



SEAGATE

Creating the Sustainable Datasphere

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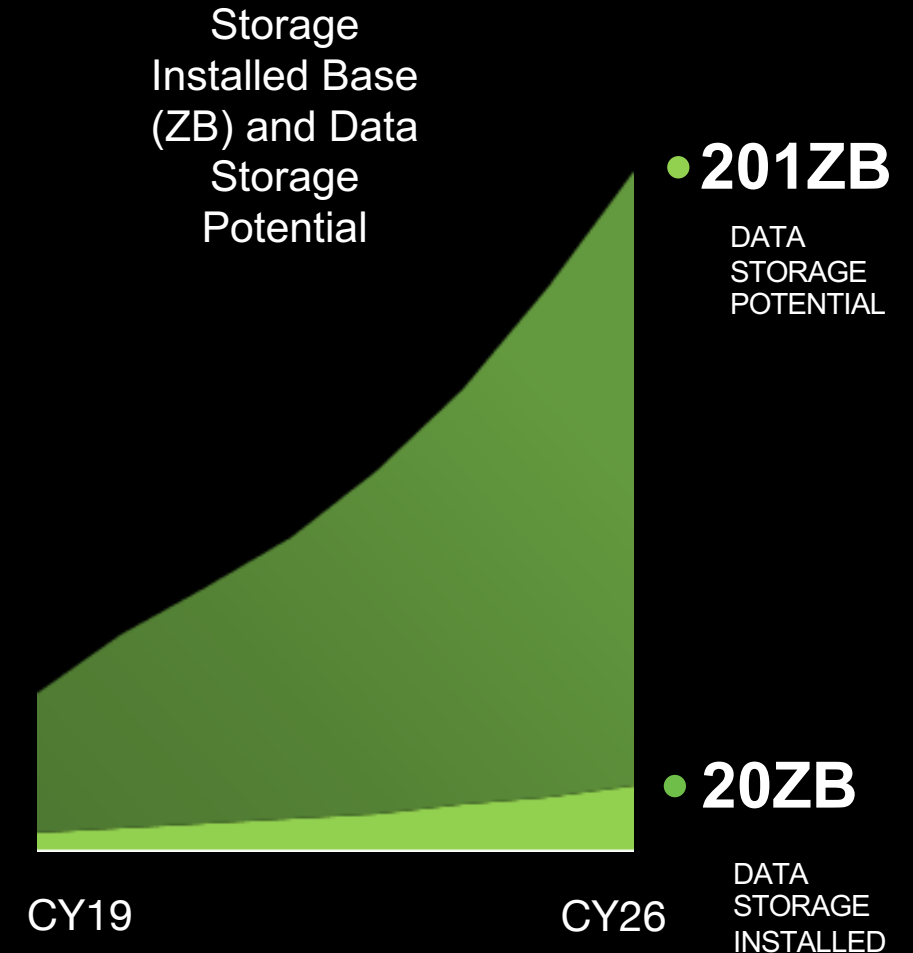
AUGUST 2, 2022

Global Data Explosion



- Data growth has a projected CAGR of 25% through 2030
- Most CO2 emissions occur pre-use
- Most storage devices are destroyed and not recycled or repurposed

Creating a sustainable Datasphere requires a new mindset.



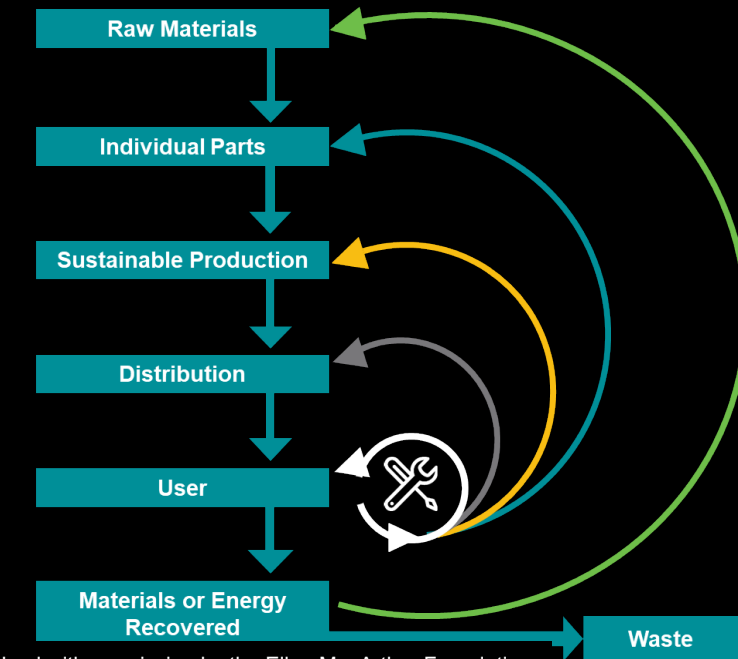
Mega Trends Driving Need for Mass Capacity Storage At The Edge



