Spectra Logic

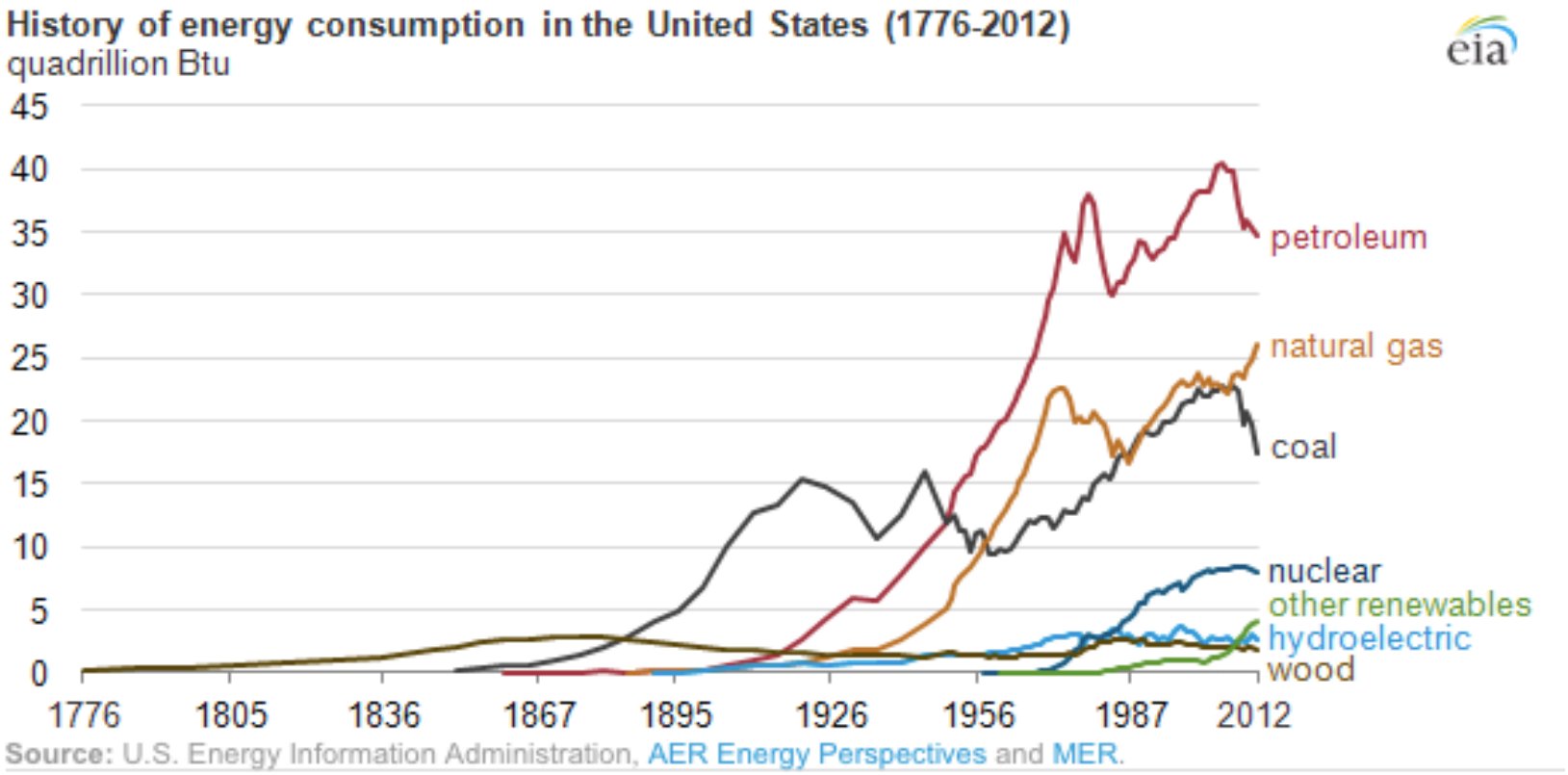
Spectra Logic Overview

- **Nearly 4 decades of technology innovation**
  - Privately held corporation founded in 1979
  - Debt free since inception
  - 100% employee owned
- **Storage industry leadership**
  - Founding member: Active Archive Alliance
  - Founding member: Tape Storage Council
  - Member: Object Storage Alliance
- **Worldwide presence**
  - HQs located in Boulder, CO – Bracknell, UK – Sydney, AUS
  - Over 430 employees
  - 25,000 libraries installed in over 60 countries

About me

- BS Electrical Engineering
- CTO at Spectra Logic
- Over 30 years of industry experience
- Over 50 US patents
- Award winning amateur wine maker
  - Bottling on Sunday

Energy usage over time



Close to **2.5 BILLION** people are online around the world

a number that has grown **566%** since the year 2000

and **70%** of them use the Internet every day.

EVERY 60 SECONDS:[a]

- **204 MILLION** EMAIL MESSAGES ARE EXCHANGED[b]
- **5 MILLION** SEARCHES ARE MADE ON GOOGLE[c]
- **1.8 MILLION** "LIKES" ARE GENERATED ON FACEBOOK[d]
- **350,000** TWEETS ARE SENT ON TWITTER[e]
- **$272,000** OF MERCHANDISE IS SOLD ON AMAZON[f]
- **15,000** TRACKS ARE DOWNLOADED VIA ITUNES[g]

All of our online activity is delivered through data centers, and the more we send email, watch online videos, use social media like Facebook, and conduct business online, the more demands on data centers will grow.

a As of 2013
b http://www.domo.com/learn/infographic-data-never-sleeps
c http://www.statisticbrain.com/google-searches/
d http://gizmodo.com/5937143/what-facebook-deals-with-everyday-27-billion-likes-300-million-photos-uploaded-and-500-terabytes-of-data
e http://www.internetlivestats.com/twitter-statistics/
f http://www.domo.com/learn/infographic-data-never-sleeps
g http://www.billboard.com/biz/articles/news/1538108/itunes-crosses-25-billion-songs-sold-now-sells-21-million-songs-a-day

Power and Usage

- As of 2014 the US consumed 3,913,000,000,000 kw-h/yr
- US data centers use about 78,260,000,000 kw-h/yr
- Seattle (776,336) uses about 9,157,494,000 kw-h/yr

- In 2017 there will be 3 times more connected devices than people
- 4K video consumes 8.6 times more storage than standard DV

- What is 80 billion Kilowatt hours?

