anywhere, minimizing the need for travel and on-site assistance.

Chapter 7:
Case study: Zoho Corp.'s sustainability journey

Zoho Corp.'s HQ in Chennai, where 90% of the company's workforce is based, is on its path of becoming a self-sustaining ecosystem. With over 15,000 employees and admin staff, it's crucial that we take steps to operate in an environmentally conscious manner. So, how do we decide what factors to focus on?

A materiality assessment or matrix is a strategic tool that allows organizations to identify and prioritize their ESG goals and challenges. Zoho Corp.'s materiality matrix has been developed after extensive discussions with senior leadership and stakeholders, combined with a thorough analysis of industry and sustainability standards.



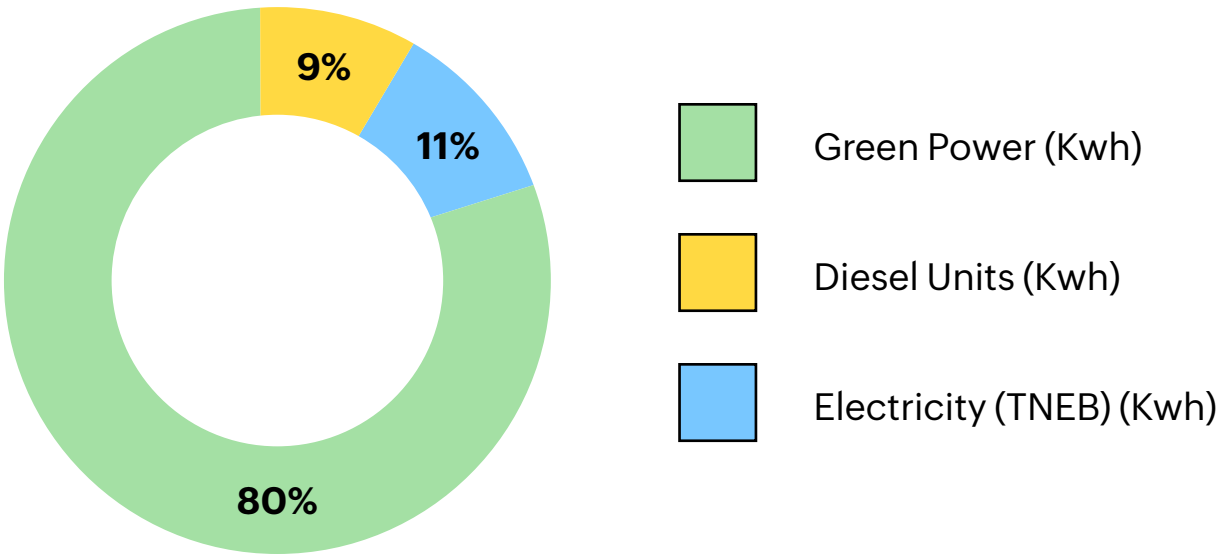
Source: ESG report FY 2023-2024, Zoho Corp.

The materiality assessment made it evident that environment-related goals like climate action, energy management, and waste management are non-negotiable and must be at the top of our list. With this in mind, we further streamlined our efforts and pushed for effective and scalable actions. Here's a glimpse of how it's done.

Solar power

Zoho Corp.'s data centers and office spaces are powered by solar panels and solar farms. Solar panels installed at the HQ, in addition to a the 2 * 5 megawatt on-grid solar energy farm about 180 miles (290 kms) away, help reduce the company's carbon footprint and environmental impact significantly.

Undertaken in partnership with the state's electricity department, the solar plant serves local power needs, allowing the company to receive credits to offset its energy consumption. This initiative also benefits surrounding communities by providing surplus electricity, ensuring that Zoho Corp.'s commitment to sustainability extends beyond its own operations. This helps in saving approximately 7,200 tons per year of CO2 emissions, equivalent to planting 14,400 trees. Furthermore, the company has acquired 375 acres at the US HQ to set up solar panels.



