Sustainability
Saving the Planet 28PBs at a time
—

Shawn O. Brume Sc.D.

June 2022

https://www.youtube.com/watch?v=B-nEYsyRIYo

By-the-Numbers

~70 tons of Coke[1] to produce

4.0 mtons CO2 per year*
(228 g/mile)

3.7 mtons CO2 per year*
(209 g/mile)

Saves 470 million metric tons of CO2e per year when compared to fossil fuel energy production

*Based on 18,000 miles per year

1. Metallurgical process for metal production
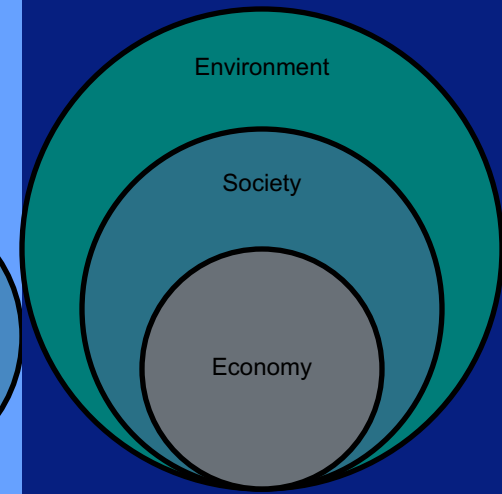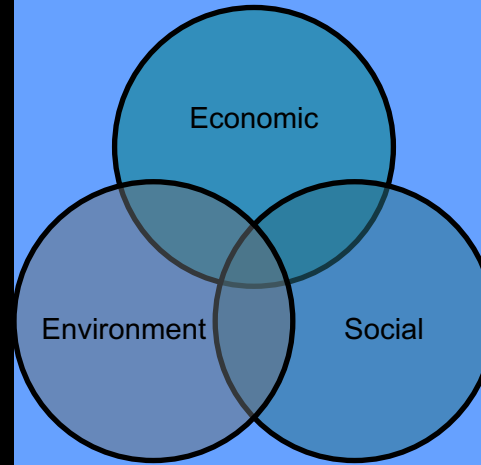
What is Sustainability?

Avoidance of the depletion of natural resources in order to maintain an ecological balance.

- Oxford Dictionary

Focusing on meeting the needs of the present without compromising the ability of future generations to meet their needs.

- Investopedia

41%
Organizations with sustainability transformation projects*

*ESG- Application Infrastructure Modernization Trends Across Distributed Cloud Environments

Economic

Environment

Social

Environment

Society

Economy

- Sustainability Dimensions
  - Environmental
  - Social
  - Economic

Acknowledging the interconnectedness and interdependence of the three dimensions

- Triple Bottom Line
  - Planet
  - People
  - Profit

Corporate performance goes beyond financial performance

- ESG Framework
  - Environmental
  - Social
  - Governance

Measure non-financial performance of companies

High Level
# Inputs and Outcomes

System Boundaries

- Raw material extraction,

- Material manufacturing

- Supplier transportation

- Product assembly and distribution

- Packaging

- Data center usage

- End of life burdens

- Recycling burdens

  - Benefits from recycling virgin materials savings are not included

- Manufacturing systems infrastructure not included

Tape Drive: Life Cycle Climate change Contribution

End of Life 3%
Raw materials, collection, repocessing 2%
Production 1%
Distribution 1%
Usage 93%
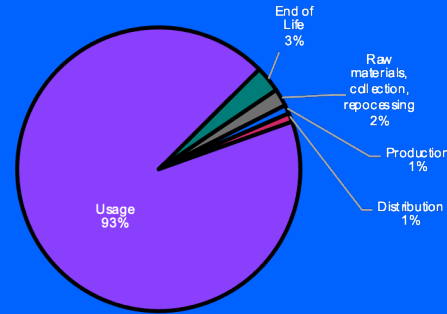
*7-year lifecycle assumed for percentage calculations

