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TECHNICAL WHITE PAPER

Pure Storage Platform Creates Over 3x Less E-waste Than Competitors

Independent research reveals Pure Storage Platform creates significantly less e-waste compared to competitive products.

Contents

Executive Summary

Electronic waste (e-waste) is the fastest growing solid waste stream worldwide, according to the International Labour Organization. In an era defined by rapid technological innovation, compressed product life cycles are escalating the amount of e-waste associated with solid-state drive (SSD) storage devices. This study finds that e-waste is rising in importance on the corporate agenda, prompting organizations to address its management as a core element of their overarching sustainability strategies. Technology equipment producers are reacting to this shifting priority, focusing not only on the technical efficiencies of storage devices, but also considering the environmental impact of e-waste. This analysis finds that Pure Storage's FlashArray//X70—which runs on an upgradeable Evergreen model—generates at least 3 to 8x less e-waste than its competitors.

Research Methodology

To gain critical insight into how large organizations manage e-waste in their operations, Pure Storage, a US-headquartered provider of data storage hardware and software products, commissioned independent research firm Verdantix to conduct a comprehensive study. Verdantix undertook independent and anonymized interviews with 31 executives across IT infrastructure, operations and technology roles who have influence over the purchasing decisions of storage products. These organizations have at least $1 billion in yearly revenue and are located across North America, APAC and EMEA. Verdantix gained insights from the respondents about the key purchasing decisions for selecting storage arrays, as well as the drivers of e-waste reduction within their organizations and their approach to managing e-waste produced by data storage products.

Furthermore, as part of the analysis, Pure Storage commissioned Verdantix to develop a calculation model to compare the e-waste generation of a typical Pure Storage solution to comparable all-flash storage solutions from competitors. To allow for direct comparison, Pure Storage provided Verdantix with a mock set-up utilizing its FlashArray//X70—its most popular FlashArray model. The effective capacity of this unit was 2.3 petabytes (PB), with a 5:1 data reduction ratio. The Pure Storage array software manages data reduction, data protection and other functions. Comparable products to the FlashArray//X70 were selected from two well-known global competitors. For this analysis, the competitor set-ups had equal effective capacity, using 7.68TB NVMe SSDs, the vendor-published data reduction ratios and data protection. The calculation model used vendor-published data, alongside primary research, to simulate the e-waste produced by each product with an effective storage capacity of 2.3PB over 10 years. **Figure 1** below shows an overview of the technical specifications for the e-waste model.

Technical specifications for e-waste model

Device	FlashArray//X70	Competitor 1	Competitor 2
Effective storage capacity (TB)	2300	2300	2300
Data reduction ratio	5:1	4:1	5:1
System overhead factor	0.73	0.75	0.75
Drive capacity (TB)	18.60	7.68	7.68
Data protection	RAID6	RAID6	RAID6

FIGURE 1 Technical specifications for e-waste model

Framing the Data Storage Challenge in an Era of Sustainability

One of the key challenges faced by IT infrastructure executives is balancing the current and future needs of business-critical applications alongside newly established environmental, social, governance (ESG) and sustainability targets, all while ensuring a high degree of data security. To keep pace with growing storage requirements, firms must replace or upgrade their hardware; findings from the survey show that 71% of organizations typically replace or upgrade their storage arrays every five to seven years, with another 19% replacing their arrays more frequently (see **Figure 2)**. When making these replacements, reliability, scalability and data security emerge as the three most important selection criteria for firms (see **Figure 3**).

How frequently do you typically replace or upgrade storage arrays?

