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Reducing costs while improving sustainability with modern tape storage

Brad Johns

Brad Johns Consulting LLC

brad.johns@bradjohnsconsulting.com

www.bradjohnsconsulting.com

About Me

- **40+ year IT career started with IBM in 1978 as a sales trainee in the Data Processing Division.**

- **Career included management and project management positions in sales, marketing, and consulting.**

- **Fourteen years with IBM managing storage marketing, business strategy and product management in Tucson, Arizona.**

- **President of Brad Johns Consulting LLC assisting data storage technology companies develop and implement Total Cost of Ownership and Sustainability assessments.**

- **Earned a Master in Business Administration and Bachelors degree in Economics from the University of Arizona.**

Storage capacities have dramatically increased, and $/GB dropped in 40+years!

Early 1980's

IBM 3420 Tape Drive

IBM 3380 Disk Drive

2.5 GB/unit - $81,000 to $142,000

Reprint Courtesy of IBM Corporation ©
https://www.ibm.com/ibm/history/index.html

Max 170 MB/tape reel –
$13,000 to $28,440 per drive
$23,670 to $39,420 per controller

Reprint Courtesy of Computer History Museum
https://computerhistory.org/

Today

LTO

HDD

18 TB/ tape cartridge–
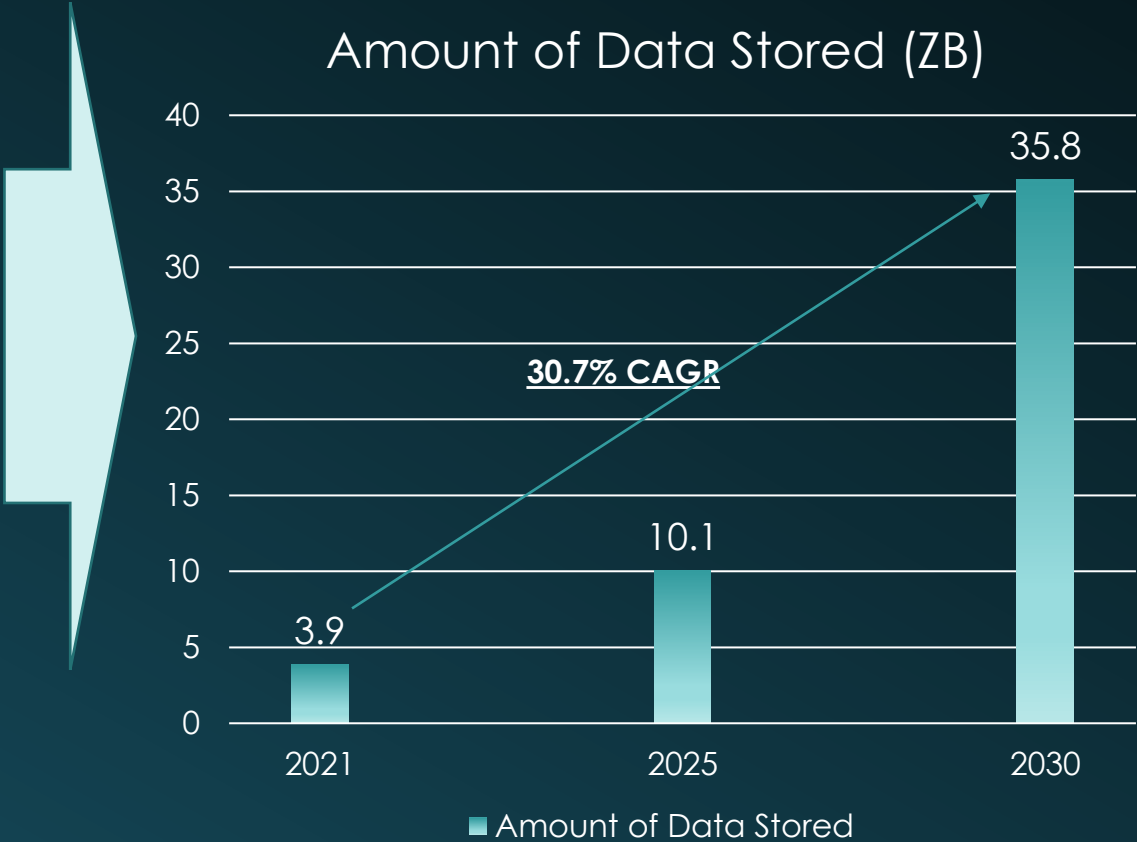$5,000 to $52,690/Drive
Tape Media - ~$115/cartridge

22TB/ HDD
$549.99/Drive

The amount of digital data is projected to grow significantly over the coming years

- Growth drivers include:
  - The Internet of Things (IOT)
  - 5G networks
  - AI and Machine Learning
  - Analytics
  - Social Media
  - Video
  - Scientific Research
  - Life Science

Amount of Data Stored (ZB)

Year	Amount of Data Stored
2021	3.9
2025	10.1
2030	35.8

30.7% CAGR

■ Amount of Data Stored

This will challenge data storage costs and sustainability

Source: Further Market Research March 2023
https://furthurdata.com/

Data storage is a significant contributor to data center power consumption

- Rapid growth of data center power consumption in the early 2000's resulted in studies of data center power

- Data centers consume approximately 1.8% of all power in the United States

- The rate of growth flattened in the 2010-2020 decade.

- Storage consumes approximately 19% of the data center power including infrastructure

- Since 2018 study crypto mining has emerged and it's estimated to consume between 0.4 and 0.9 percent of the world's electricity usage*
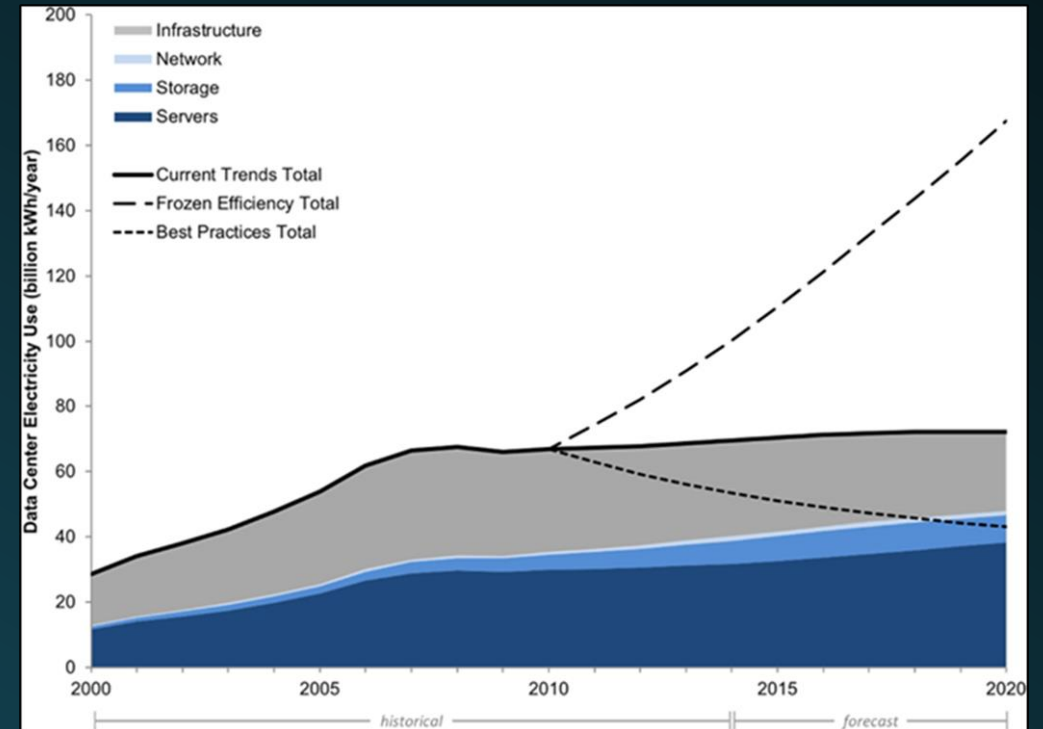
Source: Arman Shehabi et al 2018 Environ. Res. Lett. 13 124030