Carbon foot print of 78,260,000,000 kw-h/yr

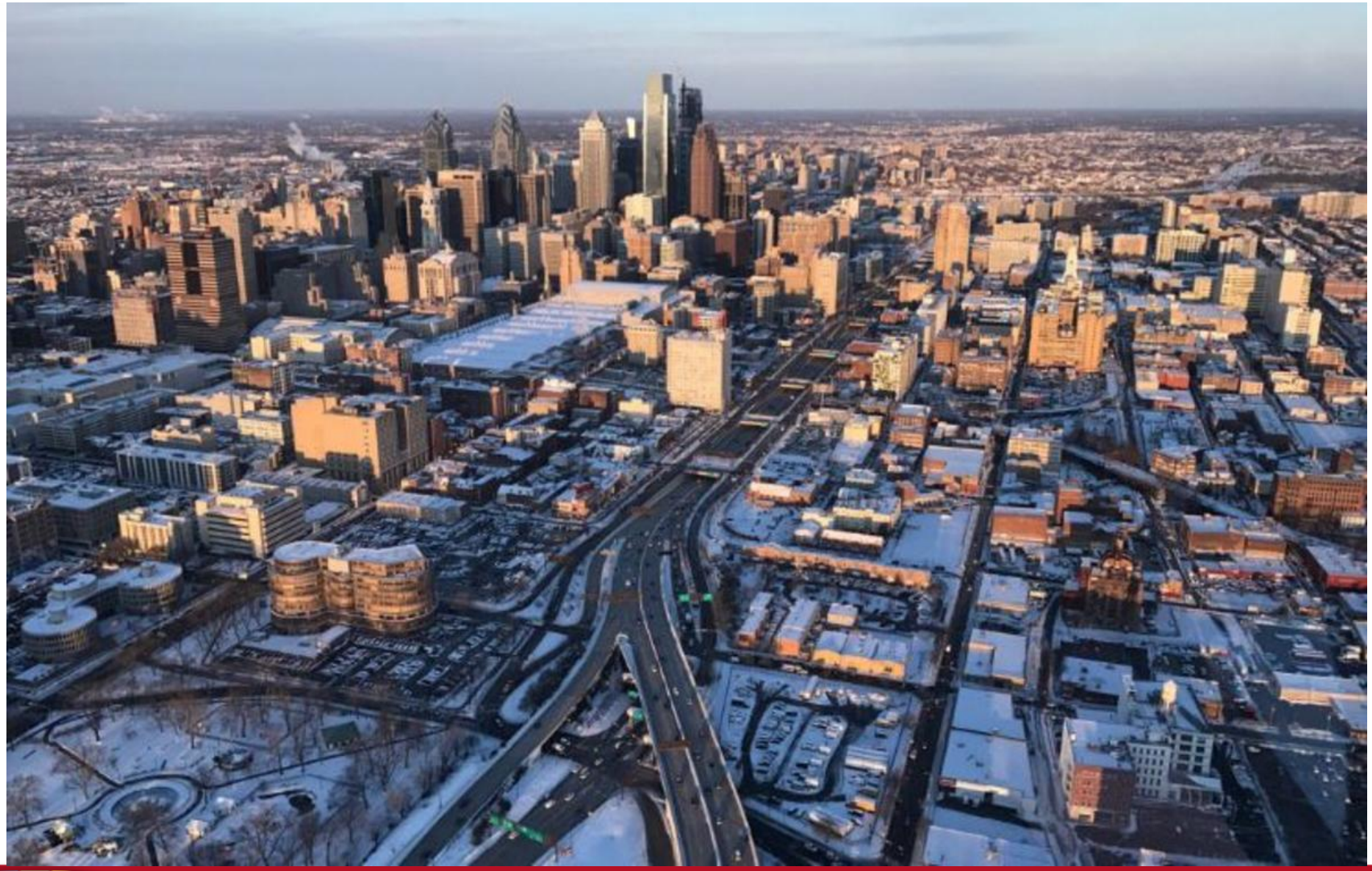
Greenhouse gas emissions from

11,617,688	131,814,260,53	17,454,345	2,493,478
Passenger vehicles driven for one year	Miles driven by an average passenger vehicle	Tons of waste recycled instead of landfilled	Garbage trucks of waste recycled instead of landfilled

CO_2 emissions from

6,188,730,703	58,689,429,825	728,086	5,807,735
gallons of gasoline consumed	Pounds of coal burned	tanker trucks' worth of gasoline	homes' energy use for one year
13,890	8,121,567	292,896	1,949,636,645
Wind turbines running for a year	homes' electricity use for one year	railcars' worth of coal burned	Incandescent lamps switched to LEDs

-or-



SPECTRA

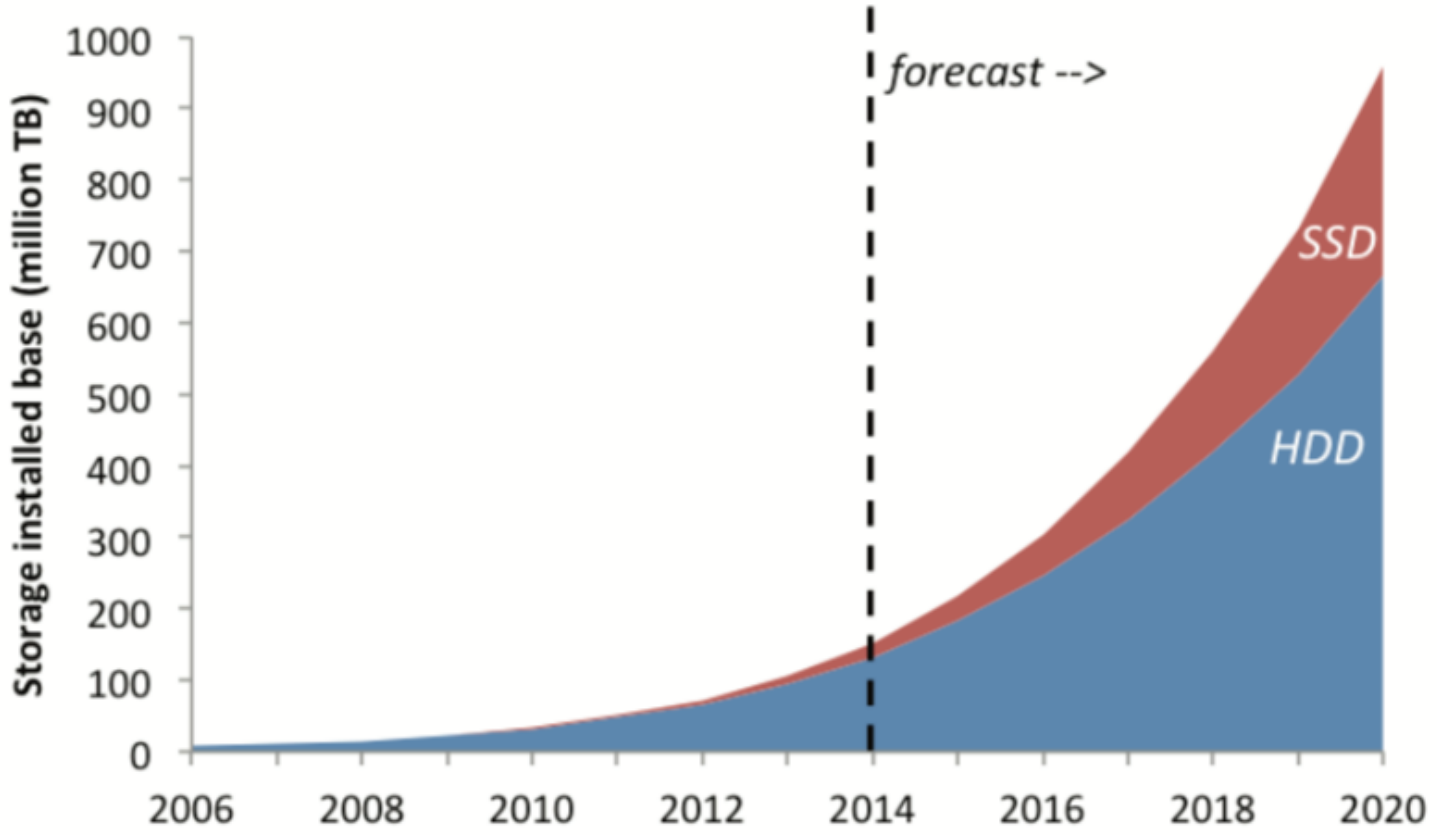


Figure 12. Total U.S. Data Center Storage Installed Base in Capacity (TB)