Circularity is Key to a Sustainable Future

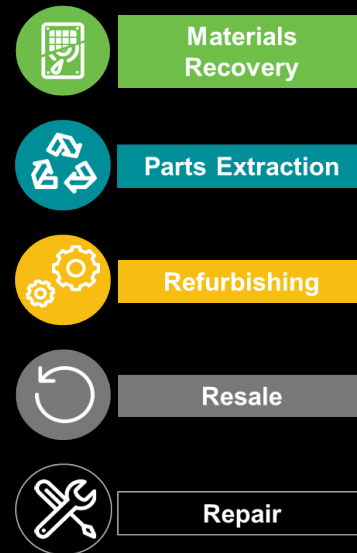


Linear Production Model



Used with permission by the Ellen MacArthur Foundation

Circular Production Model



Design

Increased drive capacity, ease of recycling, power efficiency, security

Life of drive

Power consumption, Repair in field to extend the usable life of hardware

Manufacturing

Use of scarce materials, recycled content, packaging

Disposal

Reuse and recycling. Common parts reuse with 10D platform

Life Cycle Assessment (LCA)

<https://www.seagate.com/global-citizenship/life-cycle-assessment>

Sustainable Datasphere

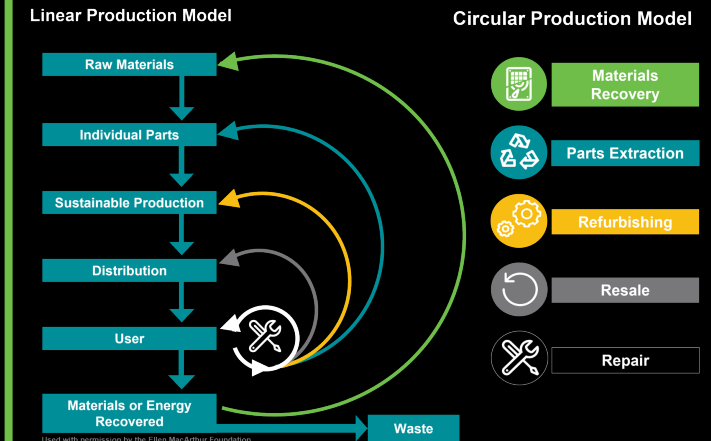
Sustainable Operations



Sustainable Products



Sustainable Use/End of Life



Barriers to Reuse and Recycling



- Data sanitization & reuse is by far the most sustainable practice
- There are many barriers to reuse — most are misconceptions related to security
- IEEE P2883 (2022) is the gold standard in data sanitization requirements & guidance

Today's Widespread HDD Shredding:



>200 million drives are destroyed each year.

Creating a sustainable datasphere requires a new mindset.