* https://www.whitehouse.gov/wp-content/uploads/2022/09/09-2022-Crypto-Assets-and-Climate-Report.pdf

There are three major cost components that must be incorporated into a TCO analysis

- Acquisition Costs (Capex)
  - Hardware Purchase Price
  - Software Initial License Charges
  - Extended Warranties
  - Purchase of additional capacity

- Operational Costs (Opex)
  - Maintenance and Support
  - Power and Cooling
  - Network
  - Systems Management

- Technology Refresh
  - Replace initial storage at end-of-life with new technology
    - Replace disk after five years
    - Replace all initial generation tape drives and media with new drives and media in year 6

An example highlights the environmental and cost benefits of moving "cold data" to tape storage

- 50 PB of HDD resident data is identified as being "cold data"

- It is projected to grow at 30% CAGR for the next ten years

- 1%/month retrieval rate

- Configuration highlights
  - Tape estimates based on LTO 9
  - Disk estimates based on 16-22 TB HDD External Controller based disk systems
  - Cloud estimates based on deep archive

- What would be the TCO savings over this period from migrating this data to tape storage?
  - Using the Fujifilm TCO model

Source: https://www.fujifilm.com/us/en/business/data-storage/resources/tco-tool

What's not included
- Floor space
- Servers
- On-site storage infrastructure
- Software licenses

Other variables are needed when estimating the ten-year TCO of storage

- The amount of energy consumed and energy costs - US Commercial rate of $.125/kWh per US EIA Nov, 2022

- Power Usage Effectiveness (PUE) - 2

- Storage management labor costs - $120,000/FTE

- Ratio of tape cartridges to drives – 100 to 1

- Disk RAID level – RAID 6 - 75% usable

- Networking costs (for cloud storage) -$.43 mbps

Storage cost projections

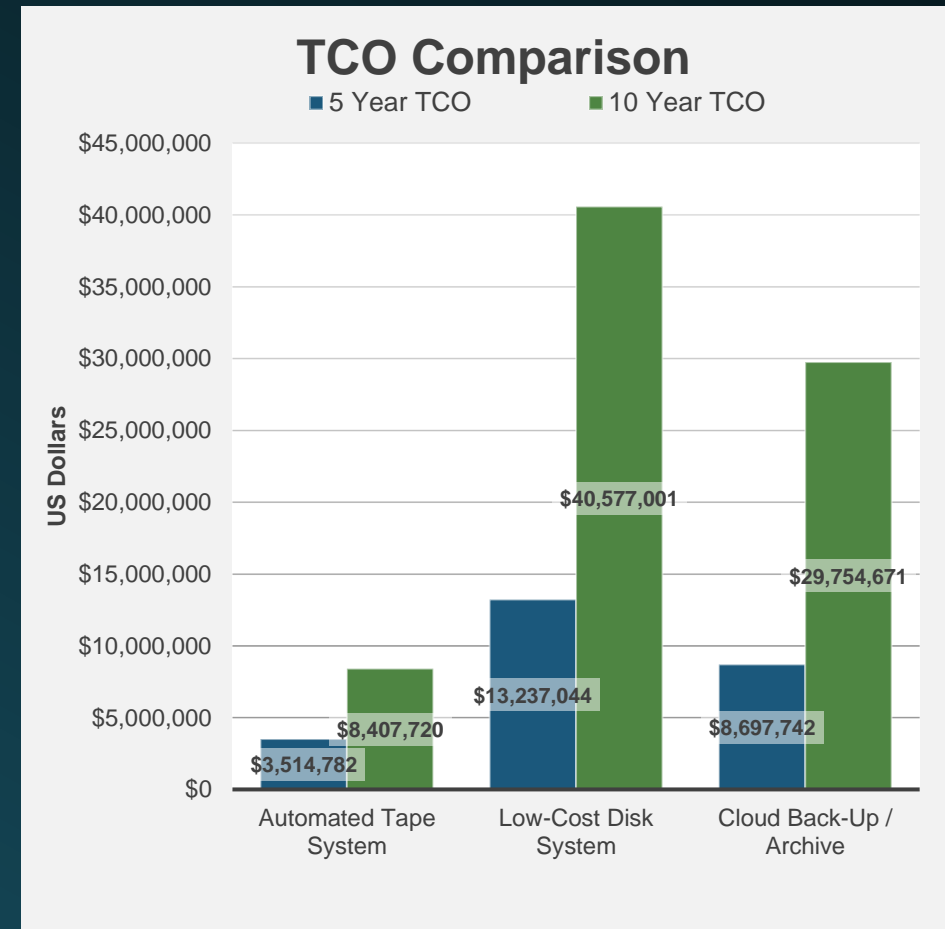"Prediction is very difficult, especially about the future."