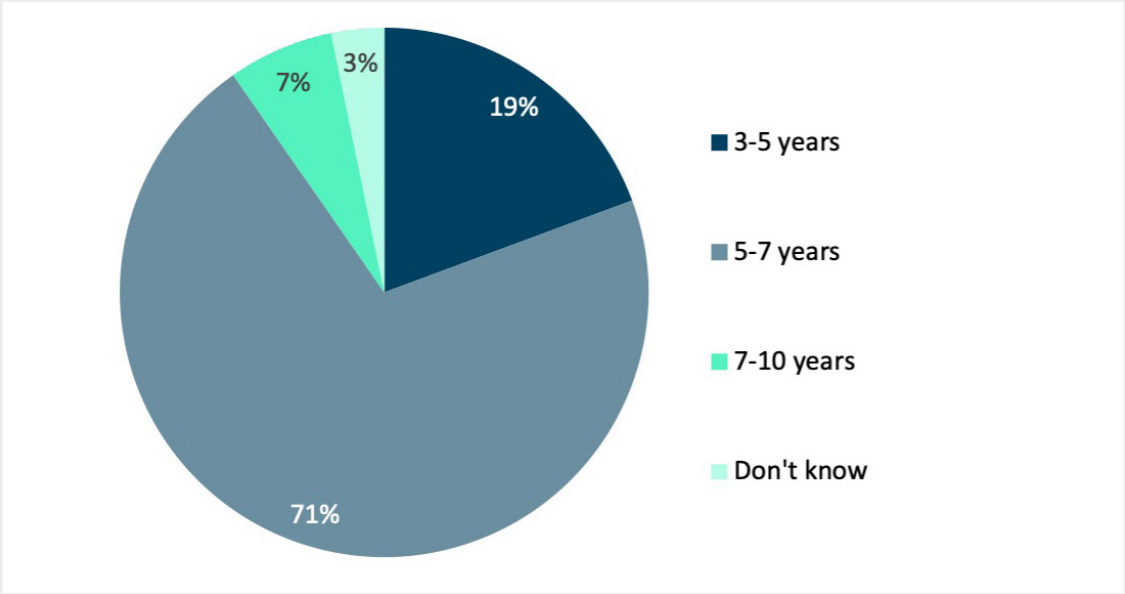

FIGURE 2 How frequently do you typically replace or upgrade storage arrays?

How significant are the following factors when selecting storage arrays?

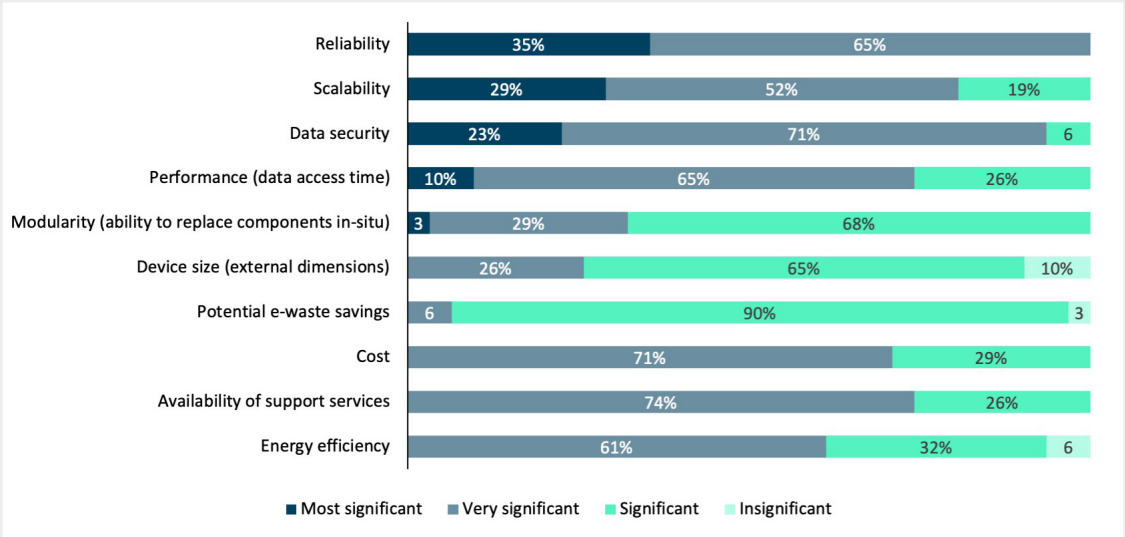

FIGURE 3 How significant are the following factors when selecting storage arrays?

For organizations operating legacy storage architecture, upgrading storage solutions involves a full forklift upgrade to completely replace their old hardware with newer, more efficient technology. Handling this process end-to-end is a complex undertaking, requiring IT teams to manage physical waste disposal, overcome security concerns and ensure that downtime is minimized. As firms increasingly integrate ESG and sustainability considerations into their IT procurement strategies, this model is fundamentally incompatible with achieving sustainability goals and reducing e-waste. Having a flexible model that allows a firm to upgrade storage capacity and extend the product life cycle, while minimizing e-waste generation, is an alternative option that can minimize disruption and align with a firm's sustainability goals.