Automation Frame: Life Cycle Climate change Contribution

End of Life 3%
Raw materials, collection, repocessing 11%
Production 8%
Distribution 5%
Usage 73%
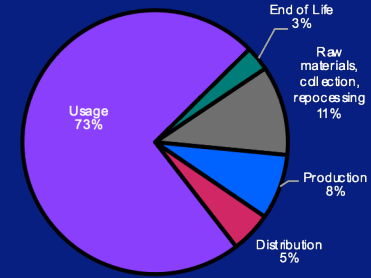
*TS4500 frame average, small automation not included. 16.4 Year Lifecycle

Hazardous/Restricted Materials Statements

- Contain no bromine or chlorine above 900 parts per million (ppm) or listed phthalates at the homogeneous material level.

- No JIG/IEC 62474 restricted chemicals over allowed limits

- No ozone depleting chemicals, and no REACH substances of very high concern (SVHC) over 1000 ppm at the article level.

Tape Media
Third party Assessment

- Raw Materials –   2.12kg-CO2

- MFG Process –   4.58kg-CO2

- Operational Energy –   0kg-CO2

- Cooling Energy* –   .01kg-CO2

- End-of-Life –   .76kg-CO2

Contribution by Life Cycle Stage

- Bill of Materials
- Manufacturing Energy
- Packaging
- Distribution
- End of Life
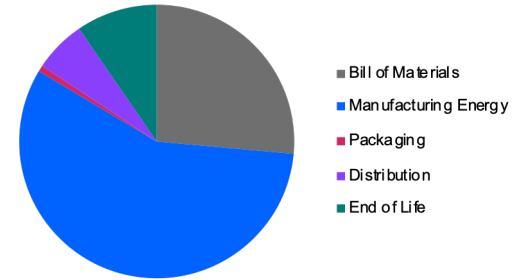
.007
metric tons
CO2e

*Cooling energy is based on media averages per install of a library set across the total cooling of the automation device

Component Report:
LTO Full High Tape Drives

Full High tape drives are installed as enterprise level interface to write and read tape media. Tape drives receive power from larger sub-systems. On average, Tape drives are deployed in a 1:175 ratio with tape media.

- FE
- Aluminum
- CU
- Plastics
- Silicon Card
- Silicon Processor
- Tin

Base (aluminum)	1
Sheet metal assembly	2
Misc. Motors	1
Media motors	2
Silicon card Assembly (8 Layer, Including all connectors)	1
Head Assembly	1
Plastic Assemblies	8
Fibre Channel Interface (integrated for SAS)	2
Weight	2.9kg
Recycle Offset.	3.2kg
Energy usage (average)	.031 kWh
Life Cycle	6.85 Yrs
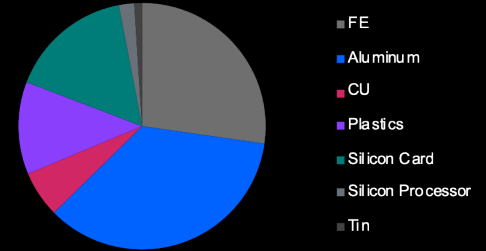
- Production – 41.3kg
- MFG Distribution – .4kg
- Operational Energy – 836.4kg
- Cooling Energy – 347.1kg
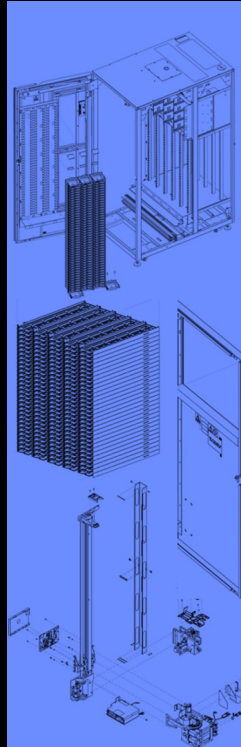- End-of-Life – 4.94kg