Zoho Corp. energy mix FY 2023-24

Water conservation

Water availability in Chennai fluctuates based on the climate. Being a tropical region, summers are intense with temperatures crossing 88.4 °F (31.3 °C) mid-year. This means water may be scarce, and it is crucial to conserve as much as possible for sustainable operations. Groundwater or raw water collected goes through the water treatment plant and is purified for drinking and cooking. Water used for domestic purposes, like washing hands or utensils, is sent to a sewage treatment plant, where it is treated and used for flushing toilets, landscape irrigation, and for the air conditioner's cooling tank. We also use a dual-plumbing system that segregates potable and non-potable water flows within our facilities.

To monitor the water usage, the admin and sustainability teams collaborated with the IoT team to build an in-house IoT solution and install monitors throughout the campus. These sensors collect data, which is displayed on a common dashboard, allowing teams to determine:

- Real-time usage categorized by location and purpose.
- Leakage of faucets in restrooms.
- Whether sprinklers are required, based on the weather.
- Usage per capita.

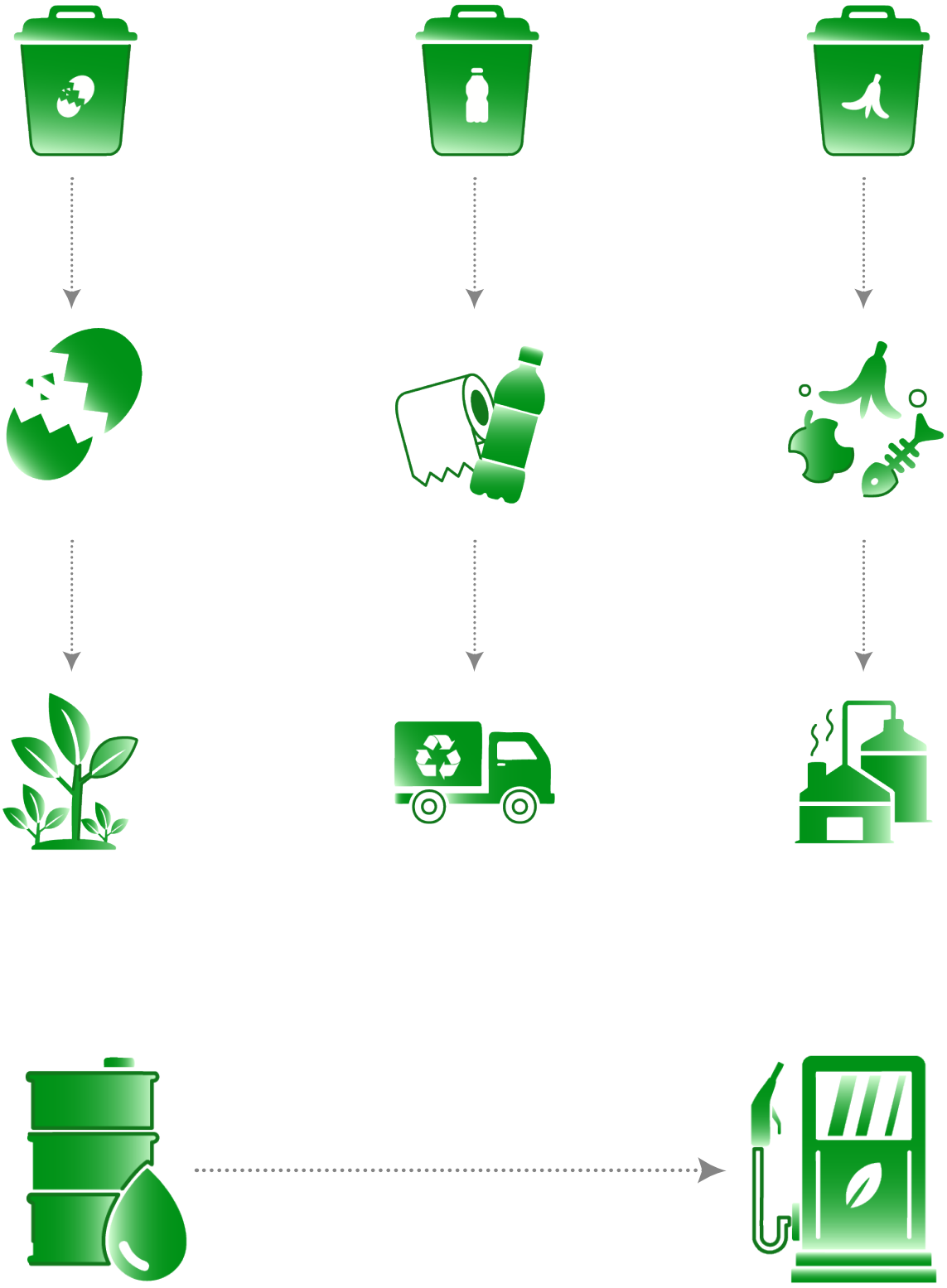


The dashboard also provides easy-to-read reports, simplifying the monitoring process. The sustainability team can then review if they are meeting water usage standards. Additionally, the construction of ponds and lakes on site helps preserve rainwater and recharge the groundwater table. **With this closed-loop system, Zoho Corp. has achieved 100% water recycling at its India HQ.**

Zero waste

By 2030, we aim to achieve zero waste to landfills across significant operations, including owned facilities.

Daily operations: Waste from the campus is segregated as fruit peels, egg shells, dry waste, and general food waste. Egg shells, owing to their high calcium content, are ground up and used for gardening. Dry waste, like tissues, bottles, and milk cartons, are sent to a vendor for recycling. Cooking oil is also sent to a vendor for conversion to biodiesel.



Biogas plant: General food waste is collected and sent to one of the three 4.5 ton-per-day digesters within the HQ campus. When mixed with manure and water, the waste is broken down to release biogas, which is then directed to a generator that converts gas into electricity. The plant generates enough electricity to power itself and a part of the sewage treatment plant operations.

To ensure that vendors follow strict protocols, the sustainability team often conducts surprise checks to their sites or factories. Each vendor also provides a certificate, declaring the quantity of waste or recyclables obtained from the company.