Thank you



The Circular Drive Initiative

How Crypto can help Solve E-waste for Storage

Aug 2022

Jonmichael Hands, Chia Network

Today's common practice – Physical Destruction

- Companies physically destroy devices to avoid the perception of risk
- Makes lawyers feel warm and fuzzy
- Drilling, shredding, smashing...are not approved sanitization methods
- Large businesses that specialize in physical destruction promote the myth that destruction is only safe way to prevent unauthorized access to data



Data Security as Barrier

- Cloud service providers, enterprises, and businesses don't want confidential data leaking
- Trust between CSP and customer
- Privacy, compliance, and data management for physical and virtual access to storage
- Security is a top priority for CSPs
- Encryption of customer data in flight and data at rest is standard practice
- Policies minimize or eliminate all risk
- CSPs often make legal agreements on end-of-life for storage

Storage Market - Units



HDD Type	Average Weight (grams)	2021 Units (millions)	Total Weight
2.5in	200g	96M	19.2M kg
3.5in	670g	162M	108.5M kg



SSD	2021 Units (millions)
All segments	429M

1. [IDC Worldwide Hard Disk Drive Forecast, 2022–2026](#), May 2022 - Market Forecast - Doc #US49050622
2. [Worldwide Solid State Storage Forecast, 2022–2026](#), May 2022 - Market Forecast - Doc #US47831722

SSD carbon scales with capacity

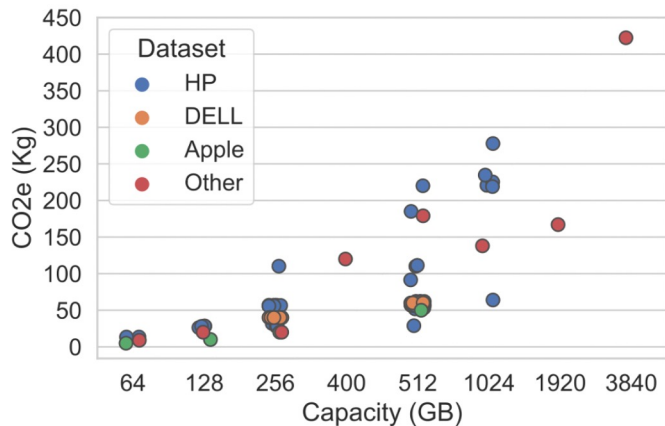


Figure 4: Carbon emissions for manufacturing 94 Solid State Drives, data based on Life Cycle Analysis (LCA) reports published by eight vendors.

<https://arxiv.org/pdf/2207.10793.pdf>

As outlined in figure 1, the manufacturing of the Dell R740 contributes to approximately 50% to the total of the life cycle impact. The majority of the impacts come from the electronic components, particularly the eight 3.48TB SSD's (~80%). Figure 2 shows that the majority of the impact of the 3.48TB SSD's comes from the NAND flash chips. The energy consumption, waste and emissions of their manufacture far outweigh the regular metallurgical or plastic production processes we see with other components such as the server chassis. This is especially the case for the associated complexity, high density and high capacity chips used in the SSD's.

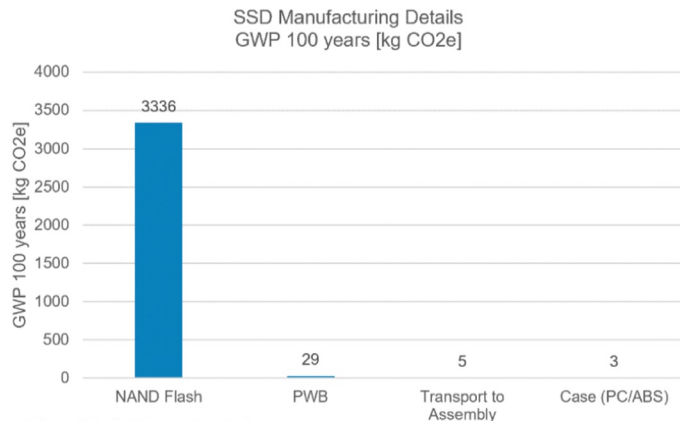


Figure 2: SSD Manufacturing Impacts

https://corporate.delltechnologies.com/content/dam/digitalassets/active/en/unauth/data-sheets/products/servers/lca_poweredge_r740.pdf

Other Barriers to Drive Reuse

Data Security: Cloud data centers assure customers and users of data security. To avoid any perception of risk, storage devices are physically shredded at the end of first use.

Government Regulations: Specifications recommend physical destruction for sensitive data when leaving an organization's control.

Secondary markets: Viable secondary markets are critical to economically reclaim and repurpose used storage devices.