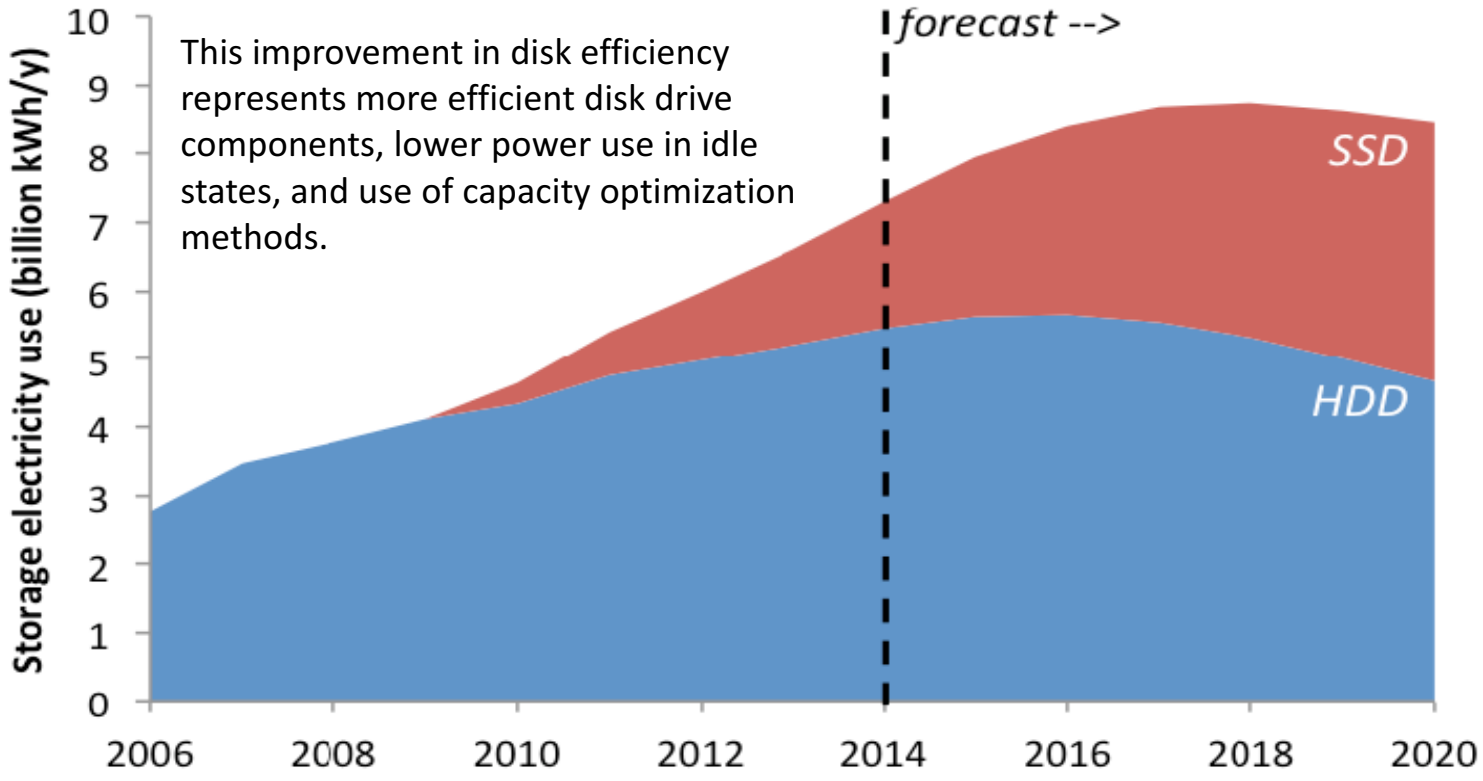


Figure 16. Total U.S. Data Center Storage Electricity Consumption

Digital Data Storage Outlook 2017

- IDC predicts 40 zettabytes (ZB) of digital data in 2020

- Spectra Logic's
  - The stored digital universe vs digital universe
  - Supply Side view
  - Unlikely to see constrained supply of storage through 2026.
  - SSD up, HDD down, Tape up

  - Yogi Berra warned us about predicting – especially the future.