1.4
metric tons
CO2e

Note: Variation in drive generations are below the threshold of change value to overall contribution to carbon impact. The represented values may be considered accurate (no more than) for all available and serviceable generations.
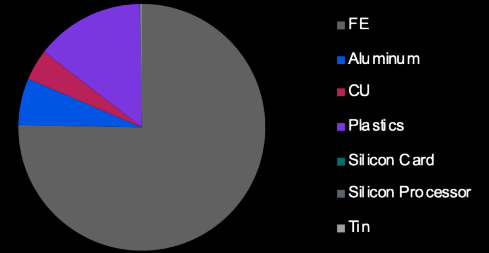
Component Report:
TS4500 Tape Automation L25/55

Enterprise level automation device used to store and orchestrate media delivery to multiple tape drives. Expandable infrastructure starting with Lx5 base .

- FE
- Aluminum
- CU
- Plastics
- Silicon Card
- Silicon Processor
- Tin

Motor	4
Silicon Card	6
Sheet Metal assembly	6*
Structural steel	8*
'Plastic' Media cells	1
Accessor Assembly	1
Tape drive mount assembly	12*
LED Display (large)	1
Computing interface (in form of mini-pc)	1
Power Supply	1
Weight	410kg
Recycle Offset.	535kg
Energy usage	.365kWh
Life Cycle	16.4 Yrs

- Production – 11049.71kg
- MFG Distribution – 6.3kg
- Drive mounts – 295.8kg
- Operational Energy – 26425.8kg
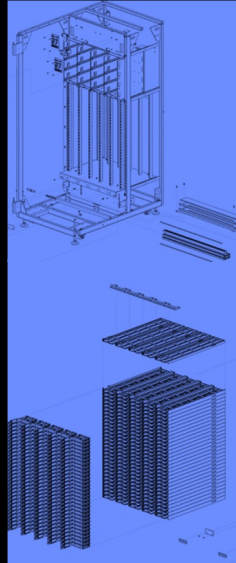- Cooling Energy – 6437.9kg
- End-of-Life – 1154.07kg

50.0
metric tons
CO2e

*Based on highest count for this assembly , actuals will vary for each individual installation
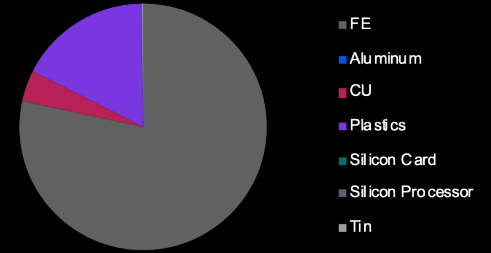
Component Report:
TS4500 Tape Automation D25/55

Performance expansion frame for enterprise level automation device used to store and orchestrate media delivery to multiple tape drives. Expands Drives and Media.

■ FE	
■ Aluminum	
■ CU	
■ Plastics	
■ Silicon Card	
■ Silicon Processor	
■ Tin	

Silicon Card	4
Sheet Metal assembly	6*
Structural steel	8*
'Plastic' Media cells	1
Tape drive mount assembly	16*
Communications distribution assembly	1
Power Supply	1
Weight	416kg
Recycle Offset.	422kg
Energy usage	.078kWh
Life Cycle	16.4 Yrs

- Production – 7250.9kg
- MFG Distribution – 6.3kg
- Drive mounts – 394.5kg
- Operational Energy – 4171.7kg
- Cooling Energy – 595.7kg
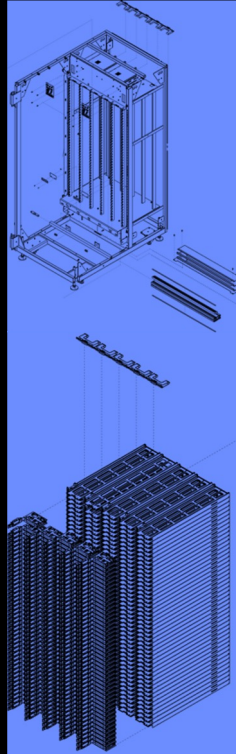- End-of-Life – 648.04kg

14.4
metric tons
CO2e

*Based on highest count for this assembly , actuals will vary for each individual installation

Component Report:
TS4500 Tape Automation S25/55

Capacity expansion frame for enterprise level automation device used to store and orchestrate media delivery to multiple tape drives. Expands media only.

