VAST

VAST SUSTAINABILITY REPORT

A MODERN APPROACH TO DATA CENTER INFRASTRUCTURE EFFICIENCY

2022

TABLE OF CONTENTS

ABOUT VAST DATA	3
REACHING THE LIMITS OF HDD MEDIA	5
A NEW ARCHITECTURE ENABLES NEW EFFICIENCIES	11
E-WASTE AND OUR SUPPLY CHAIN	15
SUMMARY	19
COMPARATIVE SUSTAINABILITY SCENARIOS	20

ABOUT VAST

UNIVERSAL STORAGE FOR UNIVERSAL EFFICIENCY

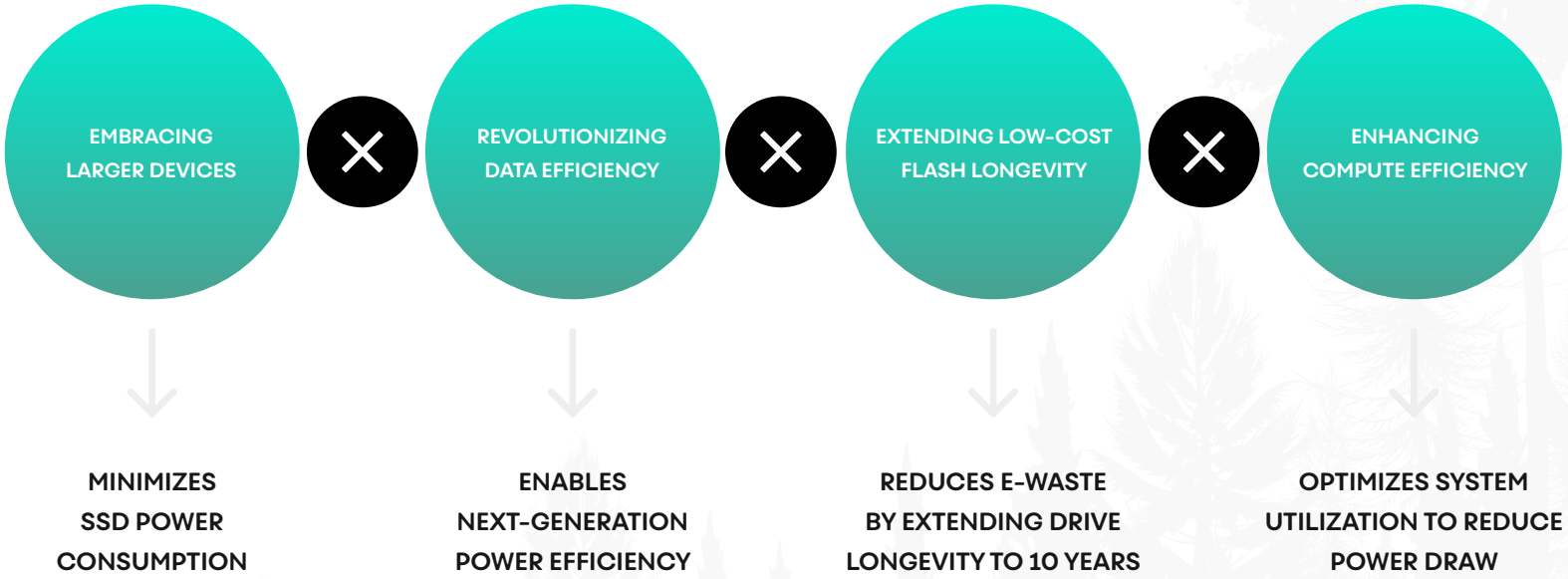
VAST Data's mission is to simplify data infrastructure and democratize fast access to all data. Our Universal Storage platform helps customers unleash insights on massive reserves of data.

We're building a world-class innovation engine with a singular focus on empowering customers to create amazing outcomes and build sustainable data center infrastructure.

This report explores how VAST's next-generation data platform lays the foundation for infrastructure environmentally superior to hard drives and last-generation all-flash storage systems.

THE VAST TRACK TO GREEN

Several efficiency innovations in VAST Universal Storage enable an environmentally-compelling proposition for organizations seeking to support sustainability objectives.



REACHING THE LIMITS OF HDD MEDIA

THE FUTURE OF THE DATA CENTER IS ALL-FLASH

Flash media is the technological foundation of VAST Data's Universal Storage. Also known as SSD, or solid state drives, flash offers superior areal density, better electronics management, lower latency, and significant power consumption improvements compared to its legacy media counterpart, the hard disk drive (HDD), which has underpinned legacy data storage infrastructure systems for decades.

The only reason data centers to date haven't been built entirely from flash storage has been the cost differential between HDD and SSD. But the gap is closing quickly and VAST has accelerated the trend, leveraging the superior input/output performance measured in IOPS (inputs/outputs operations per second) to unlock new data efficiency algorithms that bring the cost of flash below hard drives while moving organizations further toward a lower wattage envelope for the data center.