Metrics: There is a lack of transparency and data availability around product information, environmental impact, and end of first use.

Operations: Inefficient processes are costly for value recovery. Supply chains and operations require new processes for drive reuse at scale.

Circular Drive Initiative public announcement on Nov 2, 2021



Western Digital.



McDONOUGH INNOVATION
CRADLE® DESIGN
INNOVATION FOR THE CIRCULAR ECONOMY™

Industry lead with the guidance of **Bill McDonough**

Conceived by William McDonough, Chief Executive of McDonough Innovation and the renowned architect of Cradle to Cradle design and The Circular Economy, CDI counts Seagate and Western Digital as founding members alongside Chia Network, Inc., an energy-efficient decentralized blockchain.

"Much of the e-waste we see from hard drives today is driven by perceived risk and insufficient secondary markets for this technology, I am thrilled to welcome these founding members on board the initiative as we create a compelling global Circular Economy business case."



William McDonough, Chief Executive, McDonough Innovation



Purpose of the Association



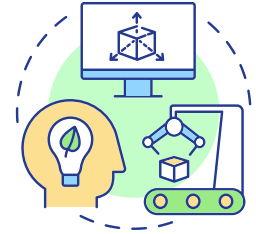
Develop Sustainable Standards

Make the storage market more sustainable by developing and promoting standards, reporting, and best practices around **circular** business models.



Increase reuse

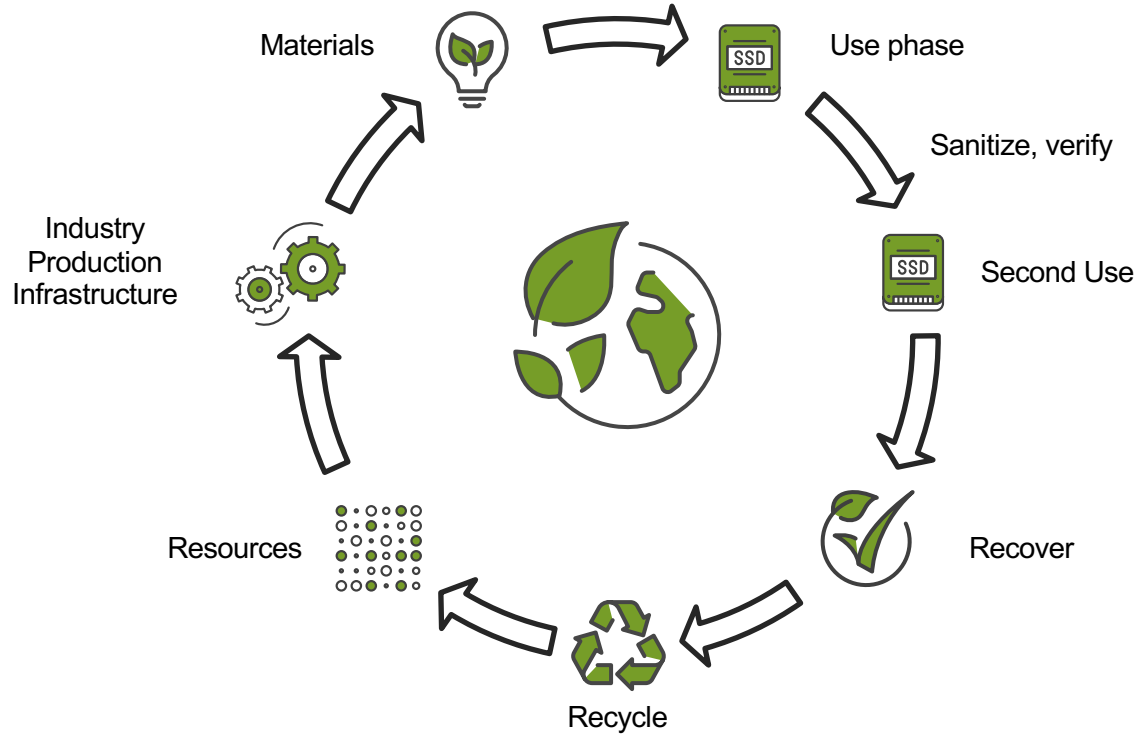
Reduce amount of physical destruction and e-waste, increase reuse for HDD and SSD