Silicon Card	2
Sheet Metal assembly	6*
Structural steel	8*
'Plastic' Media cells	1
Weight	304kg
Recycle Offset.	399kg
Energy usage	.011kWh
Life Cycle	16.4 Yrs

Measurable Component Contributions
by Percentage/Weight

- FE
- Aluminum
- CU
- Plastics
- Silicon Card
- Silicon Processor
- Tin
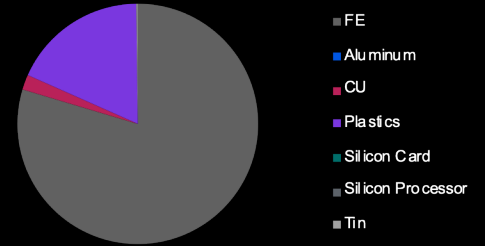
- Production –   7892.91kg
- MFG Distribution –   6.3kg
- Operational Energy –   706.0kg
- Cooling Energy –   290.2kg
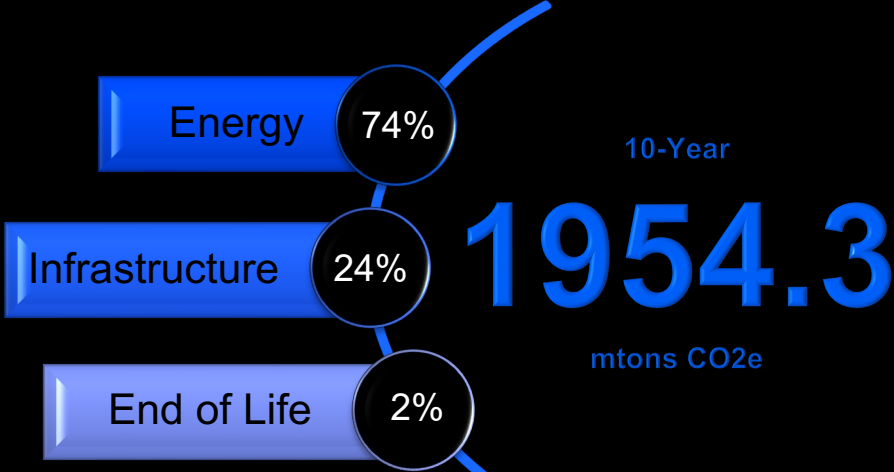- End-of-Life –   609.68kg

10.5
metric tons
CO2e

*Based on highest count for this assembly , actuals will vary for each individual installation

Sustainability – Saving the planet 28 PB at a time

10 Years of Archival data
11-nines data durability

Bryce Canyon

Energy 74%

Infrastructure 24%

End of Life 2%

10-Year

1954.3

mtons CO2e

- 5-year life
- 18TB Archive HDDs
- 3 JBOD per Controller
- 1.26 Erasure Coding
- Full replacement cycle year 5
  - Assumes 36TB drives