HDD

Density: 20 TB

Average Lifespan: Five Years

Watts per Terabyte: 0.42

Watts per 500,000 IOPS: 9,600

SSD

Density: 30 TB

Average Lifespan: Ten Years

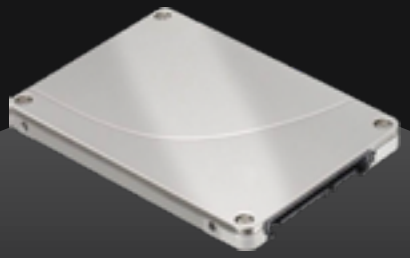
Watts per Terabyte: 0.15

Watts per 500,000 IOPS: 7

REACHING THE LIMITS OF HDD MEDIA

MEETING TODAY'S PERFORMANCE CHALLENGES

The requirements of today's increasingly data-intensive applications are forcing organizations to re-evaluate their data compute engines. Legacy HDD-based architectures consume too much data center footprint and power than is economically or environmentally viable. SSDs deliver a massive increase in IOPS performance over HDDs and represent the future of computing power in the data center.



THE IOPS OF 1 SSD = THE IOPS OF 2,400 HDDs

REACHING THE LIMITS OF HDD MEDIA

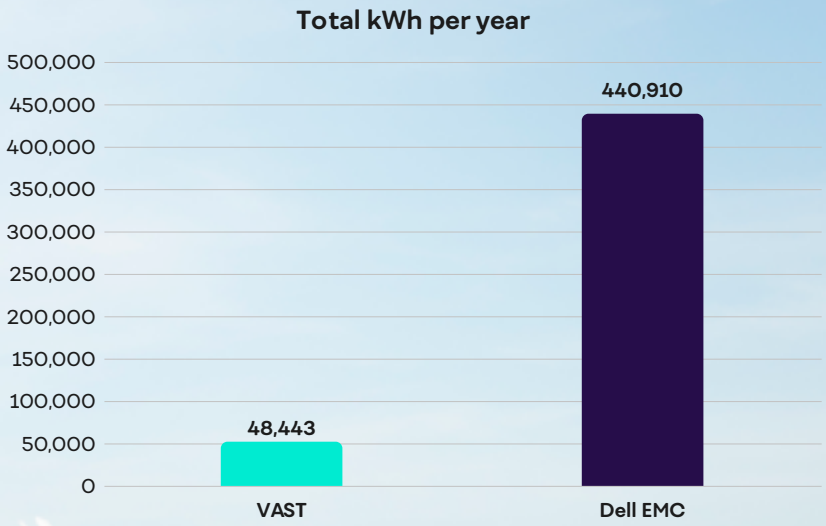
REDUCING CARBON FOOTPRINT

Today's data centers deploy a mix of flash and hard drive-based systems to manage their data; organizations never find themselves in an all-flash or all-HDD state. When a customer chooses VAST Universal Storage to replace hybrid storage infrastructure, VAST's efficiency algorithms deliver an effective cost/GB comparable to hybrid systems while providing customers superior sustained performance and environmental benefit.

Using a scale-out storage system like Dell PowerScale H500 as a comparative example, VAST customers can reduce their kilowatt-hours by nearly 400,000 per year – or 283 metric tons of carbon dioxide[1].

283t

Co2 Emissions Saved



A VAST cluster compared to a Dell EMC PowerScale H500 in a 5PB configuration[2].

1 https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

2 https://www.delltechnologies.com/asset/en-us/products/storage/technical-support/h16071-ss-powerscale-hybrid-nodes.pdf

283t

Co2 Emissions Saved

VAST vs. Hybrid Scale-Out Storage for 5PB

=

313,120

fewer pounds of coal burned

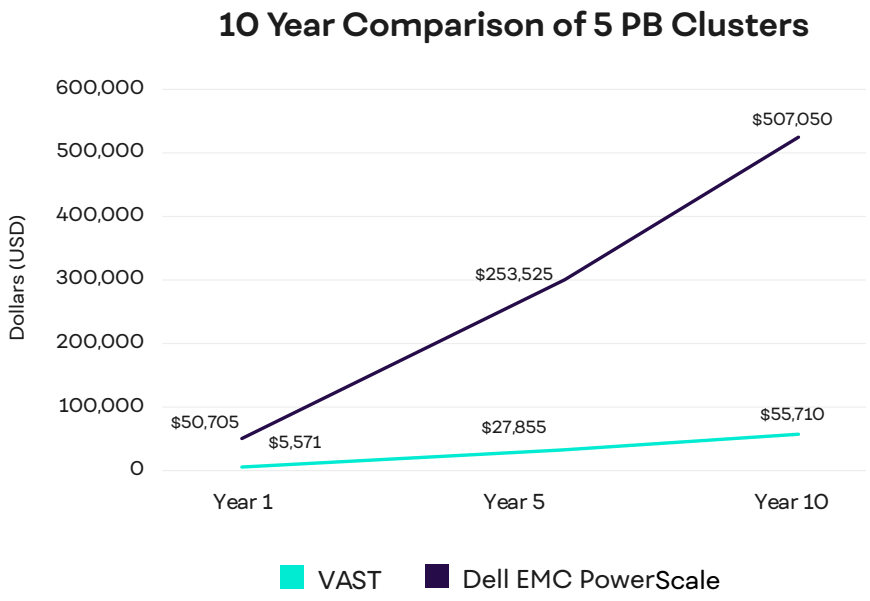
655

fewer barrels of oil consumed

REACHING THE LIMITS OF HDD MEDIA

REDUCED ENERGY COSTS

Energy-efficient solutions also offer significant economic benefits. By reducing the amount of power needed to manage large-scale datasets, VAST systems enable customers to scale energy savings on a linear curve while providing opportunities to re-invest energy savings back into the business.

