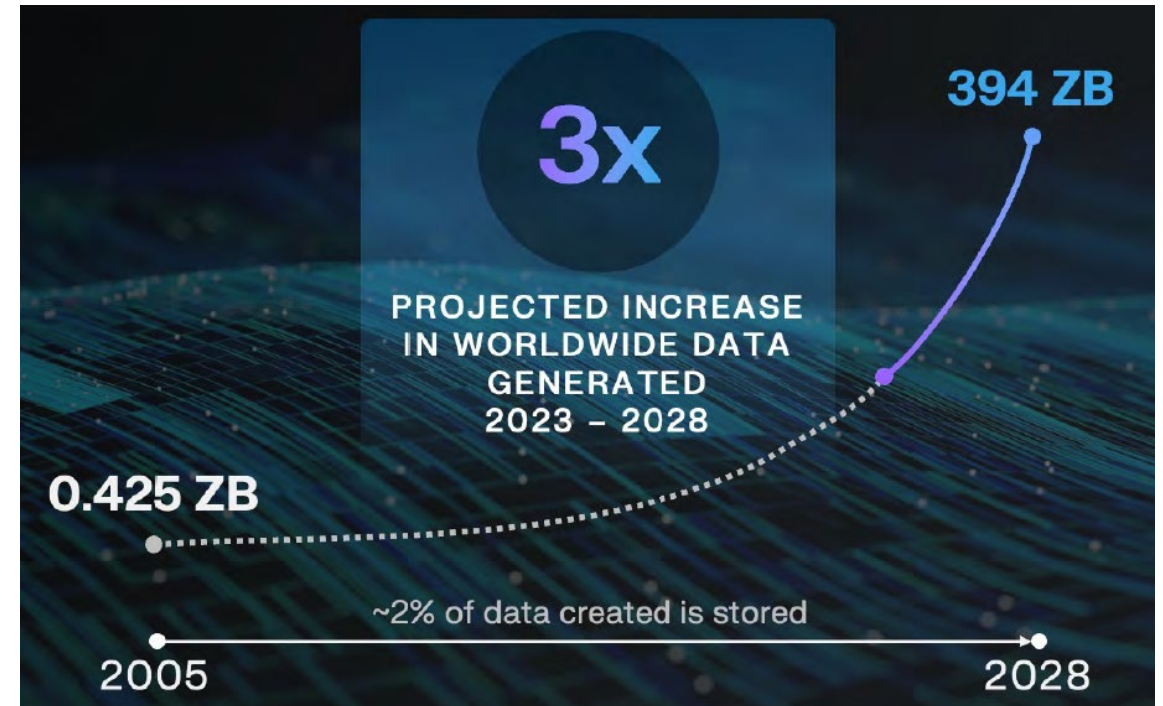# HDDs are still here to stay

There is a search for new storage media

- "Save/Discard Dilemma"
  - Increasingly expensive, impractical to save all we want with existing storage technology
  - AI is both adding to quantity of data to be saved and creating higher opportunity cost of throwing away information

- It's not **just** about the zettabytes
  - Digital archivists want to save culture, history, law, … forever
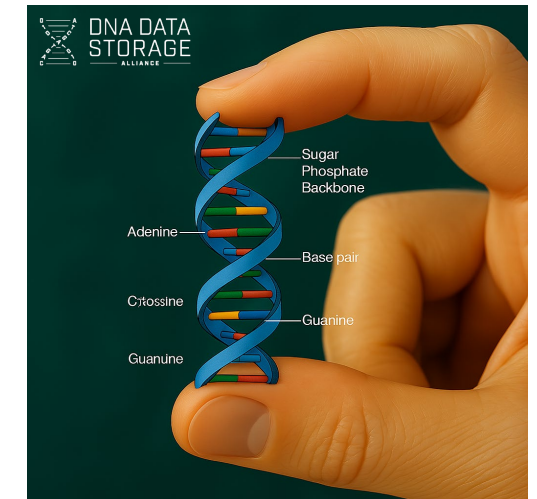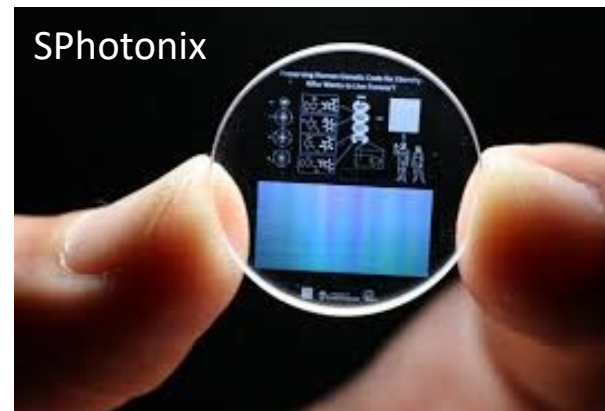 - Durability with no refresh is issue for this data, and durability of existing storage media not growing