The Need to Address E-waste Is Coming to the Fore

Research from the United Nations estimates that 57.4 million tonnes of e-waste were generated in 2021 and that 74 million tonnes will be created in 2030. Against this backdrop, e-waste is increasingly being integrated into firms' wider ESG and sustainability strategies, with 74% of organizations having set a target to reduce e-waste production (see **Figure 4**). While factors such as scalability and reliability are critical in hardware selection, e-waste considerations are quickly becoming an imperative for futureproofing business operations.

Has your organization established a target to reduce e-waste production?

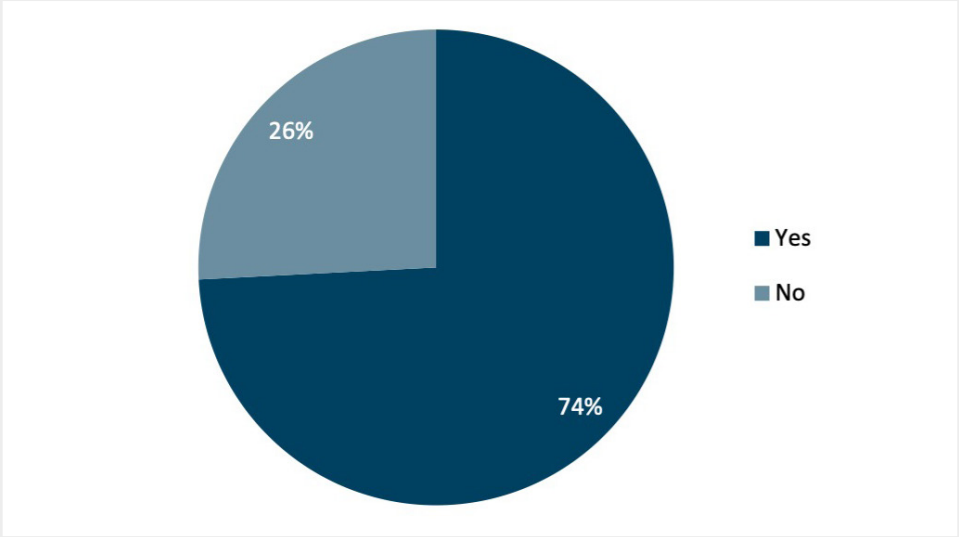

FIGURE 4 Has your organization established a target to reduce e-waste production?

> "As regulations become stronger and as opportunities for cost-cutting develop, e-waste will transform from a burden to a platform for innovation."

CHIEF INFORMATION SECURITY OFFICER, SOFTWARE DEVELOPMENT SECTOR

> "It is a critical element, and we are taking specific initiatives to reduce e-waste during the product design stage. This will include the use of recycled materials, the design of items for easy disassembly and the extension of product lifespan."

HEAD OF IT, FINANCIAL SERVICES SECTOR

Within an organization, pressure to reduce e-waste is primarily driven by regulatory compliance, organizational ESG activities and emission reduction efforts, with 45% of respondents citing regulatory compliance as the "most significant" driver (see **Figure 5**). For example, in the European Union (EU), the Waste Electrical and Electronic Equipment (WEEE) Directive has been baked into European law since 2003, requiring the separate collection and proper treatment of WEEE and setting targets for its collection, recovery and recycling. Additionally, the International Electrotechnical Commission (IEC) has been drafting an international standard for the sustainable management of e-waste, which is due to be published later in 2024.

How significant are the following drivers in influencing your organization's e-waste reduction strategy?