IBM Ultra-Dense tape Storage

82% Energy

16% Infrastructure

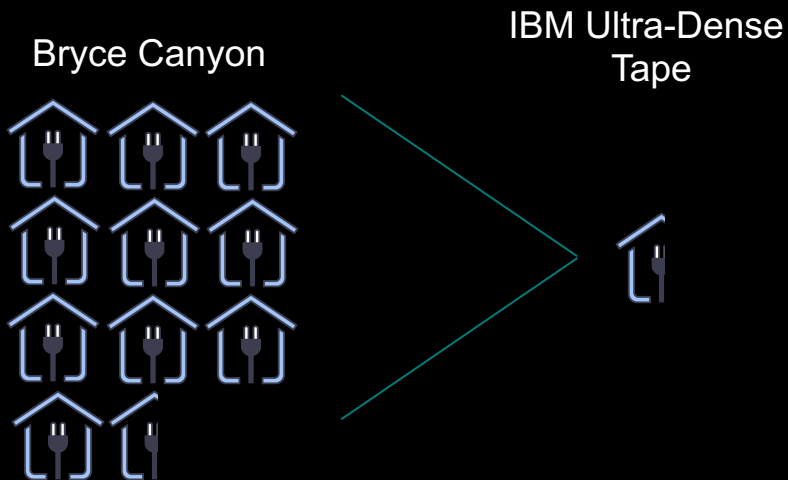2% End of Life

10-Year

78.1

mtons CO2e
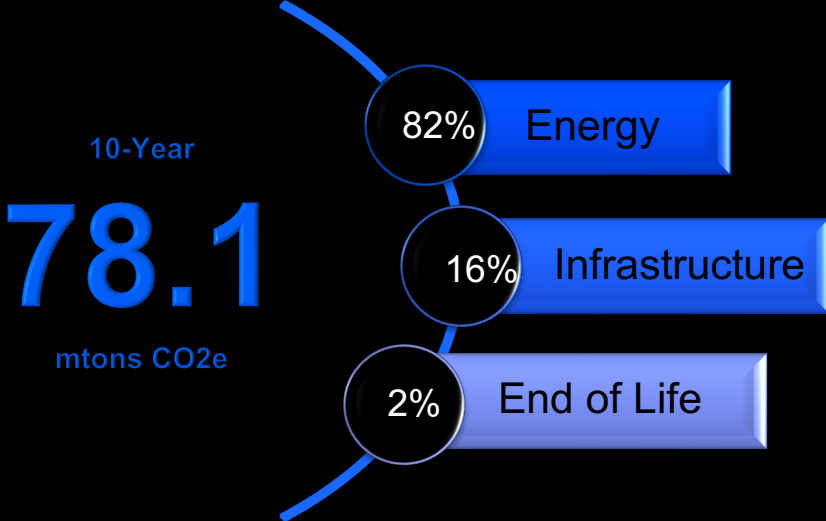
- 1 Frame
- 14 – LTO-9 Tape drives
- 1500 – LTO-9 Cartridges
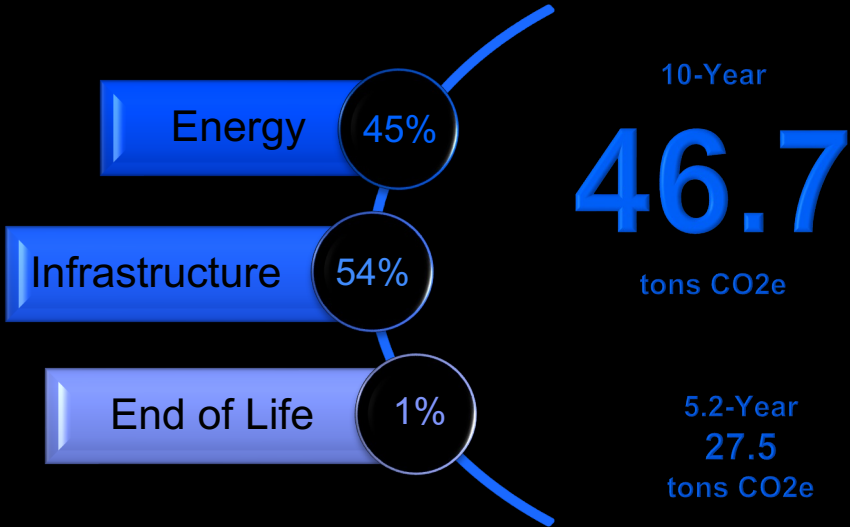 - No refresh required

Sustainability we can all understand

Highly Dense HDD storage consumes **10 times** more yearly energy than the same amount of data on tape