3x
PROJECTED INCREASE IN WORLDWIDE DATA GENERATED 2023 – 2028

394 ZB

0.425 ZB

~2% of data created is stored

2005   2028

Source: Worldwide IDC Global DataSphere Forecast, 2024-2028, doc #US52076424, May 2024
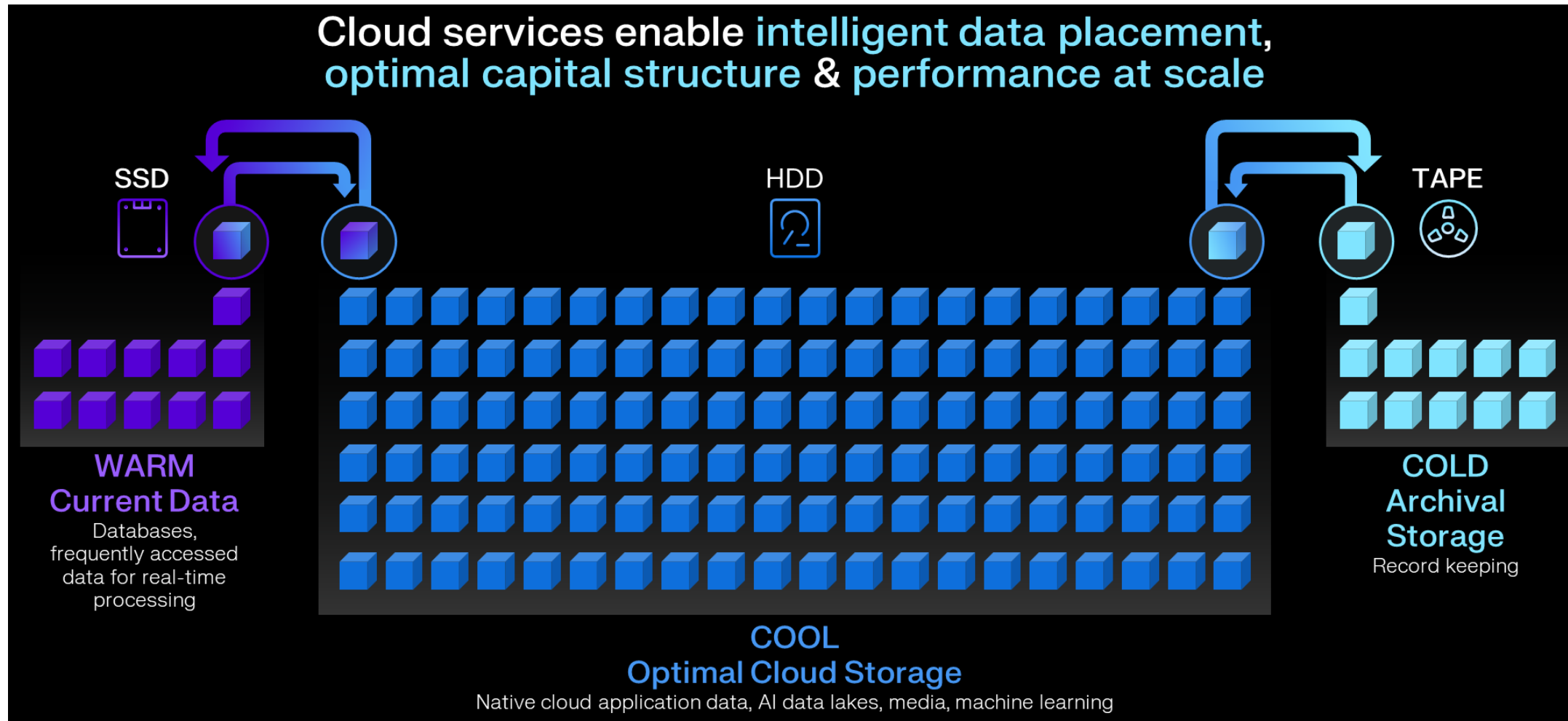
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New storage media types