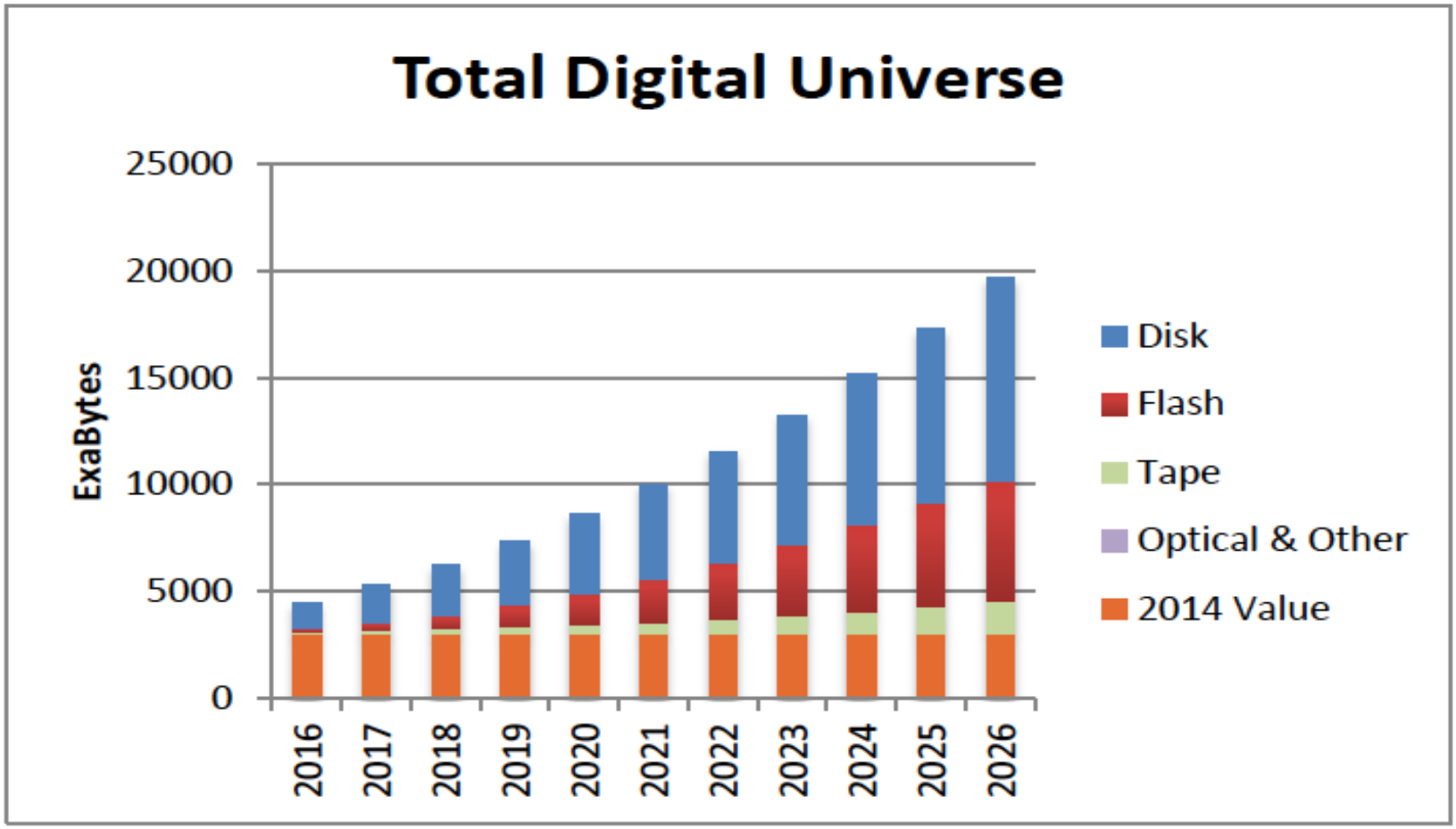
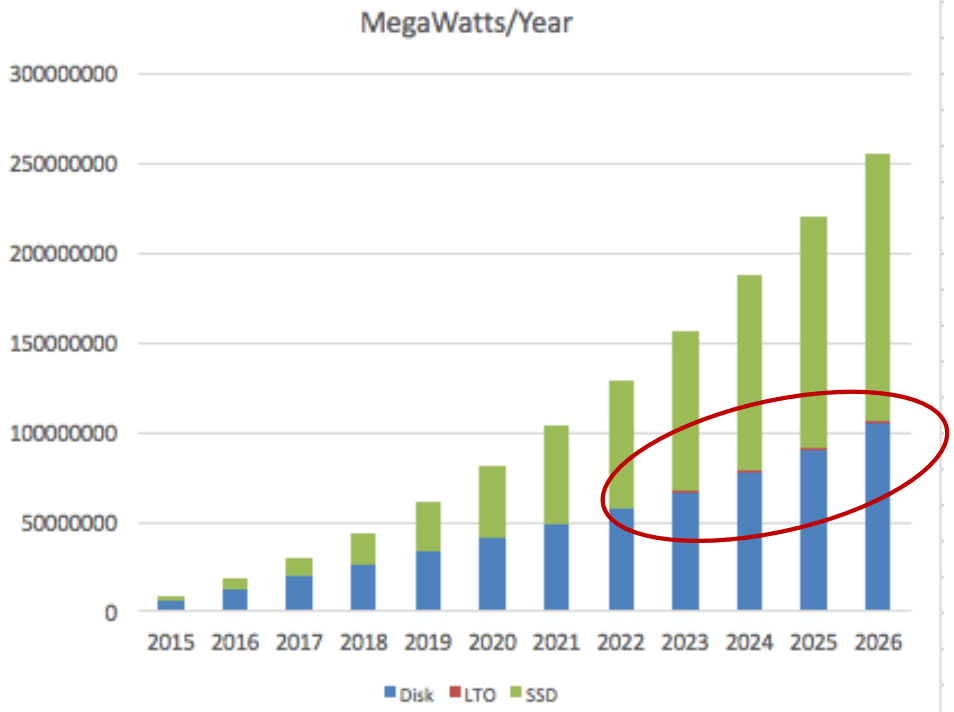
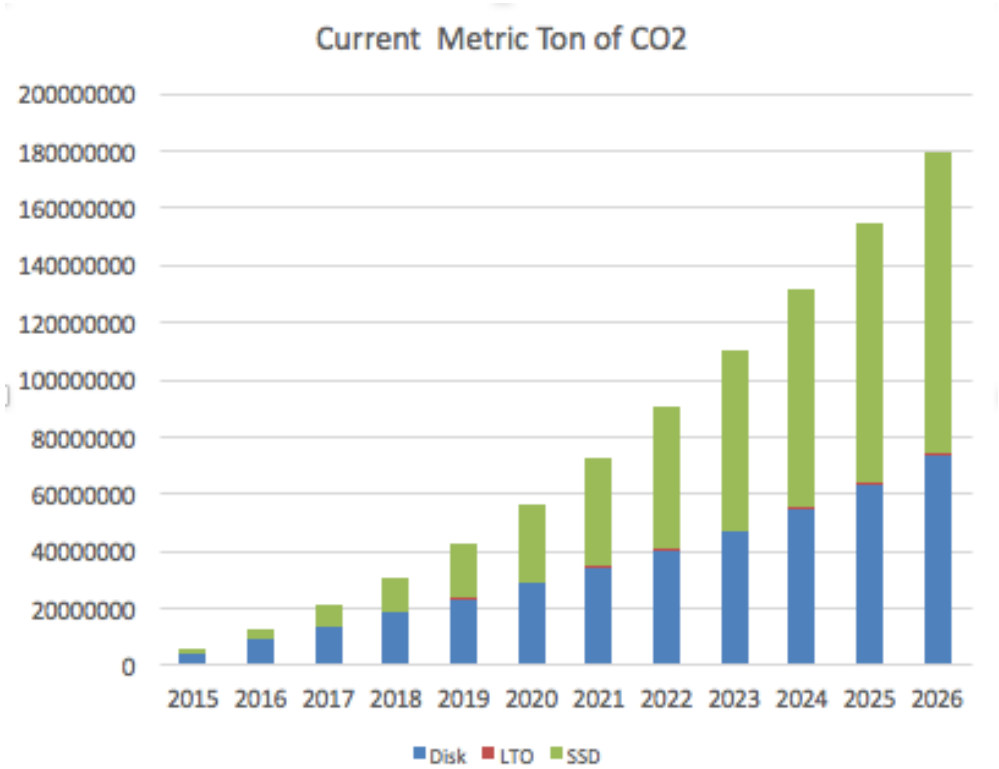