Bryce Canyon

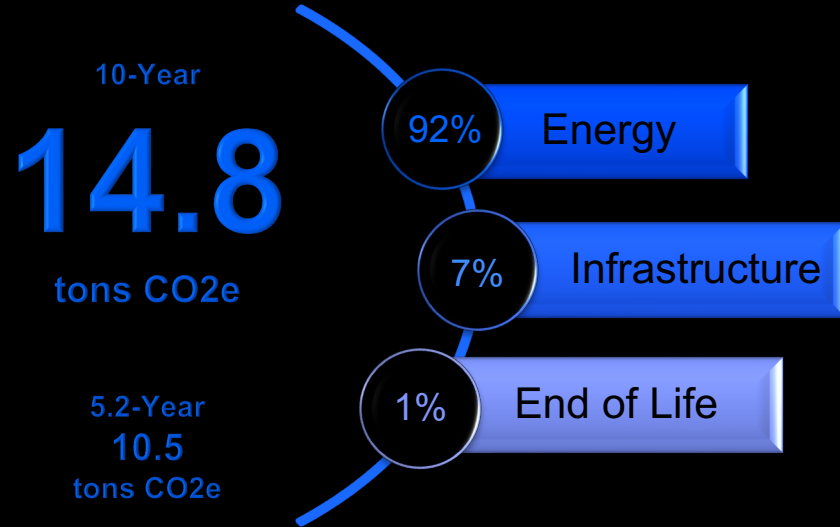IBM Ultra-Dense Tape

96%
CO2e
Reduction

Data Archives for SMB Next Gen: 500TB SSD Compare

NetApp FAS500F

Energy	45%
Infrastructure	54%
End of Life	1%

10-Year

46.7

tons CO2e

5.2-Year
27.5
tons CO2e

- 5.2-year life
- 48 – 15.3TB SSDs
- Distributed RAID
- Full replacement cycle
  - Assumes 20TB SSD

IBM TS4300

10-Year

14.8

tons CO2e

5.2-Year
10.5
tons CO2e

92%	Energy
7%	Infrastructure
1%	End of Life

- 3U
- 11-nines durability
- 3 - LTO9 Tape drives
- 48 – LTO9 Cartridges
  - No refresh required

Next Generation of Tape Technology
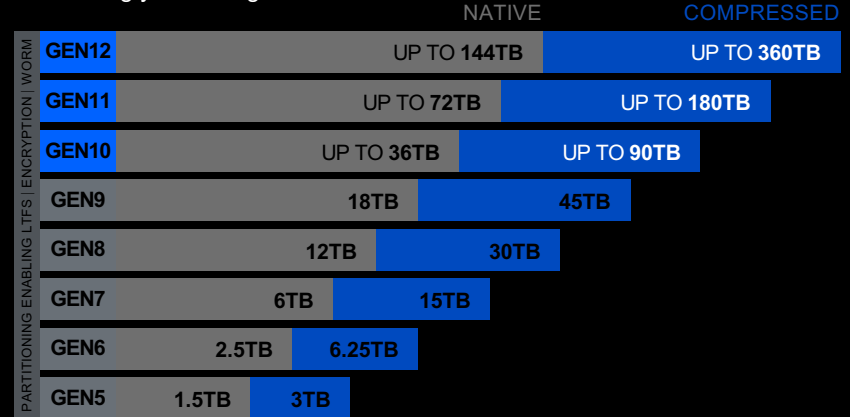
TS1100 Enterprise

Specifications	TS1160	TS1170	Gen 8
Compatibility	Compatibility	Capacity	Capacity
Max Format Capacity (Native)	Up to 20 TB (JE) 15 TB (JD) 7 TB (JC)	Up to 50 TB (JF)	Up to 100 TB (JG)
Other Format Capacities (Native)	15 TB (JD) 10 TB (JD) 7 TB (JC) 4 TB (JC, R/O)	Under assessment	Qualified
Native Data Rate	Up to 400 MB/s	Up to 500 MB/s	Up to 1000 MB/s
Attachment	FC-16, 10 GigE (RoCEv2), 12Gb SAS	FC-16, 12Gb SAS	FC-32, 12Gb SAS, ????