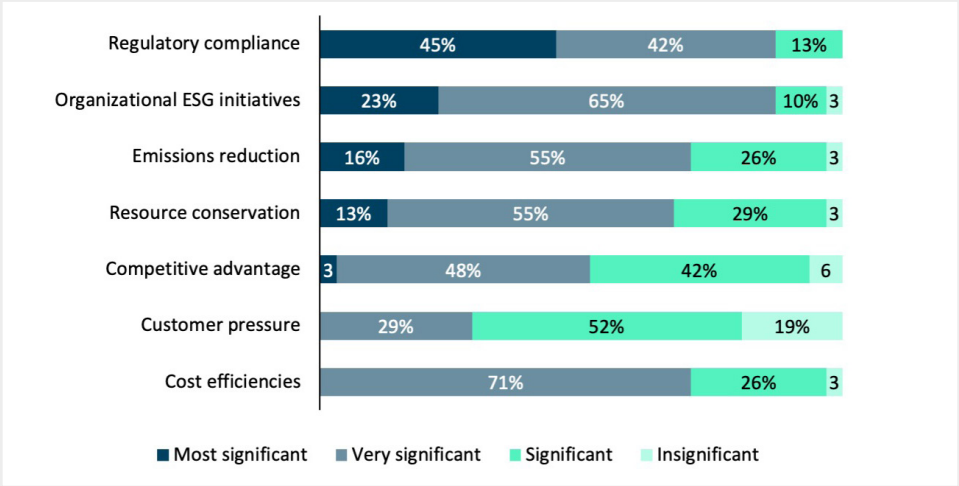

FIGURE 5 How significant are the following drivers in influencing your organization's e-waste reduction strategy?

While sustainability teams are often tasked with setting wider organizational ESG and sustainability initiatives and strategies, the defining of e-waste strategies and the subsequent operationalization of initiatives is often the responsibility of IT teams. The survey finds that the Head of IT Infrastructure and the Chief Technology Officer are the key personas driving e-waste reduction strategies, with minimal involvement from the Head of Procurement, Chief Financial Officer and Chief Sustainability Officer (CSO) (see **Figure 6**).

Within your organization, who is driving your e-waste reduction strategy?

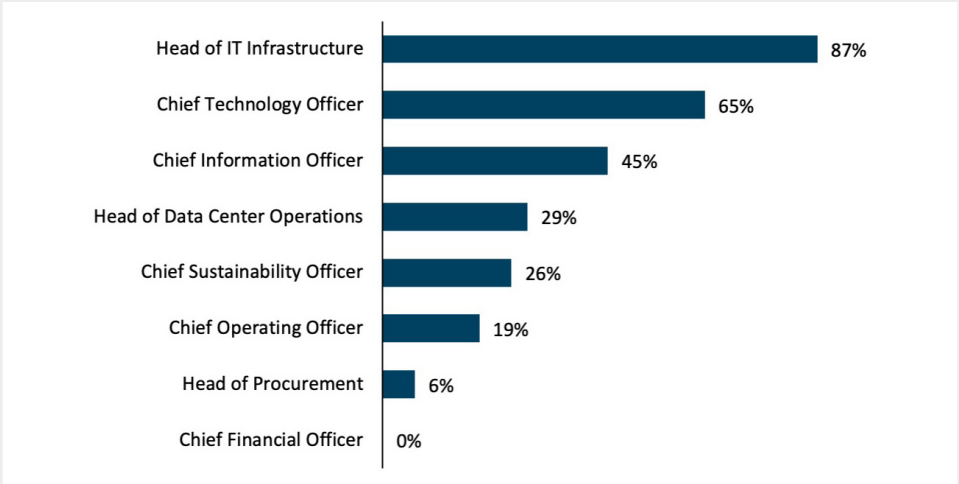

FIGURE 6 Within your organization, who is driving your e-waste reduction strategy?

Reducing E-waste Through an Upgradeable Storage Architecture

A newer model to address these concerns has emerged, whereby firms can modularly upgrade or replace elements of their data storage systems on an as-needed basis. In fact, almost a third of respondents surveyed indicate that modularity—or the ability to replace components in situ—is a "very significant" or the "most significant" factor when selecting their storage arrays.

Amongst IT executives, the concept of an upgradeable storage architecture is gaining momentum. The survey finds that 79% of respondents agree that upgradeable storage arrays save an organization time and money, and result in e-waste savings (see **Figure 7**). IT executives see operational flexibility, reduced downtime and improved scalability as the main benefits of an upgradeable storage model, as it largely eliminates the need for forklift upgrades.

Which of the following statements most accurately reflect your experience with storage arrays that are upgradeable?