Figure 11: Stored Digital Universe

Energy and Carbon of new data





SSD

Current state of flash

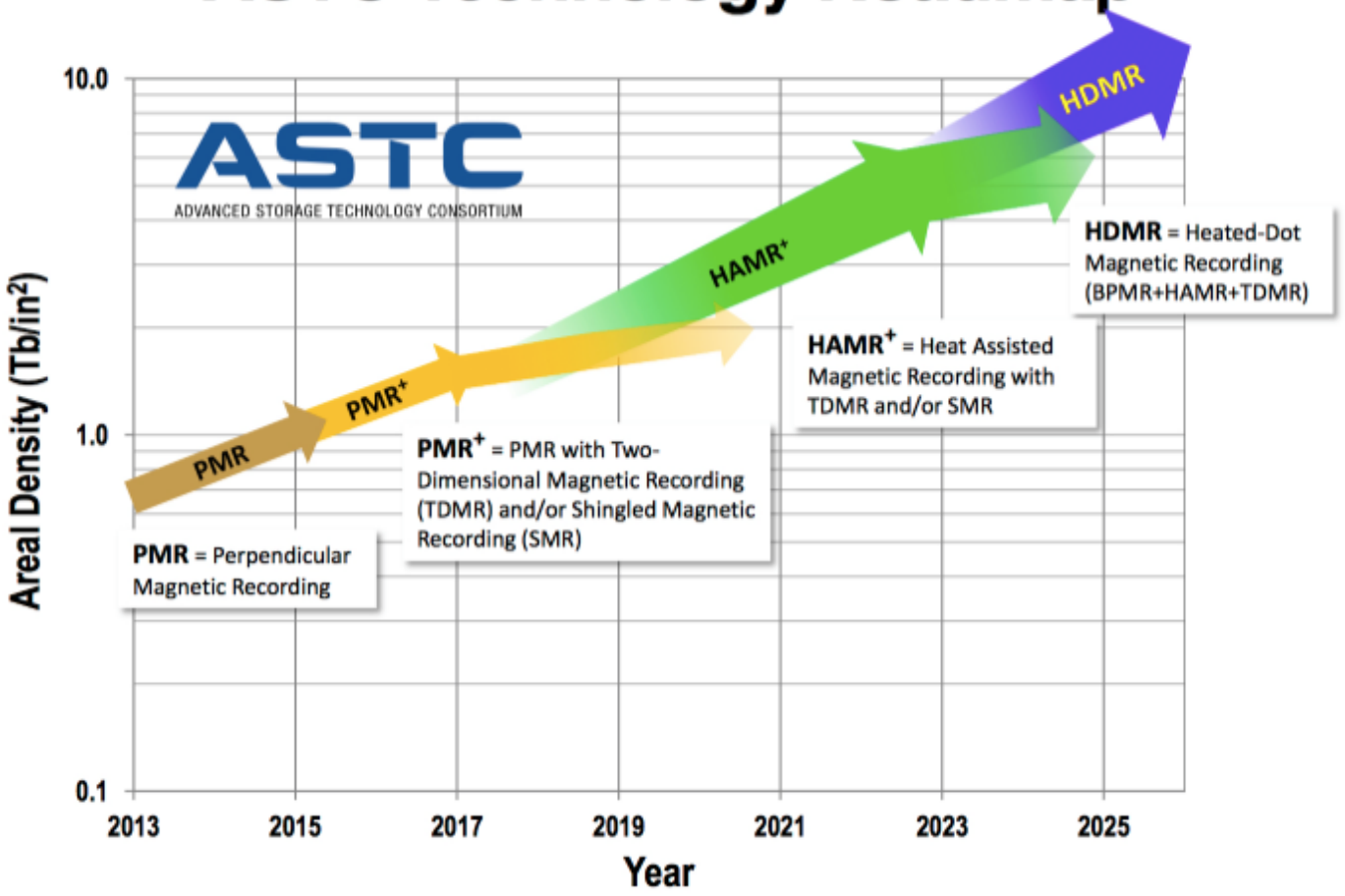
- NAND Flash under-over supply
  - Price is hovering around $0.25 per gig
- Projected revenue to grow 20% yr yr
- The areal density of flash memory is doubling every two years
- 3D flash becomes cost viable in next 2 years vs planar
- Flash is like a battery, it has a limited life, both R/W and time.
- XPoint still aimed at server market, need OS and App support
- Flash will continue to consume rotational disk market

Disk

Current state of Disk

- Worldwide revenue for disk storage declined 4% per year
  - $38 billion in 2012 to $27 billion in 2016
- Production of capacity grew 16% 2011 to 2016 in EB.
  - Units declined 7% per year during this time period.
- Next Technology: Seagate is targeting 2018-19 for HAMR
  - 16TB 3.5-inch drive planned
  - 8 platters and 16 heads
  - It is assumed the drive will be helium-filled.
  - HAMR is currently 3-5 years late
- Rotational disk market will continue to shrink

ASTC Technology Roadmap



Tape

Current state of Tape

- TMR heads in TS and LTO8
- BaFe media
- Technology demos showing over 100 Gb/in2
- Over 200 TB cartridge have been demonstrated
- 360 MB/sec transfer rate going to over a GB/S
- LTFS
- Tape Market staged to be on 2 year release path
- Tape Market slated to grow in data archiving

Datacenter Storage Power consumption will continue to grow

- Datacenter storage usages:
  - Today, SSD consume more watts per TB than Disk
  - Rotational disk R&D investment continue to decline
  - HDD are adding in platters, Helium and other tricks to gain capacity

  - What do we do about our growing power bill?
    - How do we go green?

Company	Renewable Energy (MWh)	Percentage	Year
Microsoft	1,363,235.00	50%	2014
Google	879,153.00	38%	2014
HP	280,560.00	14%	2014
EMC	113,000.00	16%	2014
Adobe	98,697.00	234%	2014
Rackspace	46,461.00	17%	2014
Sales Force	15,187.00	18%	2014
FaceBook	786,900.00	43%	2016

The cost of renewable energy

- 1.67 kg Si is used per square meter of PV panel.
- A 100 watt solar panel develops about .35khw/day
- Solar/Carbon payoff 5-15 years, some say worse
- A wind turbine takes 750,000 KWh to produce
- Solar 1 MW per 2.5 acres
- High density wind is 1 MW per 20 acres. 50 is more likely.

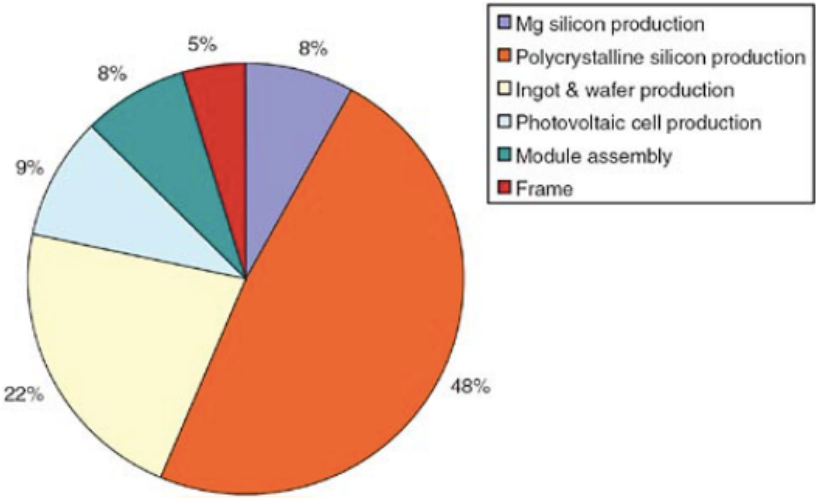
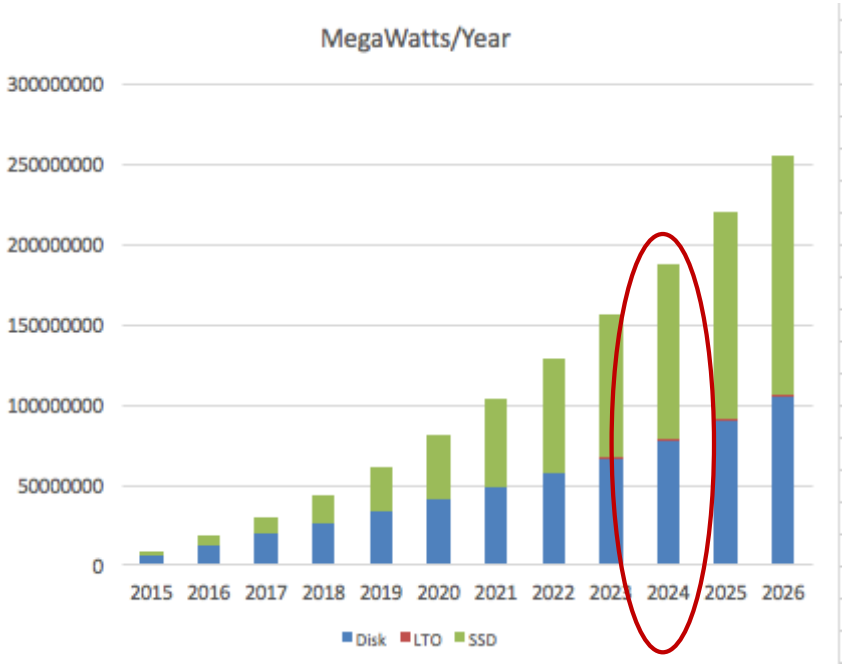


FIGURE 4-6 Breakdown of energy use in multicrystalline silicon PV module manufacturing. Adapted from estimates provided by Alsema (2000) and Alsema and de Wild-Scholten (2006).