Rethink the Ecosystem

Enable the broad ecosystem of drive reuse through CDI partners: decommissioning, media sanitization, verification, and sales channels

Circular Economy for Storage



Intro to cryptocurrency

- **Inclusive and permissionless network:** Controlling your wealth is a human right
- **Censorship resistant:** difficult or impossible to block participants
- **Independent monetary policy:** trust math instead of people
- **Unstoppable applications:** A program developed for, and run on, a secure blockchain can never be changed or stopped
- **Global standards:** collaboration, fully open source, and available for free
- **Secure and Decentralized:** decentralization, consensus, and physical assets (capex) secure the network
- **Programmable Money:** Cryptocurrency should be easier to use than cash and harder to steal

Chia is an energy efficient blockchain

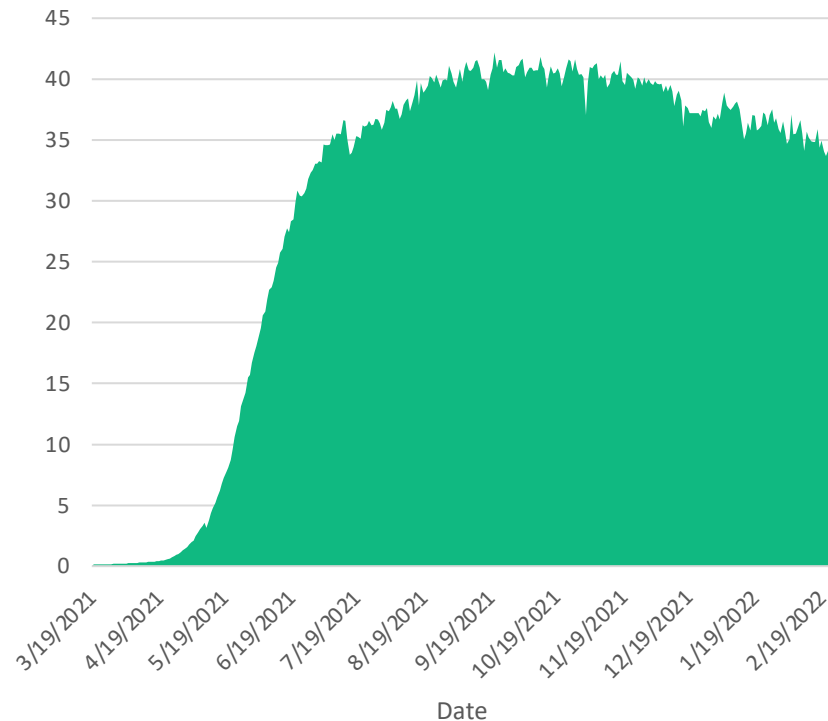
Annual Energy Consumption



■ Chia, 0.22 TWh

<https://digiconomist.net/bitcoin-energy-consumption/>
<https://digiconomist.net/ethereum-energy-consumption/>
<https://Chiapower.org> (5/16/22)

Chia Netspace (Exabytes)



Chia farming is the perfect use case to unlock 2nd use storage

Chia stores random cryptographic data called “plot” files, not user data



```
plot-k32-2021-  
08-16-23-44-  
ce80dac84af76c83  
4b4a1bda59c7053d  
dfb228dc7fdde91f  
67810ccb458f2596  
.plot
```



```
plot-k32-2021-  
08-17-00-22-  
b5ffc0de4b567087  
0d118311b0736026  
ef9859ab052228a7  
63ab6ad5ef64fb22  
.plot
```