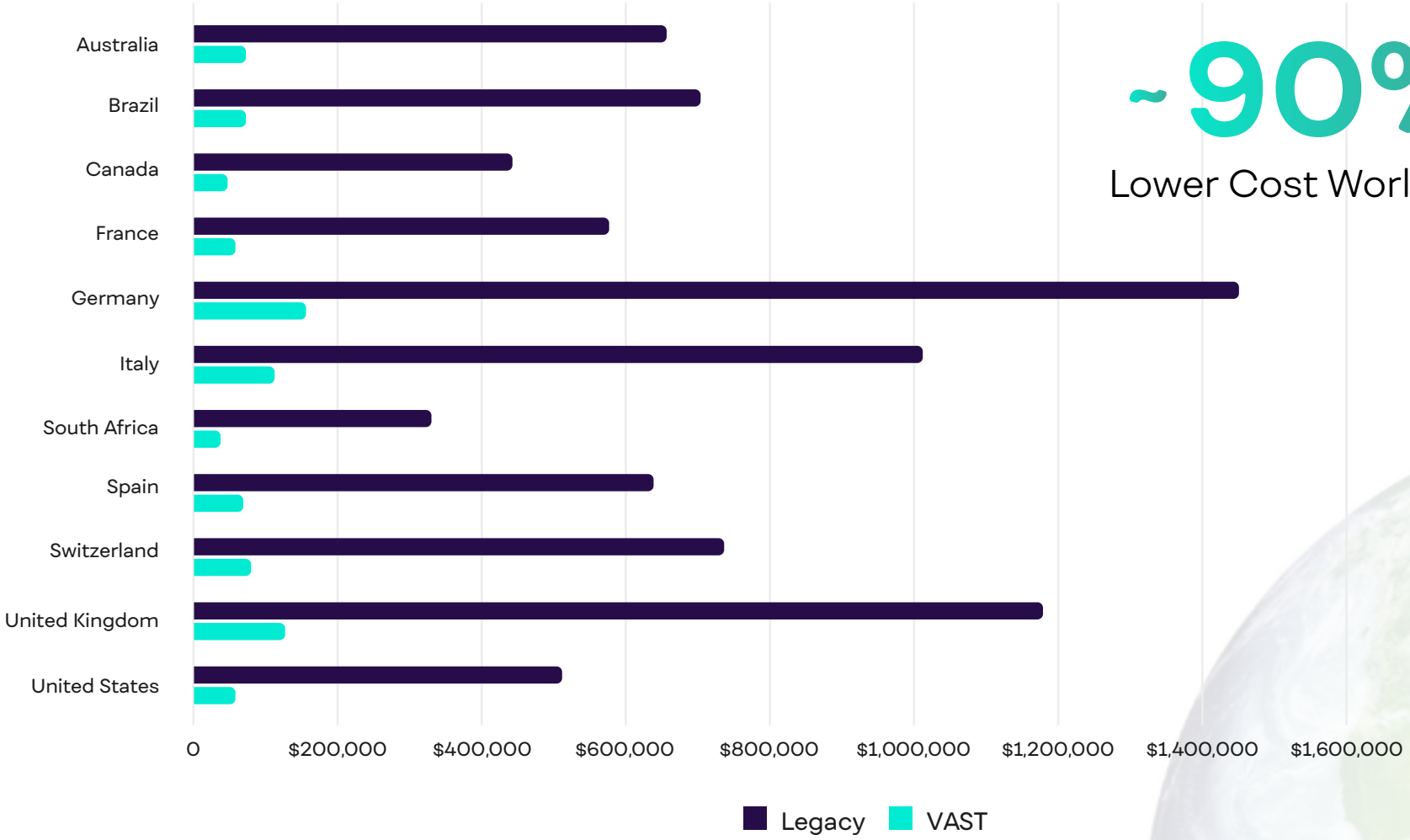


The average electric price a business customer in the U.S. pays for electricity is 11.5 cents per kWh.
https://www.globalpetrolprices.com/USA/electricity_prices

ENERGY SAVINGS AROUND THE WORLD

A GLOBAL 10-YEAR COST COMPARISON

Energy prices vary for VAST customers around the world. Here we examine the global cost differences for a five petabyte cluster, again using a Dell EMC PowerScale H500 as a comparison.



~90%

Lower Cost Worldwide

In USD, as of Dec. 2021 https://www.globalpetrolprices.com/USA/electricity_prices/

A NEW ARCHITECTURE ENABLES NEW EFFICIENCIES

DASE™ IS THE FOUNDATION FOR GREEN DATA CENTERS

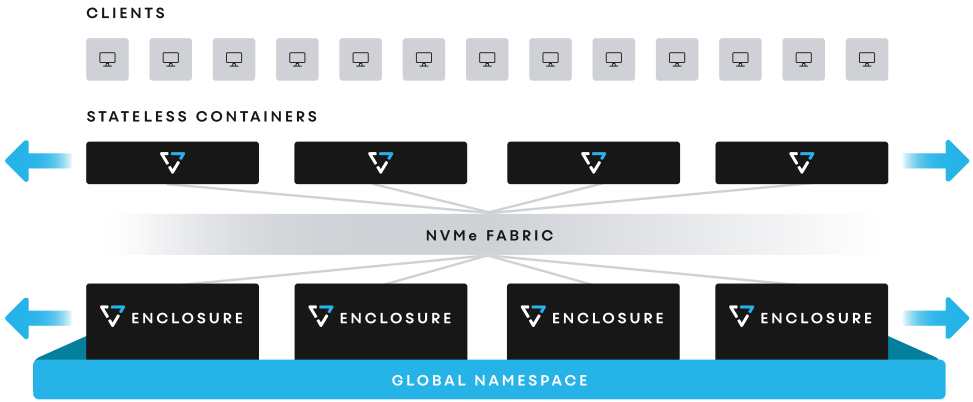
Since our founding, the VAST guiding principle has been to embrace dense flash media as the path to optimal enterprise data center performance.