Acreage needed to cover X years storage demand with wind.



Why am I here

- Good news, your willing to pay more for green energy
- More good news, I am going to show you how to use even less and save more
- More good news, the industry will be moving this way anyways.

- Tape is the most energy efficient storage system!

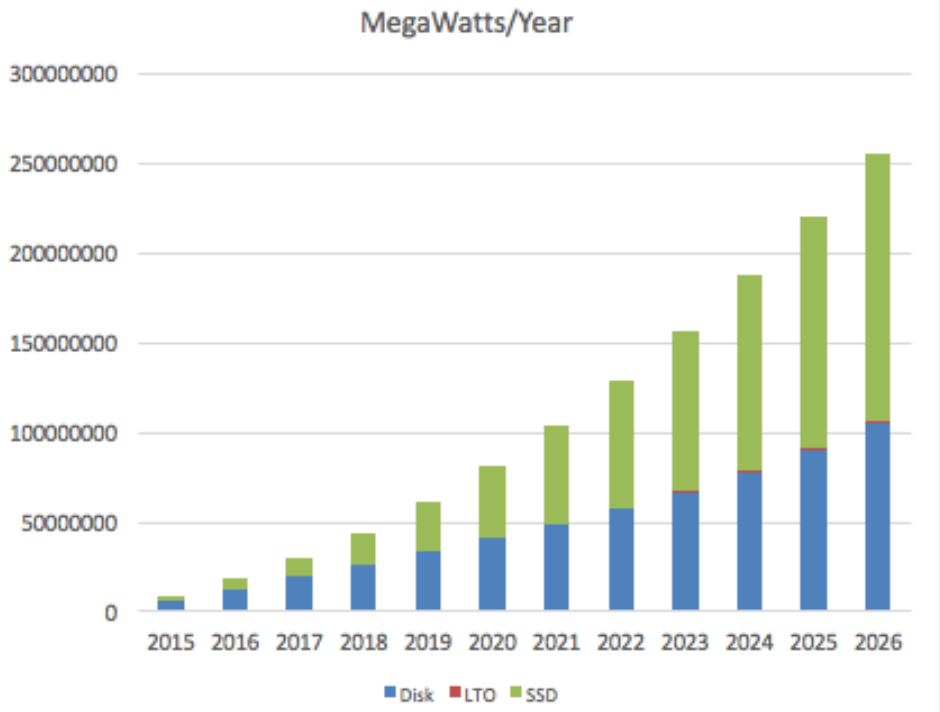
Why tape

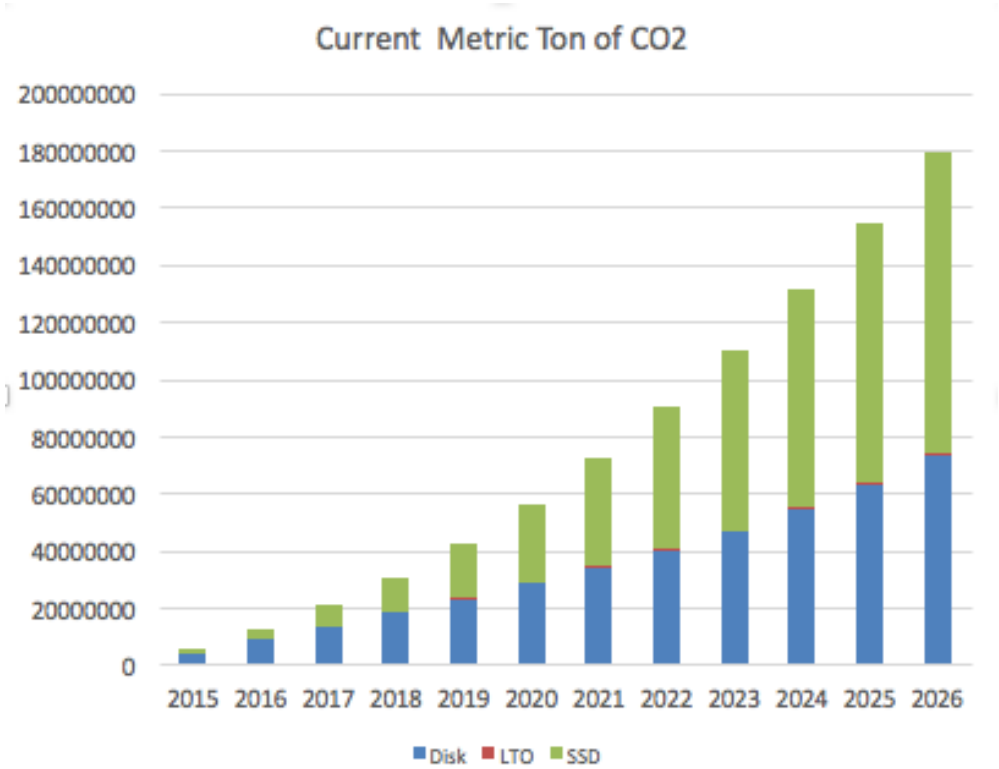
- Lowest cost per gig
- Lowest watts per gig
- Highest ECC per device
- Longest shelf life

- No new Physics!