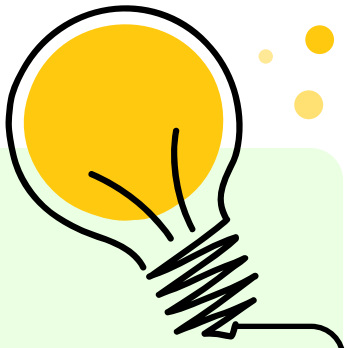
Following these sustainable practices is an ongoing process. With the majority of our workforce in one campus (which is expanding rapidly), it takes immense efforts to maintain sustainable operations. Over the next few years, our goal is to achieve zero waste to landfills and eliminate single-use items.



Sustainable procurement

When we're sourcing items like bags or notebooks for customer merchandise at Zoho Corp., we actively look out for eco-friendly, biodegradable, and responsibly sourced materials. Instead of plastic or polyester, we opt for materials like jute, bamboo, and crushed cork. Vendors provide product samples to our procurement team for quality checks. We also ensure the suppliers or vendors follow sustainable practices and share similar sustainability goals. The quality of their work is verified through certifications like the Global Organic Textile Standard (GOTS).

Sustainability with devices is reviewed through the ratio of the amount of heat emitted from them (for instance, LED and LCD screens emit significantly less heat than their older plasma counterparts), and through reusability, like rechargeable power banks. With equipment that may not be used frequently, we rent from selected vendors and operate on solar power wherever possible.



Did you know?

Zoho Corp. is featured in the list of the top 10 companies making the biggest contributions to combat climate change in India. According to The CSR Universe, Zoho Corp. has been making an impact on the environment with its sustainability programs, primarily in Tamil Nadu. The company's total CSR investment in 2020-21 was INR 54.07 crore much more than what it was supposed to invest, i.e., INR 12.74 crores. Of the INR 54 crore, **Zoho invested a whopping INR 28.01 crore in environmental sustainability programs.** Its contributions were spread across many fronts, including disaster management, sustainability, and conservation of natural resources.



General practices and initiatives

- Flexible work models with business trips only when needed.
- Daily shuttle operations for employees to reduce private transport.
- Electric vehicles for transportation of goods within the campus.
- LED lighting in buildings for cost and energy savings.
- Encouraging movement beyond Tier-1 and Tier-2 cities with the rural revival project.
- Frequent tree planting initiatives in India and the US.
- Nava Farms, a 380-acre property that produces a variety of fruits, vegetables, and livestock and ZoGro, an employee-run planting initiative, in Austin, Texas.
- Removal of single-use utensils from pantries.
- Recycling programs in hub offices.