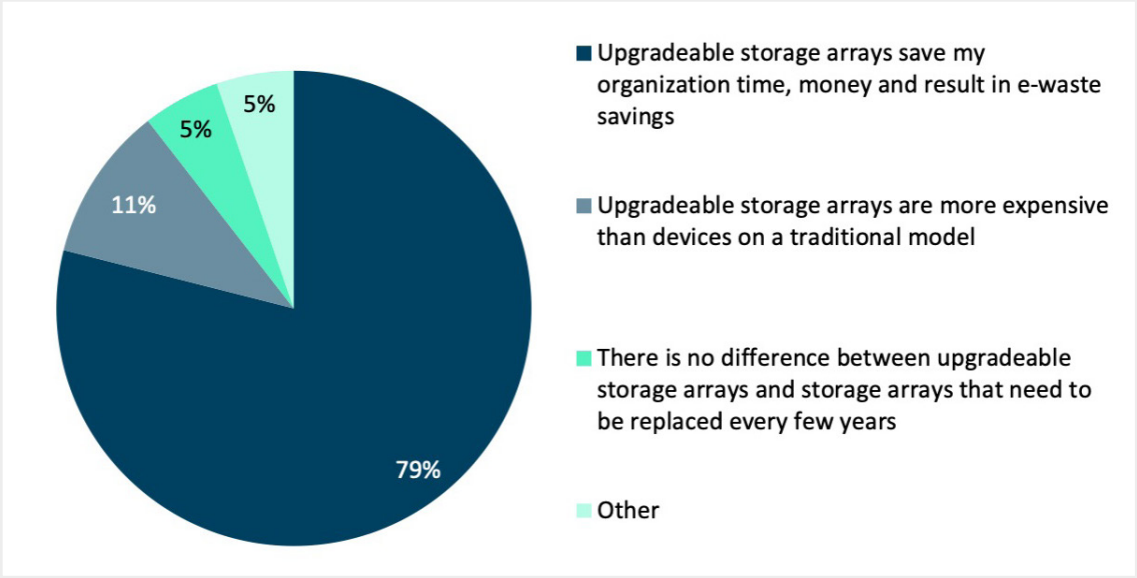

FIGURE 7 Which of the following statements most accurately reflect your experience with storage arrays that are upgradeable?

> "Upgradeable storage arrays provide flexibility and adaptability to changing needs, supporting cost-effective expansions. Traditional hardware models have restrictions and require more substantial investments for upgrades."

IT DIRECTOR, INSURANCE SECTOR

> "Upgradeable storage arrays provide futureproofing and versatility, allowing for progressive improvements. Traditional hardware models are simple, but they are vulnerable to technological obsolescence because they lack the agility and expansion capabilities inherent to upgradeable models."

HEAD OF BIG DATA, SOFTWARE DEVELOPMENT SECTOR

As shown in **Figure 8**, operational costs to maintain existing storage arrays, alongside the need for the additional security features associated with new arrays, are the primary reasons for organizations to replace storage arrays.

What are your primary reasons for replacing storage arrays?