Farming workload is very lightweight



98% idle



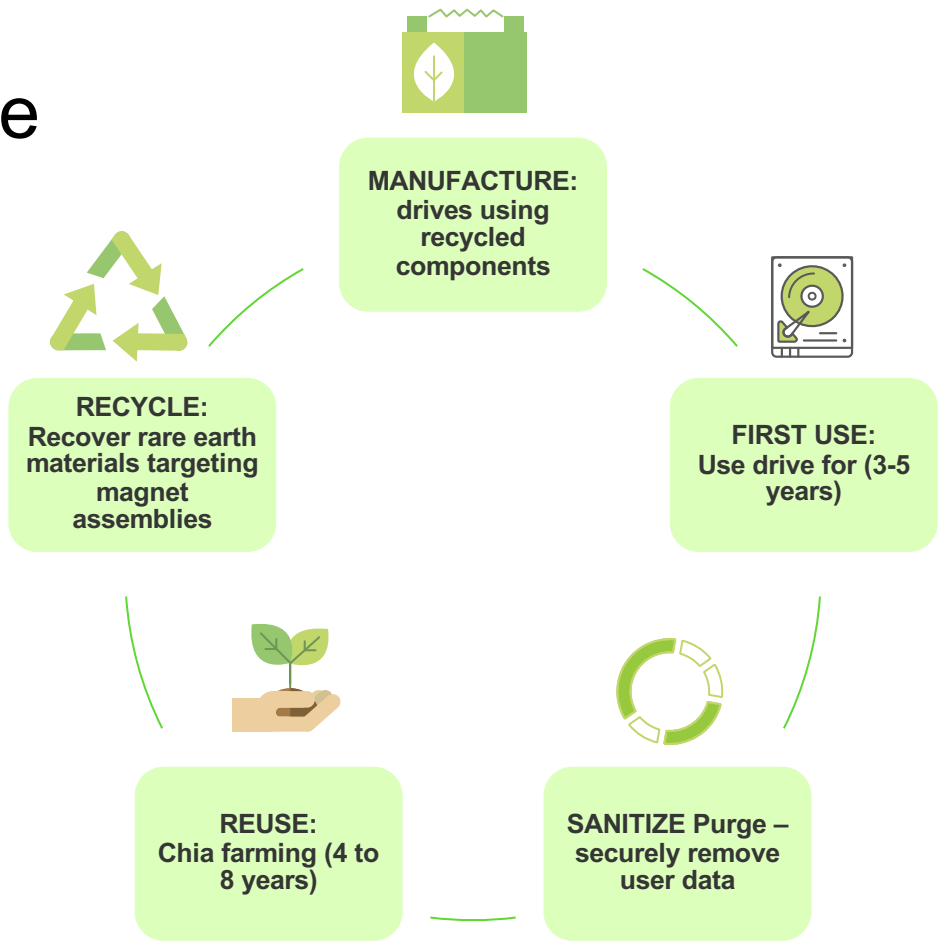
99.7% idle

Higher error rate from very low quality media
only results in a few % lost proofs

```
101010000101010001010100101111110000101010100101001101
```

Chia Farming Use Case

- **Secure** – Chia uses “plot” files that contain random cryptographic hashes, and contains NO user data
- **Sustainable**: Chia farming is energy efficient, less than 1% PoW
- **Inclusive**: anyone with storage can participate and get rewarded
- **New use case**: use very low-quality media that may not be viable for user data



backup

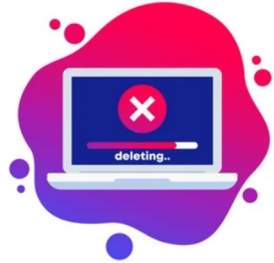
IEEE P2883 Draft Standard for Sanitizing Storage

- Sanitization - A process or method to render access to target data on storage media infeasible for a given level of effort.
- Defines Sanitization Methods and Techniques for specific media type (HDD, SSD, optical, removable, etc.)
- Specifies interface-specific techniques (SATA, SAS, NVMe)
- Align industry on terminology and modern techniques for media sanitization
- Target all logical and physical locations for data – including user data, old data, metadata, overprovisioning , etc.

Defines purge method of sanitization that is secure, fast, and enables device reuse!



Sanitization Methods



Clear

Uses logical techniques to remove data on all addressable storage

Prevent against simple non-invasive data recovery

Format, deallocate



Purge

Uses logical or physical techniques to remove all data

Infeasible data recovery with state of the art techniques

Block erase, crypto erase, overwrite



Destruct

Infeasible data recovery with state of the art techniques

Leaves device in unusable state

Disintegrate, incinerate, melt