Practical approaches to navigate sustainability

Inspired, but don't know where to start? Here are some practical ways to begin your organization's sustainability journey.

1. Promote eco-friendly habits in the workplace

Encourage employees to adopt green practices such as reducing paper usage, enabling energy-saving settings on devices, and using public transport or carpooling to the office. At Zoho Corp., we've made small changes that have a large impact, like eliminating paper cups and mandating garbage separation, to drive home the sustainability culture.

2. Educate on IT's environmental impact

Conduct workshops and awareness campaigns to highlight how IT contributes to the organization's carbon footprint. For instance, share insights on the energy consumption of data centers or the e-waste problem and offer solutions like device recycling programs or encouraging the use of refurbished hardware.

3. Implement sustainability checklists

Develop checklists to assess and ensure sustainable IT practices. Examples include evaluating the energy efficiency of hardware before procurement, assessing life cycle impacts, and verifying adherence to environmental regulations during audits.

4. Partner with green cloud providers

Choose cloud providers with a commitment to renewable energy and carbon-neutral operations. For example, some providers will offer tools to track and minimize your organization's cloud energy consumption.

5. Leveraging tools for green IT

Use tools that measure and manage IT sustainability, such as software to monitor data center energy use or carbon accounting platforms. Cloud cost management tools are a great way to compare eco-friendly vendors, identify underutilized resources, and reduce emissions through effective operations.

6. Designing energy-efficient software

Optimize software to minimize energy consumption by reducing CPU cycles and improving load times. For example, redesigning algorithms to handle data more efficiently or enabling low-power modes in applications can significantly cut energy usage.



Leveraging technology as a force for good

The convergence of technology and environmental stewardship offers a powerful sense of possibility. From energy optimization to waste reduction and global monitoring, digital systems are helping businesses and societies make smarter, cleaner choices. With the right vision, this innovation can move us from damage control to positive impact.

While digital solutions alone won't solve the climate crisis, they offer a practical, scalable foundation for progress. Paired with strong leadership, businesses can future-proof their operations and create long-term value. So, what are Zoho Corp.'s goals for the future? From the environment perspective, we call it a three-point plan for the next decade, where we'll focus on:

Climate action	Water stewardship	Circularity
• Reduce scope 1 and 2 emissions (vs. FY 2023-2024) and achieve carbon neutrality by 2035. • Reduce scope 3 emissions by 25% by 2030 (vs. FY 2024-2025).	Reduce freshwater consumption to 25% across significant operations by 2030 (vs. FY 2023-2024).	Achieve zero waste to landfill across significant operations by 2030 (for owned premises).

For Zoho Corp., sustainable IT is powerful because it addresses multiple business needs simultaneously. From our energy-efficient data centers that reduce emissions to cloud optimization tools that identify cost savings and resource inefficiencies, we have created a system that delivers long-term value. The lesson is clear: reducing environmental impact doesn't mean compromising performance. If anything, the two goals complement each other.

For organizations beginning this journey, remember that perfection isn't the goal—continuous improvement is. The path to sustainable IT is a journey worth taking for your business, your customers, and the planet. Start by measuring your current impact, identifying high-value opportunities, and building sustainability into your organizational DNA. The most successful initiatives will be those that align your environmental objectives with your core business strategy.

About ManageEngine

As the IT management division of Zoho Corporation, ManageEngine prioritizes flexible solutions that work for all businesses, regardless of size or budget. ManageEngine crafts comprehensive IT management software with a focus on making your job easier. Our 120+ award-winning products and free tools cover everything your IT needs. From network and device management to security and service desk software, we're bringing IT together for an integrated, overarching approach to optimize your IT.



About the author

Mahanya is a content writer who specializes in IT stories, documenting the journey of enterprises like ManageEngine - their ups and downs, internal processes, and core principles. She is keenly interested in interacting with IT thought leaders to get their perspective on digital transformation. A true zillennial at heart, she spends her spare time on social media finding homes for rescue dogs.