- Very dense

- Durable at room temp

- Zero power at rest

- No/minimal refresh

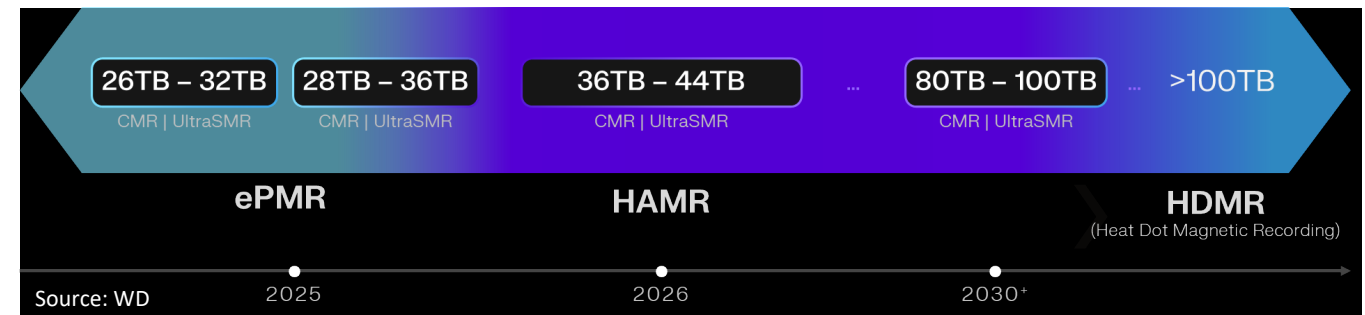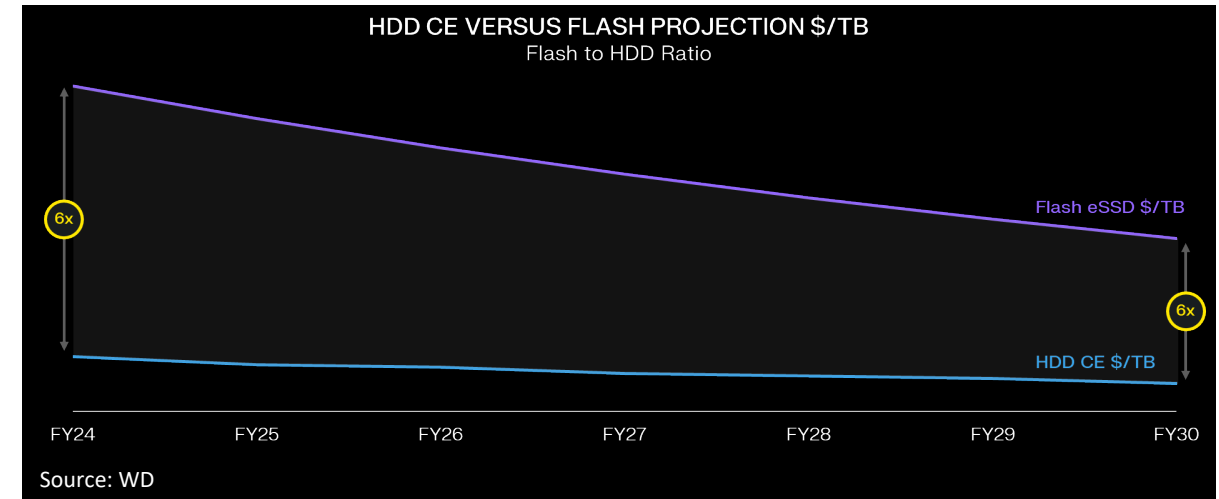These will complement, not replace, existing media

Ceramic-on-glass sheets

SPhotonix

DNA DATA STORAGE

Meanwhile, HDDs are still workhorse of the datacenter

Cloud services enable intelligent data placement, optimal capital structure & performance at scale

SSD

HDD

TAPE

WARM
Current Data
Databases, frequently accessed data for real-time processing

COLD
Archival Storage
Record keeping

COOL
Optimal Cloud Storage
Native cloud application data, AI data lakes, media, machine learning

Western Digital.