TS1100 Enterprise Technology

LTO ULTRIUM ROADMAP
Addressing your storage needs

NATIVE   COMPRESSED

PARTITIONING ENABLING LTFS | ENCRYPTION | WORM

Generation	Native	Compressed
GEN12	UP TO 144TB	UP TO 360TB
GEN11	UP TO 72TB	UP TO 180TB
GEN10	UP TO 36TB	UP TO 90TB
GEN9	18TB	45TB
GEN8	12TB	30TB
GEN7	6TB	15TB
GEN6	2.5TB	6.25TB
GEN5	1.5TB	3TB

NOTE: Compressed capacity for generation 5 assumes 2:1 compression. Compressed capacities for generations 6-12 assume 2.5:1 compression (achieved with larger compression history buffer).
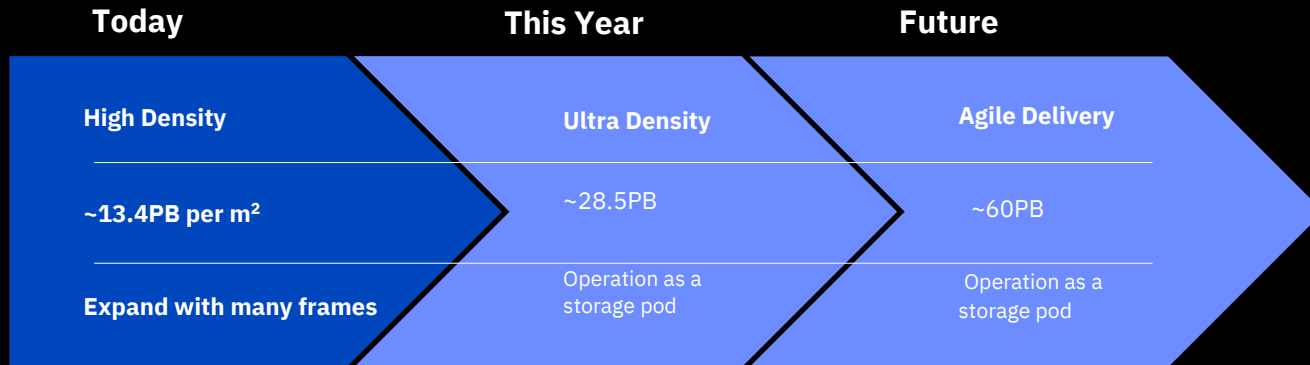
SOURCE: The LTO Program. The LTO Ultrium roadmap is subject to change without notice and represents goals and objectives only. Linear Tape-Open, LTO, the LTO logo, Ultrium, and the Ultrium logo are registered trademarks of Hewlett Packard Enterprise, International Business Machines Corporation and Quantum Corporation in the US and other countries.
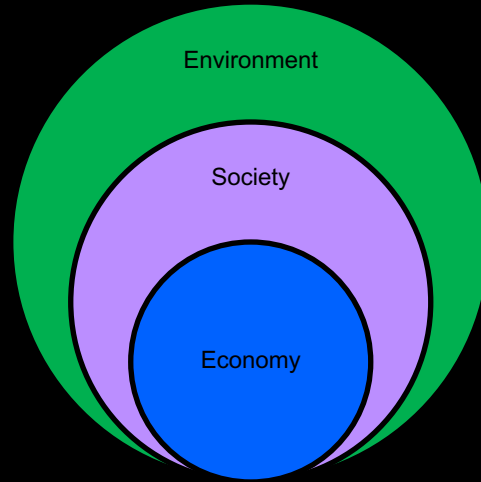
LTO Technology

Transformation of Tape Automation – 28.5 PB in a Rack

- Availability and durability defined by the storage pods, not hardware HA

- Density is in the floor space not just the media

- Let's Create archive storage that matters

Today	This Year	Future
High Density	Ultra Density	Agile Delivery
~13.4PB per m²	~28.5PB	~60PB
Expand with many frames	Operation as a storage pod	Operation as a storage pod

Tape lives the definition of sustainability

Environment

Society

Economy

Thank You