To that end, we've built an entirely new data center system architecture from the ground up. VAST's DASE is the world's first Disaggregated & Shared Everything Data platform architecture, a scale-out systems concept that aims to eliminate many of the classic storage architecture constraints of the past.

VAST disaggregates (separates) the storage media from the CPUs that manage that media and provide storage services. This disaggregated storage, including all the system metadata, is shared by all the VAST Servers in the cluster. DASE allows users to scale the capacity of a VAST Cluster independently from the compute resources of the cluster, adding enclosures for capacity and servers for performance. For more information on the DASE architecture, we invite you to read the VAST White paper (vastdata.com/whitepaper).

By pairing new data efficiency algorithms with modern technologies, we've achieved what was previously unthinkable: to make solid state, or flash, storage affordable enough for all organizational data.

The byproduct of such a radical rethink of enterprise data infrastructure is a uniquely environmentally-friendly architecture that unlocks unprecedented green benefits for the data center.



A NEW ARCHITECTURE ENABLES NEW EFFICIENCIES

LESS POWER, MORE INSIGHTS

VAST improved NOAA compute efficiency by 50% for data post-processing workloads, which was directly attributable to a power reduction of 50% from their post-processing compute infrastructure. – Reported at the 2022 HPC Forum

INVITAE

"Invitae moved to using VAST to speed up their workflows... Current test runs took 24 hours to run, but with VAST and GPUs they can do these runs in 15 minutes." – Forbes

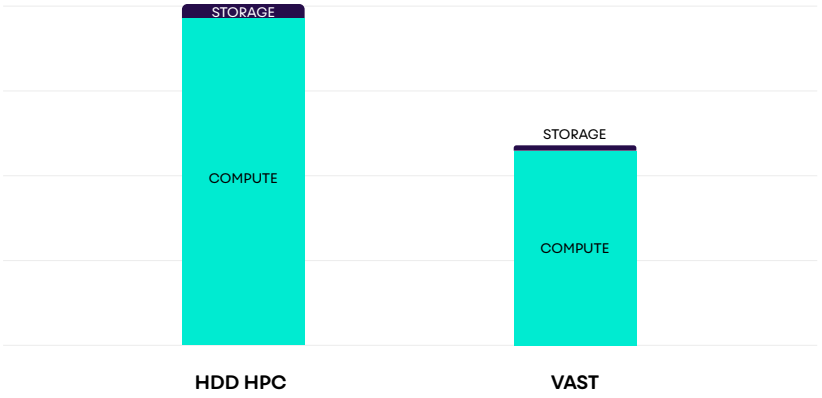
NIH

NIH deploys massive amounts of compute power to analyze massive datasets and attempt seemingly impossible projects. VAST infrastructure reduces processing time by up to 25% on NIH's analytical workloads, creating massive energy saving opportunities.

As we've noted, flash enjoys significant performance advantages over hard drives that enable applications to process data faster, drive better time to insights, and perhaps more importantly, enjoy power efficiency gains.

Organizations implementing high performance computing (HPC) to tackle highly complex challenges generate large amounts of compute power. VAST's all-flash approach to the datacenter enables these organizations to better utilize servers and significantly reduce the amount of compute needed to run workloads.

When customers can run the same applications while consuming less compute energy, they can make smarter decisions and move faster in the same space and power envelope.



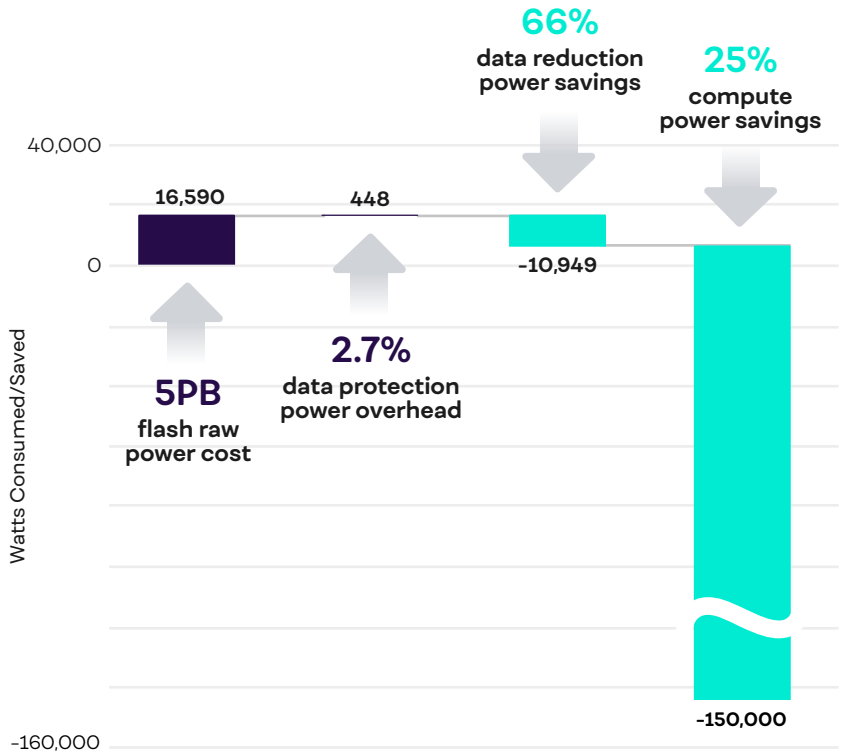
VAST can reduce compute power consumption by 25-50% for workloads moving beyond legacy HDD storage.