–Neils Bohr, Nobel prize winner in physics

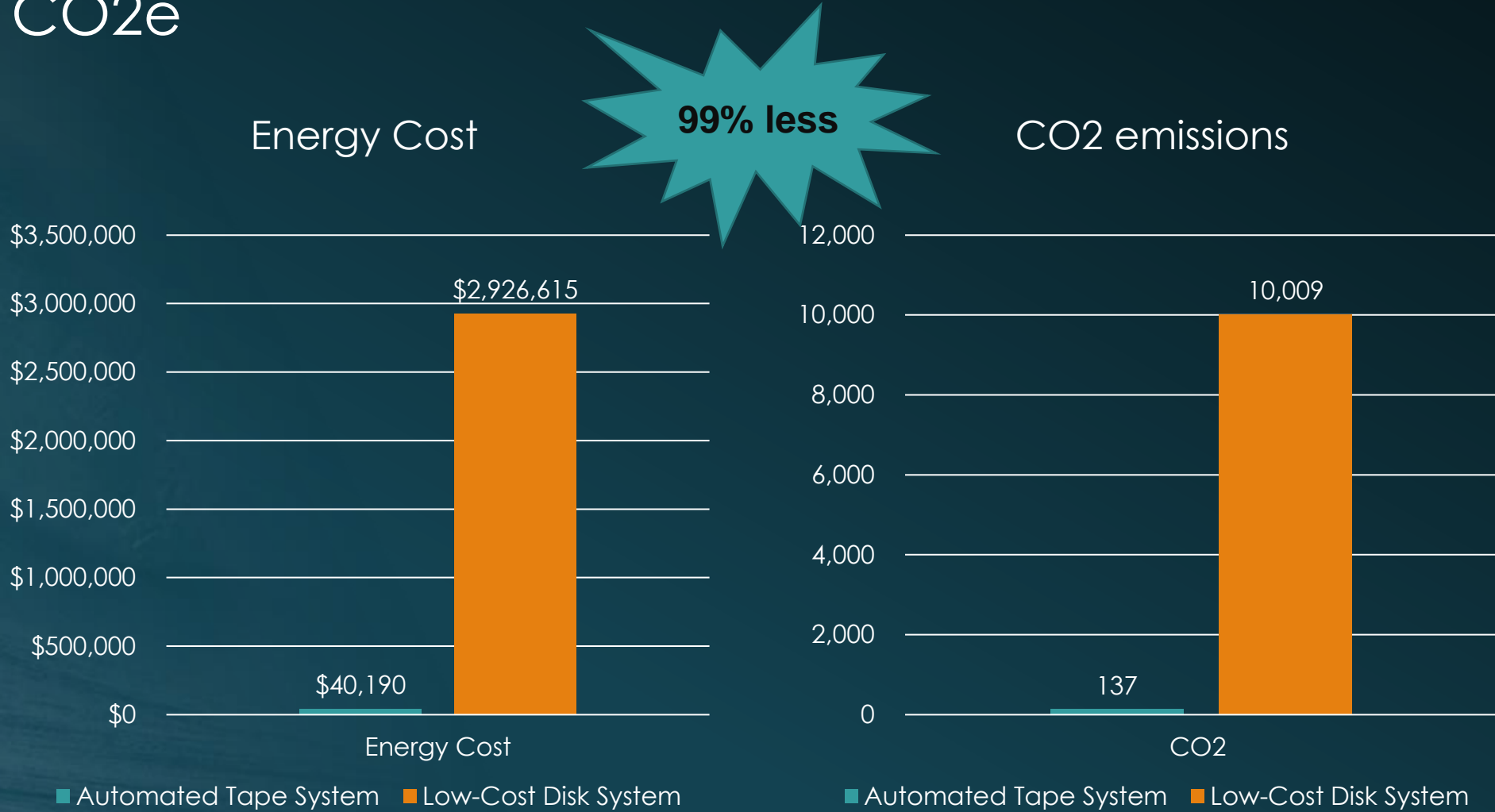| Cost Component	Comments	Year 1 Cost (US Dollars)	Annual Cost Decline
Tape media cost (per TB)	Fujifilm LTO Ultrium 9 market pricing	$6.39	20%
Tape hardware - drives & automated libraries (per TB)	Includes tape drives and fully-automated tape libraries including extended warranty	$6.86	0%
Tape energy cost (per TB per year)	Offline nature of tape requires minimal power	$0.05	15%
Disk acquisition cost (per TB)	Market pricing for low-cost disk including extended warranty	$89.61	10%
Disk energy cost (per TB per year)	Published data on average energy usage and costs	$2.22	10%
Cloud storage annual cost (per TB)	Based on lowest available published pricing of leading cloud storage providers for archive storage	$11.88	13%
Cloud retrieval and transfer fees (per TB)	Based on lowest available published pricing of leading cloud storage providers for archive storage	$57.90	0%
Bandwidth (monthly cost per Mbps)	U.S. Industry average business bandwidth	$0.43	10%