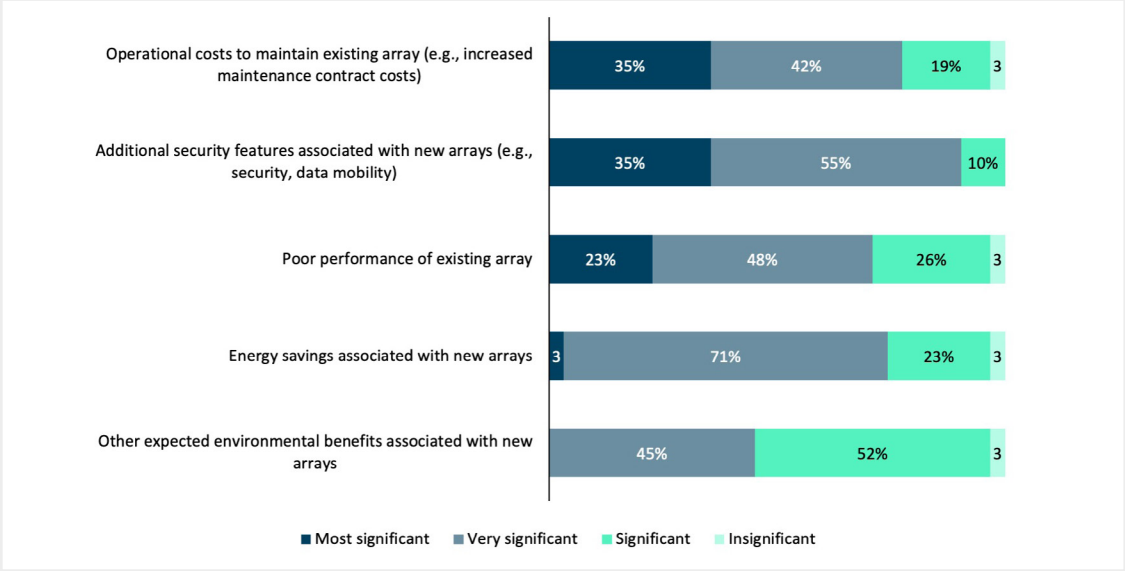

FIGURE 8 What are your primary reasons for replacing storage arrays?

Pure Storage's upgradeable storage model, which it calls Evergreen Storage, is built on a modular, software-driven, stateless architecture that can be upgraded non-disruptively. Non-disruptive upgrades can extend the lifespan of an array by up to 10 years without compromising performance. Furthermore, cross-generational compatibility ensures that different flash geometries can be mixed within an array, while according to information published by Pure Storage, the newer controllers are compatible with older flash modules. Controllers and arrays can be returned to Pure Storage to be reused or recycled—creating a closed loop.

In addition, the data density of Pure Storage's FlashArray storage allows users to fit more data into less equipment, requiring less rack space and reducing the potential e-waste burden from the start. This efficiency results in lower energy requirements and a reduction in power-generation-related emissions of up to 85%. Pure Storage's software-driven architecture enables ongoing security and other feature updates. Extending the product life cycle via modular upgrades, and removing the need for a full forklift upgrade, boost e-waste savings even further.

Key Insights From the Calculation Model

Pure Storage's Evergreen® model, data architecture and operating system allow for non-disruptive software, controller and storage capacity upgrades throughout the product lifetime. Using this model, forklift upgrades are not required for performance, feature or storage capacity upgrades; new features, greater performance and higher capacity can be added at any time without disruption to applications. The results derived from the e-waste calculation model show that by removing the need for a forklift upgrade, Pure Storage's Evergreen model produces 16 kg of potential e-waste each time controllers are swapped.

Competitors advertise 'non-disruptive data-in-place' upgrades where nodes, controllers,, and/or storage capacity are added and other equipment is maintained. These types of upgrades, however, typically impact application performance during the upgrade and are limited to the same storage platform, hw generation, and/or array model. When comparing Pure Storage's Evergreen model to competitors' limited controller- or node-only upgrades over two upgrade cycles over 10 years, Pure Storage continues to come out ahead. Over a 10-year period, Pure Storage's Flash Array//X704 produces 31 kg of e-waste, whereas an upgrade for Competitor 1 produces 87 kg and Competitor 2 generates 252 kg. Under these scenarios, Pure Storage's devices generate 3x to 8x less e-waste than competitors. **Figure 9** below shows the high-level results from the e-waste calculation model.