A NEW ARCHITECTURE ENABLES NEW EFFICIENCIES

VAST'S COMPOUNDING EFFICIENCIES

VAST achieves never-before-seen energy efficiency by marrying global data algorithms with state-of-the-art technology.

The combination of hyperscale flash, breakthrough erasure code efficiency, global data reduction, and compute power reduction all compound into an environmentally-compelling proposition for organizations seeking to achieve demonstrable energy efficiency improvements – as well as a storage system that essentially pays for itself.



This example synthesizes several VAST deployment experiences in large-scale computing centers. 5PB of effective storage capacity and 800 compute nodes (some with GPUs) in a large cluster environment accelerated by 33% vs. HDD.

All-flash DASE™ systems can

PAY FOR THEMSELVES

just in compute power savings vs HDD.

A NEW ARCHITECTURE ENABLES NEW EFFICIENCIES

NEXT-LEVEL EFFICIENCY DRIVERS

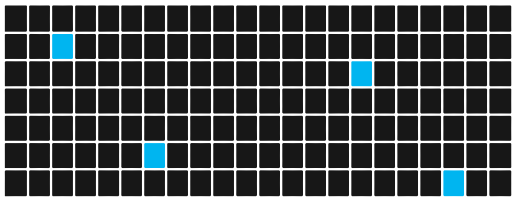
MINIMIZING WATTAGE PER EFFECTIVE TERABYTE

Minimal Overhead.

Protecting user data is the primary responsibility of any enterprise storage admin, but conventional systems offer data protection solutions like replication, RAID, and Reed-Solomon erasure coding that require significant storage overhead (as much as 66% of total drive storage) to deliver optimal resiliency.

VAST's locally decodable erasure codes are far more efficient, needing just a fraction of the available data capacity to reconstruct data, bringing system overhead down to as little as 2.7%, far lower than previously possible and drastically reducing watts per effective TB.

Locally Decodable Erasure Codes

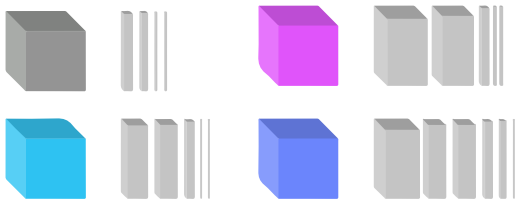


Maximum Capacity.

VAST delivers unprecedented data reduction to enable a smaller environmental footprint than any other storage system. Our new approach to global data reduction, Similarity-Based Reduction, is based on deep pattern matching enabled by the random access capabilities only available in flash.

VAST's global similarity reduction can reduce data more than the combination of data deduplication and compression used by other all-flash storage systems. VAST customer testing shows data reduction of up to 20:1 for backup data (2x-3x more efficiency than legacy deduplication appliances for backups), and 33%-66% better efficiency than traditional shared-nothing systems. We are so confident in our new approach to data reduction that we guarantee that it will reduce data better than any other storage system.

Similarity-Based Data Reduction



A NEW GENERATION OF ALGORITHMS TO PIONEER UNPRECEDENTED FLASH EFFICIENCIES

E-WASTE AND OUR SUPPLY CHAIN

EXTENDING THE LIFESPAN OF DATA CENTER STORAGE INFRASTRUCTURE

The only way to build an economically feasible all-flash data center is to use its lowest cost form factor as the foundation. But low-cost flash inherently has far lower endurance than its more expensive counterparts. VAST solves this challenge with predictive placement technology known as Foresight that reduce the impact of writing data to flash, which in turn allows the drive to last much longer than it otherwise would. This allows us to guarantee the drives in our systems to last for 10 years.

Legacy architectures frequently require clusters to be built from homogenous pools of servers and storage, forcing customers to perform forklift upgrades of entire clusters – therefore creating tons of new electronic waste, or e-waste – whenever they need to add system capacity or performance. The asymmetric design of the VAST architecture eliminates such e-waste events, allowing customers to expand their VAST cluster across multiple generations of VAST hardware. By extending the hardware's lifetime well beyond the three to five years life typical for storage, customers never have to perform resource-intensive data migrations and forklift upgrades.