Moving 50 PB of cold data to tape storage results in substantial savings

- Saves $32 million over ten years versus HDD
  - 79% cost reduction

- Saves $21 million over ten years versus Cloud
  - Deep Archive
  - 72% cost reduction

Your mileage will vary!

TCO Comparison

- 5 Year TCO ■ 10 Year TCO

US Dollars

	5 Year TCO	10 Year TCO
Automated Tape System	$3,514,782	$8,407,720
Low-Cost Disk System	$13,237,044	$40,577,001
Cloud Back-Up / Archive	$8,697,742	$29,754,671

Moving cold data from HDDs to tape media also dramatically reduces ten-year energy cost and CO2e

99% less

Energy Cost

CO2 emissions

$3,500,000	
$3,000,000	$2,926,615
$2,500,000	
$2,000,000	
$1,500,000	
$1,000,000	
$500,000	
$0	$40,190

Energy Cost

■ Automated Tape System ■ Low-Cost Disk System

12,000	
10,000	10,009
8,000	
6,000	
4,000	
2,000	
0	137

CO2

■ Automated Tape System ■ Low-Cost Disk System

Implementing Intelligent Data Management that moves cold data to tape and can reduce costs and environmental impact

Performance and Cost

NVM, SSD

HDD

Tape

Intelligent Data Management (AI?)