And HDDs will stay the datacenter workhorse for a while

- Will high bit/cell SSDs replace HDD?
  - Endurance/Retention challenging for "warm" tiers
  - Sustainability challenging - **embedded carbon**[1]
  - Can market build enough SSDs at reasonable price?
    - SSD $/TB ~6X HDD today; still ~6X by 2030

- Will tape replace HDD?
  - AI/ML requiring more active access
  - Media storage outside data center less efficient

- And HDD continuing to innovate
  - Areal Density
  - Form Factor
  - Performance

HDD CE VERSUS FLASH PROJECTION $/TB
Flash to HDD Ratio

Source: WD

Source: WD

1. Tannu S., Nair P., The Dirty Secret of SSD: Embedded Carbon; arXiv:2207.10793v2 [cs.AR]; https://doi.org/10.48550/arXiv.2207.10793 Energy Informatics Review (Volume 3 Issue 3, October 2023)

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We are just at the beginning on AI
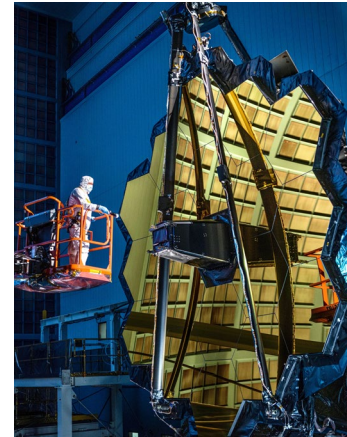
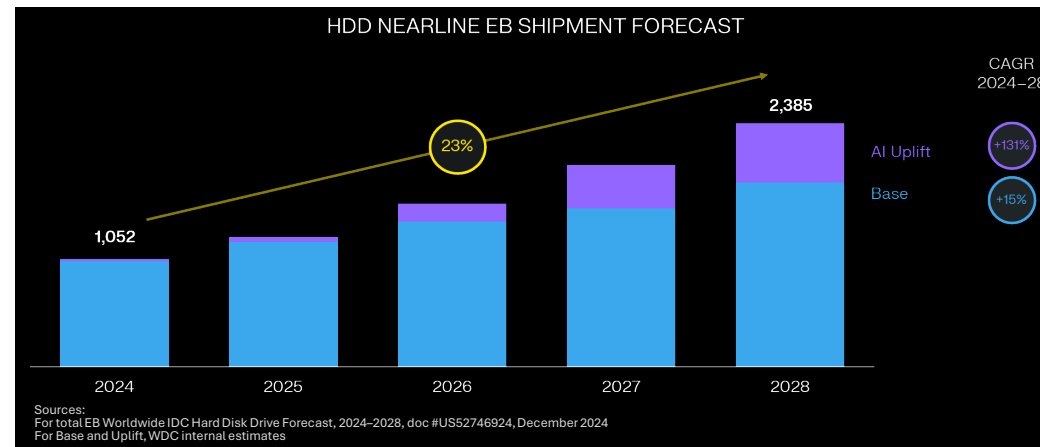- If you think YouTube has a lot of video today

https://zapier.com/blog/best-ai-video-generator/

- Discovery here; data mining there

- AI HDD uplift (purple) is not huge part of total yet (blue + purple), but uplift growth accelerating
  - Uplift CAGR 131% 2024-2028

- AI needs active data, that is, HDD

HDD NEARLINE EB SHIPMENT FORECAST

CAGR 2024–28

23%

2,385

AI Uplift +131%
Base +15%

1,052

2024   2025   2026   2027   2028

Sources:
For total EB Worldwide IDC Hard Disk Drive Forecast, 2024–2028, doc #US52746924, December 2024
For Base and Uplift, WDC internal estimates

Western Digital

HDDs are here to stay!

Western Digital

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FMS

the Future of Memory and Storage