E-WASTE AND OUR SUPPLY CHAIN

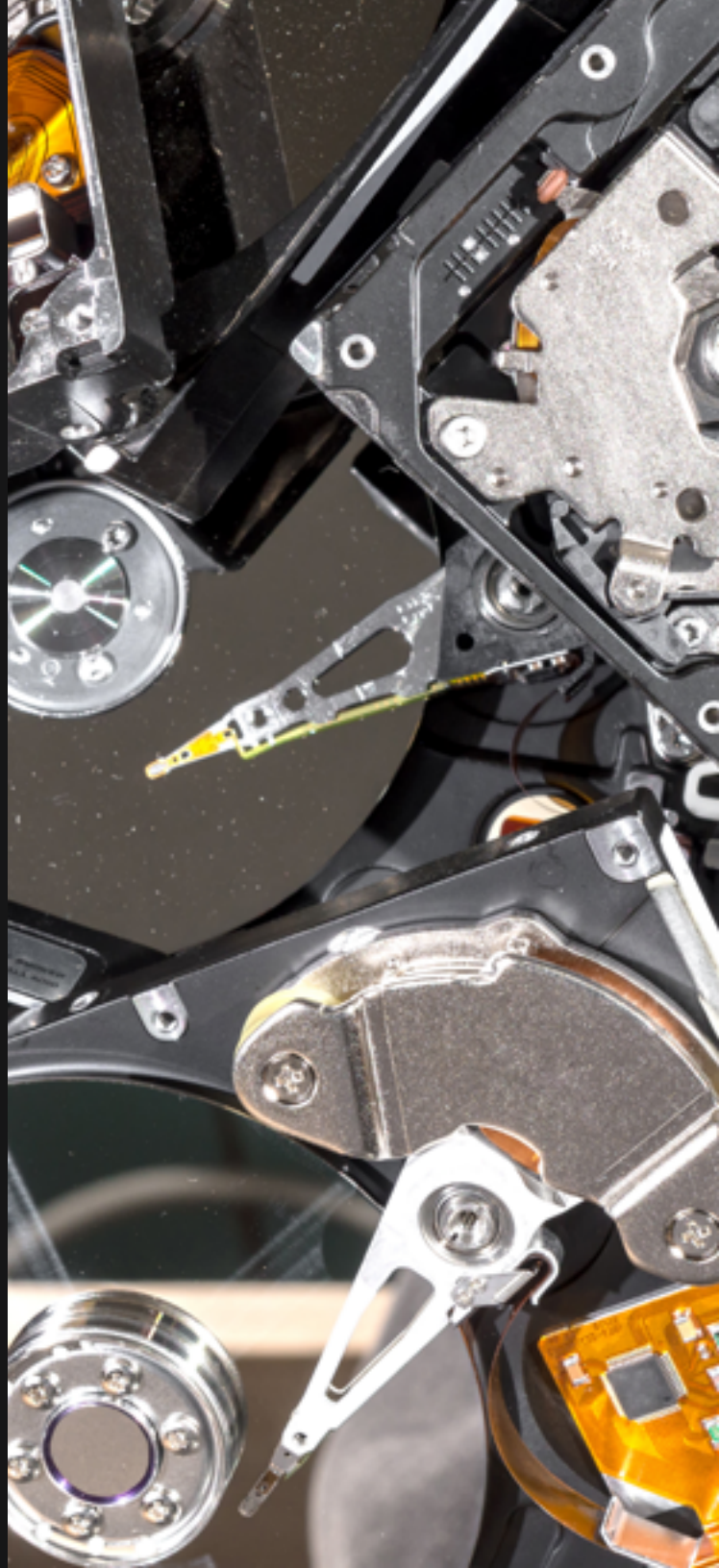
MINIMIZING E-WASTE

E-waste is the fastest-growing waste stream in the United States, according to the United States Environmental Protection Agency[1], and the relatively short working life of hard drives has been a notable contributor.

Storage vendors traditionally have limited the length of support contracts to five years – the average lifespan of HDDs – to avoid the rising cost of increasing failures. As a result, customers have been conditioned to expect the need for new data center hardware at the end of a five-year support contract, creating new e-waste cycles.