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Migrates data to lower cost tier based on policy
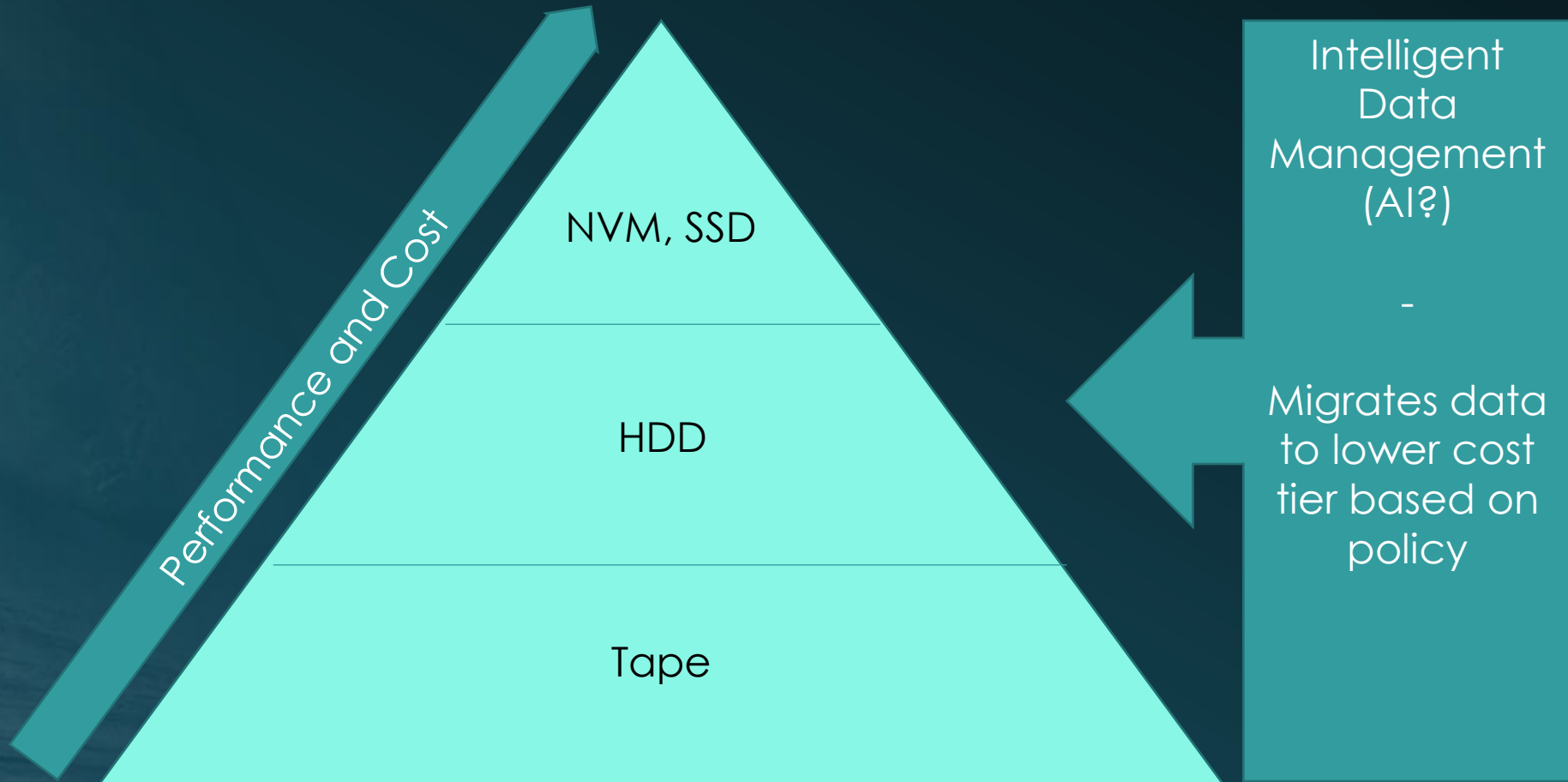
In conclusion

The amount of stored data is projected by analysts to grow to over 35 ZB by 2030

Sustainability is a significant issue and data centers and storage consume a lot of energy

Much of the data stored on HDDs is "cold data"

Moving cold data to tape storage can dramatically reduce costs

Carbon emissions and electronic waste can be dramatically reduced by moving cold data to tape media

Brad Johns Consulting L.L.C

Questions

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