E-waste generated over 10-year period

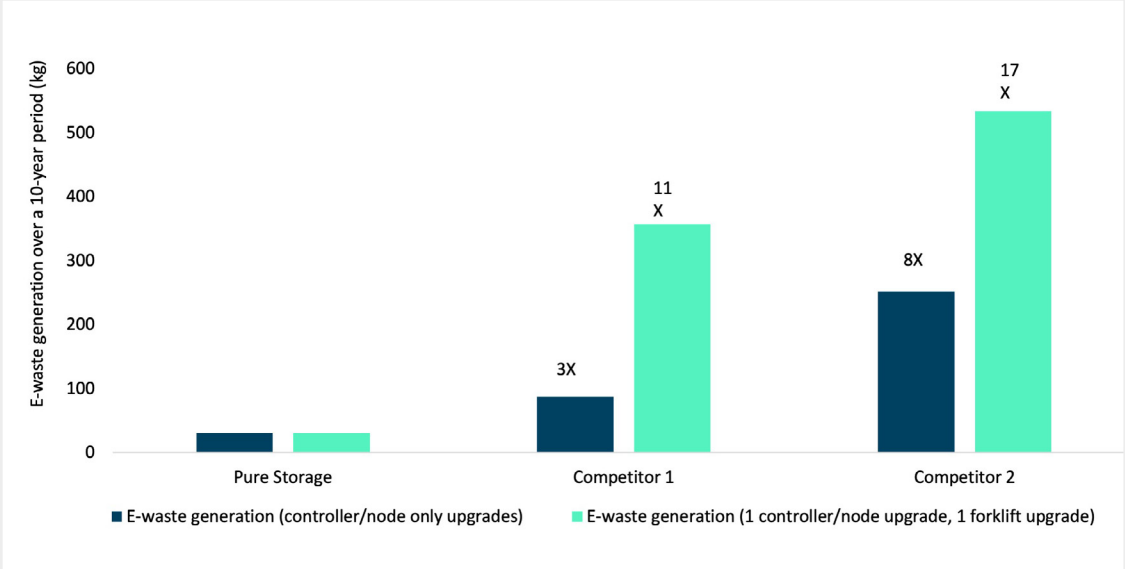

FIGURE 9 E-waste generated over 10-year period

However, the conservative controller- or node-only upgrade comparison model fails to highlight the full benefits and additional e-waste savings of the Pure Storage platform's consistent architecture and operating system across all Pure Storage products.. Pure Storage has demonstrated the ability to upgrade its products over the past decade across multiple product generations, thanks to its consistent, upgradeable storage platform. Competitors' storage devices often have different source platforms for different storage use cases, meaning that customers must remain with one platform even as their storage needs change—and cannot switch between platforms unless they perform a full forklift upgrade. In this instance, if we assume that firms would need one partial upgrade and one forklift upgrade over a 10-year period to keep up with changing requirements, technologies and platforms, the e-waste savings from utilizing Pure Storage's devices are even clearer, with Pure Storage resulting in 11 to 17x less e-waste generation than its competitors.

Three Steps to Empower an Effective E-waste Reduction Strategy

Businesses need to find a way to minimize e-waste in their IT operations, while remaining flexible, to meet changing requirements. In light of this, Heads of IT and IT Infrastructure should consider:

1. **Enhancing Internal Collaboration Between It and Sustainability Teams**
   While CSOs typically set sustainability-related targets, data from the survey show that e-waste reduction strategies are usually driven by Heads of IT Infrastructure, Chief Technology Officers and Chief Information Officers, with lesser involvement from the CSO. These functions have historically operated in silos, but the fostering of internal collaboration between IT and sustainability teams is becoming imperative to understand how e-waste contributes to wider corporate waste reduction goals and sustainability targets. This intersection holds the key to ensuring that environmental objectives can be met, while optimizing performance requirements.
2. **Raising Awareness of Potential E-waste Reduction Benefits**
   Alongside the environmental benefits associated with e-waste savings, IT executives should leverage the cost savings associated with e-waste reduction to build a robust business case. The ability to extend product life cycles from five to seven, to 10 years, coupled with higher data density arrays, results in both maintenance and energy cost savings. Furthermore, addressing e-waste aligns a firm with existing and emerging regulatory standards, reducing legal and compliance risks.
3. **Replacing Traditional Hardware With Upgradeable Storage Solutions**
   Firms need to rethink their IT infrastructure strategies to proactively minimize e-waste. Specifically, they must balance their requirements for up-to-date, reliable and secure storage solutions with the need to avoid generating excessive amounts of e-waste. By using upgradeable storage solutions, firms can upgrade or replace elements of their data storage systems on an as-needed basis. Upgradeable models can support a business in managing disposal securely and effectively, ensuring that business-critical applications and workloads are supported, while helping to minimize the labour and equipment costs associated with systems replacement, and driving e-waste reductions. As demonstrated through this study, the use of an upgradeable model results in e-waste savings in comparison with traditional data storage models, thus supporting businesses in managing disposal in a secure, efficient and environmentally sustainable way.

PS2570-01-en 03/24