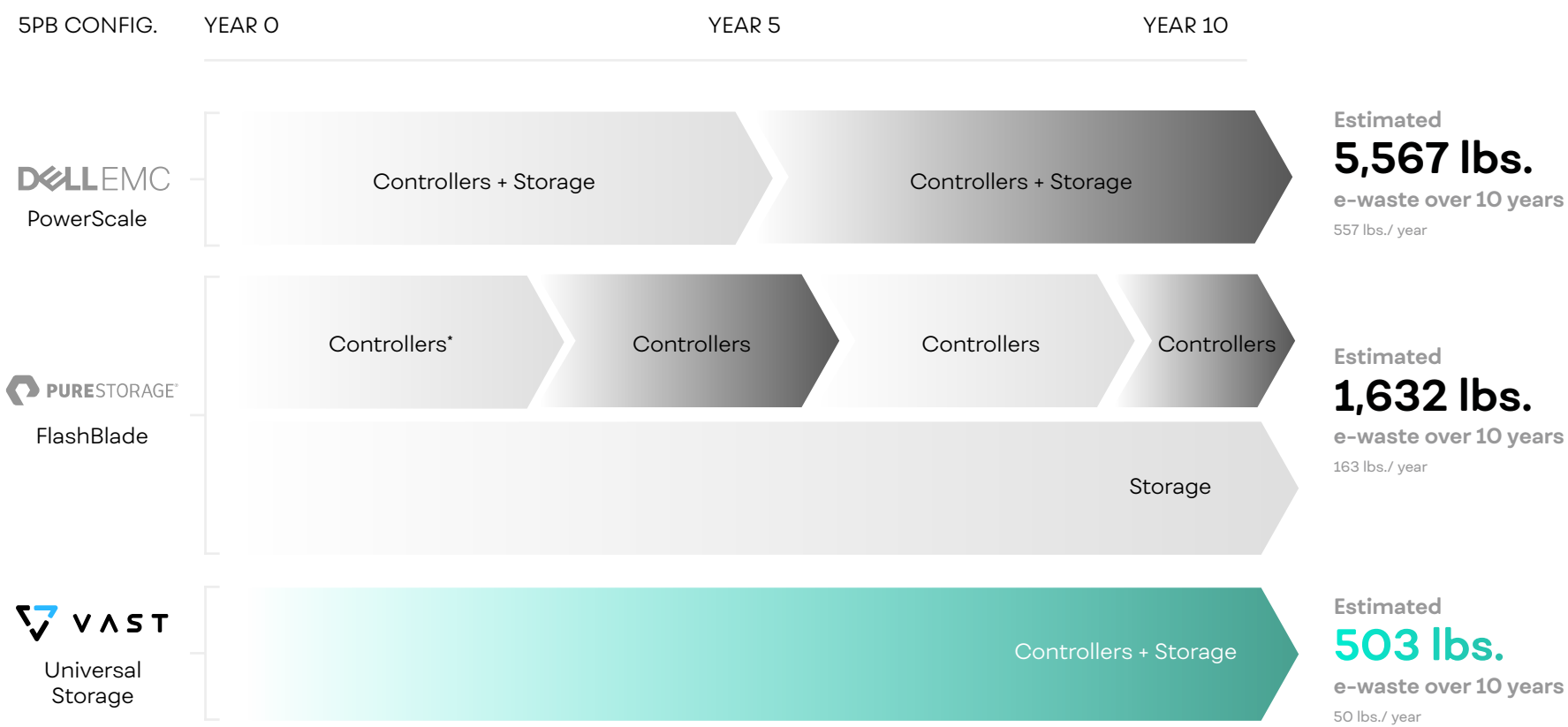
Because flash lasts longer, is more dense, and creates more opportunities for data reduction than disk does, an all-flash data center produces just a fraction of the e-waste of legacy infrastructure. VAST customers won't contribute e-waste until 10 years from their initial deployment (at minimum), or at a point when it becomes technologically worthwhile to upgrade.

1 https://www.epa.gov/sciencematters/helping-communities-manage-electronic-waste



ELIMINATING THE REFRESH CYCLE

Legacy vendors have forced customers into migrations that effectively reduce system lifespans to 4-5 years. Migrations themselves can be painstaking, lengthy processes required to upgrade to new hardware and software (often coupled together).



5 petabyte configurations shown. Pure Evergreen/Forever Subscription allows customer to replace compute for FlashArray and FlashBlade, assuming 10% e-waste reduction compounding annually.
https://www.purestorage.com/content/dam/pdf/en/legal/evergreen-forever-subscription-program-description.pdf

E-WASTE AND OUR SUPPLY CHAIN

INTEGRITY AND RESPONSIBILITY THROUGHOUT THE VAST SUPPLY CHAIN

As a software company VAST doesn't sell hardware, but we work closely with our hardware partners to deliver infrastructure that meets the exacting requirements of Universal Storage.

Today, we partner with many of the world's leading hardware companies that share our commitment to both sustainability and responsible supply chains, including HPE, Kyoxia, NVIDIA, Solidigm, and many more.

Equally as important as our component suppliers are the VAST integrators who maintain this high standard of excellence, including Avnet, which emphasizes environmental protection across their supply chain operations.

AVNET®

"Sustainability is integrated into supplier relationships by way of either our distribution or service agreements... Avnet expects vendors and suppliers in our supply chain to be responsible global citizens... (and) are encouraged to adhere to the RBA Code of Conduct for the fair treatment of workers, for their health and safety in their work environment, for the protection of the environment, and for excellent business ethics."

AVNET SUSTAINABILITY REPORT FY21 AVNET.COM

SUMMARY

THE ULTIMATE IN EFFICIENCY FOR A GREENER TOMORROW

The
LOWEST STORAGE POWER DRAW

The
LEAST AMOUNT OF E-WASTE

All-Flash
OPTIMIZED COMPUTE EFFICIENCY

VAST GUARANTEE

THE GREENEST DATA INFRASTRUCTURE – GUARANTEED

At VAST, we believe in making bold commitments to improve the world around us — and taking bold steps to meet them. We're so confident that Universal Storage is better for the environment than any other data storage infrastructure that exists today that **we guarantee it**.

If a VAST cluster consumes more power than any other comparable storage system, we will buy carbon credits to offset any additional power used.

VAST's industry-first sustainability guarantee ensures customers are doing the most good for the environment with their data center agenda.