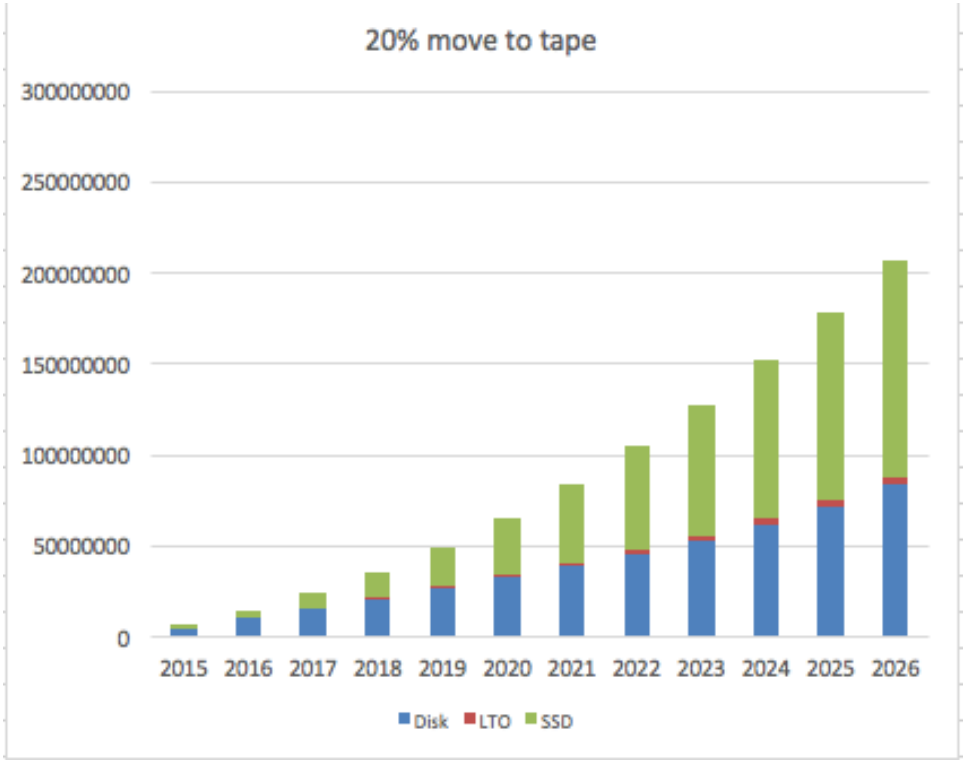
- Tape loves the long tail of data

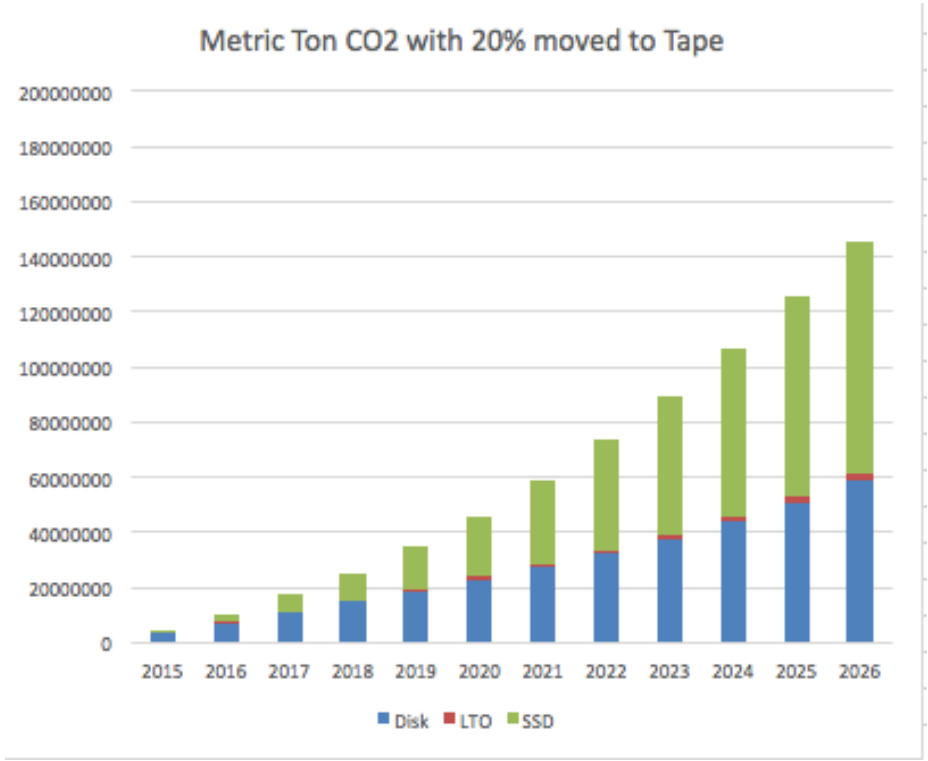
Current Energy and carbon foot or new storage