COMPARATIVE SUSTAINABILITY SCENARIOS

COMPARATIVE SUSTAINABILITY SCENARIOS

VAST SUSTAINABILITY IN ACTION

HYBRID (SSD/HDD) SYSTEM VS. VAST AT 5PB

PowerScale H500 w/8TB HDD

DELL EMC		VAST
4,800 TB	Raw Capacity	2,028 TB
3,648 TB	Usable Capacity	1,784 TB
5,308 TB*	Effective Capacity	5,355 TB**
40	Rack Units	14
5,567 LBS.	E-Waste*** (10 years)	581 LBS.
19,100	Watts	5,530
~50 GBps	Throughput (read bandwidth)	~96 GBps

Universal Storage 3 x 6

90% LESS E-WASTE

79% LESS POWER CONSUMED

65% FEWER RACK UNITS

*Assumes 1.5 data reduction ratio (DRR). ** Assumes 3:1 data reduction ratio (DRR). ***Assumes 10% e-waste reduction compounding annually.
https://www.delltechnologies.com/asset/en-us/products/storage/technical-support/h16071-ss-powerscale-hybrid-nodes.pdf
All data in this document is based on our best understanding of comparative offerings and should not be considered authoritative.

COMPARATIVE SUSTAINABILITY SCENARIOS

VAST SUSTAINABILITY IN ACTION

FIVE-YEAR-OLD HDD-BASED SYSTEM VS. VAST AT 5PB

PowerScale H500 w/4TB HDD

DELL EMC		VAST
4,500 TB	Raw Capacity	2,028 TB
3,420 TB	Usable Capacity	1,784 TB
5,130 TB*	Effective Capacity	5,355 TB**
75	Rack Units	16
7,451 LBS.	E-Waste*** (10 years)	737 LBS.
33,750	Watts	5,530
~75 GBps	Throughput (read bandwidth)	~128 GBps

Universal Storage 4 x 6

90% LESS E-WASTE

84% LESS POWER CONSUMED

79% FEWER RACK UNITS

*Assumes 1.5 data reduction ratio (DRR). ** Assumes 3:1 data reduction ratio (DRR). *** Assumes 10% e-waste reduction compounding annually.
https://www.delltechnologies.com/asset/en-us/products/storage/technical-support/h16071-ss-powerscale-hybrid-nodes.pdf
All data in this document is based on our best understanding of comparative offerings and should not be considered authoritative.

COMPARATIVE SUSTAINABILITY SCENARIOS

VAST SUSTAINABILITY IN ACTION

ALL-FLASH (NON-VAST) VS. VAST AT 5PB

PowerScale F900 11 369TB Nodes

DELL EMC		VAST
4,059 TB	Raw Capacity	2,028 TB
3,419 TB	Usable Capacity	1,784 TB
5,236 TB*	Effective Capacity	5,355 TB**
24	Rack Units	14
1,085 LBS.	E-Waste*** (10 years)	581 LBS.
9,450	Watts	5,530
~66 GBps	Throughput (read bandwidth)	~96 GBps

Universal Storage 3 x 6

50% LESS RAW CAPACITY NEEDED

43% LESS POWER CONSUMED

46% LESS E-WASTE

** Assumes 1.5:1 data reduction ratio (DRR). ** Assumes 3:1 data reduction ratio (DRR). ***Assumes 10% e-waste reduction compounding annually.*
https://www.delltechnologies.com/asset/en-us/products/storage/technical-support/h15963-ss-powerscale-all-flash-nodes.pdf
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COMPARATIVE SUSTAINABILITY SCENARIOS

VAST SUSTAINABILITY IN ACTION

ALL-FLASH (NON-VAST) VS. VAST AT 5PB

FlashBlade//s 3 Chassis
10 blades, 4 x 48 (4 DFMs 48 TB each DFM)

PURESTORAGE®		VAST
5,760 TB	Raw Capacity	2,028 TB
3,744 TB	Usable Capacity	1,784 TB
5,616 TB*	Effective Capacity	5,355 TB**
17	Rack Units	14
1,632 LBS.	E-Waste*** (10 years)	581 LBS.
8,000	Watts	5,530
~75 GBps	Throughput (read bandwidth)	~96 GBps

65% LESS RAW CAPACITY NEEDED

31% LESS POWER CONSUMED

45% LESS E-WASTE

Universal Storage 3 x 6

*Assumes 1.5:1 data reduction ratio (DRR). **Assumes 3:1 data reduction ratio (DRR). ***Assumes 10% e-waste reduction compounding annually.
https://www.purestorage.com/products/file-and-object/flashblade.html
All data in this document is based on our best understanding of comparative offerings and should not be considered authoritative.

COMPARATIVE SUSTAINABILITY SCENARIOS

VAST SUSTAINABILITY IN ACTION

HDD-BASED PURPOSE-BUILT BACKUP APPLIANCE (PBBA) VS. VAST

PowerProtect DD9900*

Universal Storage 1 x 1

DELL EMC		VAST
2,400 TB	Raw Capacity	1,350 TB
1,920 TB	Usable Capacity	1,105 TB
9,600 TB*	Effective Capacity	11,050 TB**
33	Rack Units	5
2,250 LBS.	E-Waste*** (10 years)	210 LBS.
6,077	Watts	2,230
~5 GBps****	Throughput (read bandwidth)	~32 GBps

91% LESS E-WASTE

85% FEWER RACK UNITS

63% LESS POWER CONSUMED

*Assumes 5:1 data reduction ratio (DRR) via deduplication. ** Assumes 10:1 DRR wtih Similarity-Based Reduction.
Assumes 10% e-waste reduction compounding annually. * Dell EMC does not publish restore throughput; Estimate of 1/8 its write throughput.
All data in this document is based on our best understanding of comparative offerings and should not be considered authoritative.