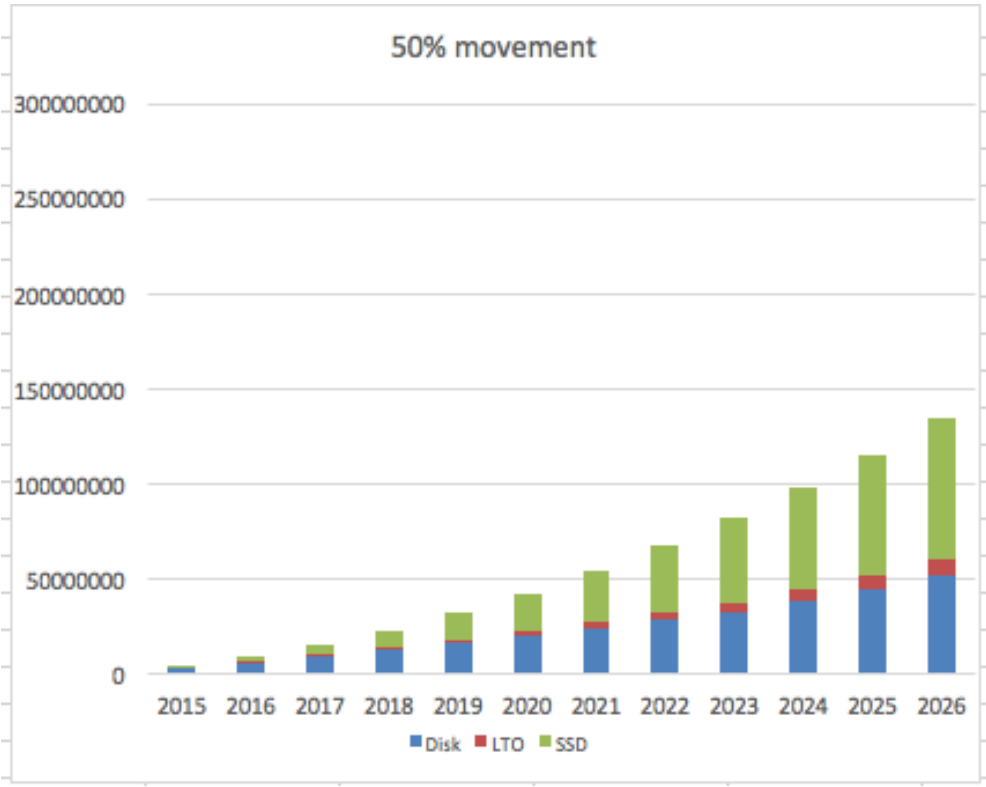


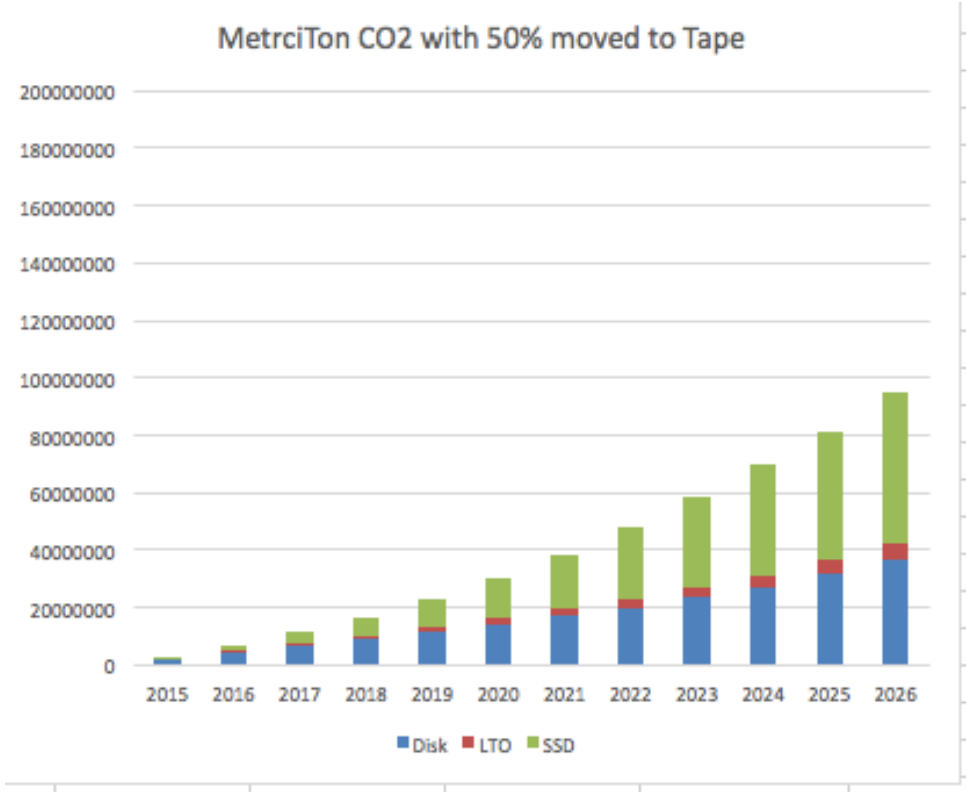
What if moved 20% more data to tape





What if we moved 50% of our data to tape





Moving to more tape

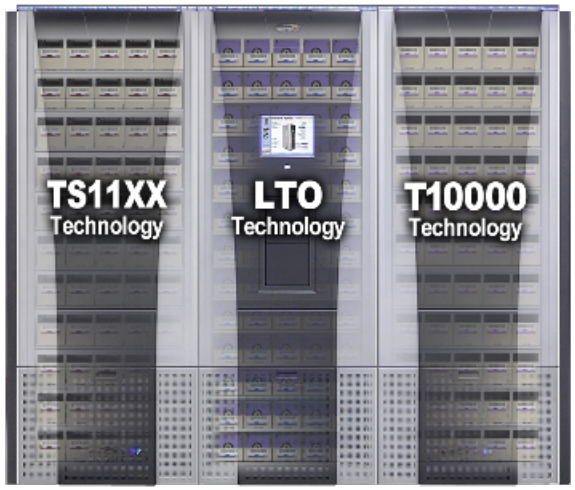
- Your going to be forced into a tier storage model to be competitive
- Rotational Disk market will continue to shrink.
  - Capacity 7200 RMP will be the last drive
- Soon…
  - Flash systems will be for processing data
  - Tape for long term storage, second copy, third copy
  - Think about a second copy on a genetically diverse storage tier

- Hardest thing is getting started
- Here is how to do that.

How to start using a Spectra Library

The New Spectra TFinity Research Platform

- Evaluate all 3 major tape technologies on a single platform
- Deploy a development HPC tape library for $120K (€ 120K or £ 120K) before investing in the full-scale production model!
- Eliminate risk with a Money Back Guarantee
- Minimize effort with a small beginning footprint
- Support program customized for development:
  - Significantly reduced cost
  - Tailored for non-production needs
- Seamless upgrade to full production unit



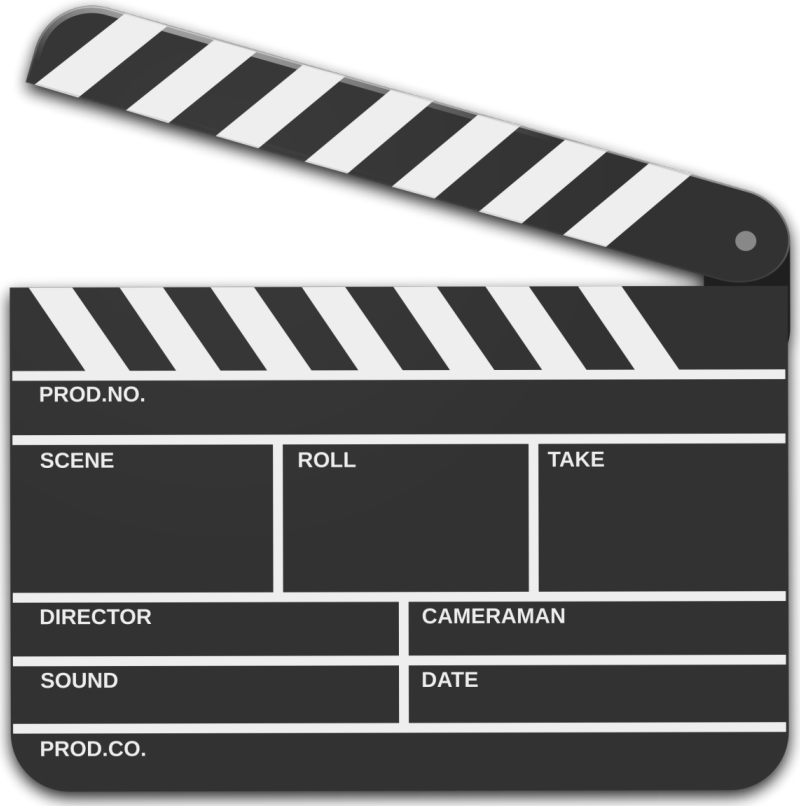
TFinity Research Platform's Library Hardware & Software

- Single High Performance Transporter Robot
  - Lowers cost from standard dual robot. Upgradeable.
- Drive credits allow for any drive configuration (6 credits included)
  - 1 credit per LTO-7 / 2 credits per LTO-8 drive
  - 3 credits per IBM® TS1155 tape drive technology
  - 1 credit per Oracle® T10000 drive sled (allows for customer-owned Oracle® T10000 drives to be moved to Spectra's ExaScale TFinity library)
- Full BlueScale® Software Suite
  - Encryption, Media Lifecycle Management, Drive Lifecycle Management, Data Integrity Verification, AutoSupport, Library Partitioning (SLS), Universal Interface, more…
- Customized "skins" on library panels to share *your* mission
- Extra drives available at standard price

What Do You Have to Lose?

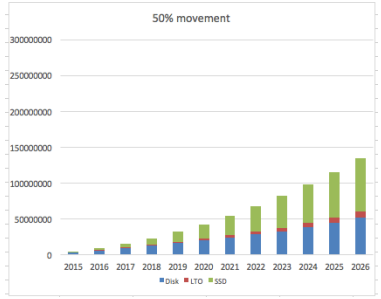
Deploy, test, run, evaluate and provide feedback on a development Spectra TFinity Tape Library before investing in a full production TFinity ExaScale with zero risk and a money back guarantee.

Money Back Guarantee and Scalable to Full Production


PROD.NO.
SCENE
ROLL
TAKE
DIRECTOR
CAMERAMAN
SOUND
DATE
PROD.CO.

Storing a Zettabyte

- A few thousand tape libraries can store a Zettabyte
- Those tape libraries would only use a few thousand kwh
- Green power cost 20%-50% more than conventional power
  - Tape cost 1/2 – 1/10 Cap EX
  - Tape cost 1/10 – 1/100 as much to power



- You want a green statement for your customer:
  - ”Our data centers use 35% less power than our competitors….”
  - The magic of tape

Thank you

Data center power usage (notes)

- US data centers use about 2% of all the power in the US
- Data center power usage doubled from 2000 to 2006
- As of 2014 the US consumed 3,913,000,000,000 kw-h/yr
- US data centers use about 78,260,000,000 kw-h/yr
- The sum of the greenhouse gas emissions you entered above is of Carbon Dioxide Equivalent. This is equivalent to: 54,999,250 metric tons
- Every 2 Megawatts of wind cost has a $50,000 premium (Xcel energy)
- Renewables usually carries 5-10% premium

https://www.nrel.gov/docs/fy15osti/64011.pdf
https://en.wikipedia.org/wiki/List_of_countries_by_electricity_consumption