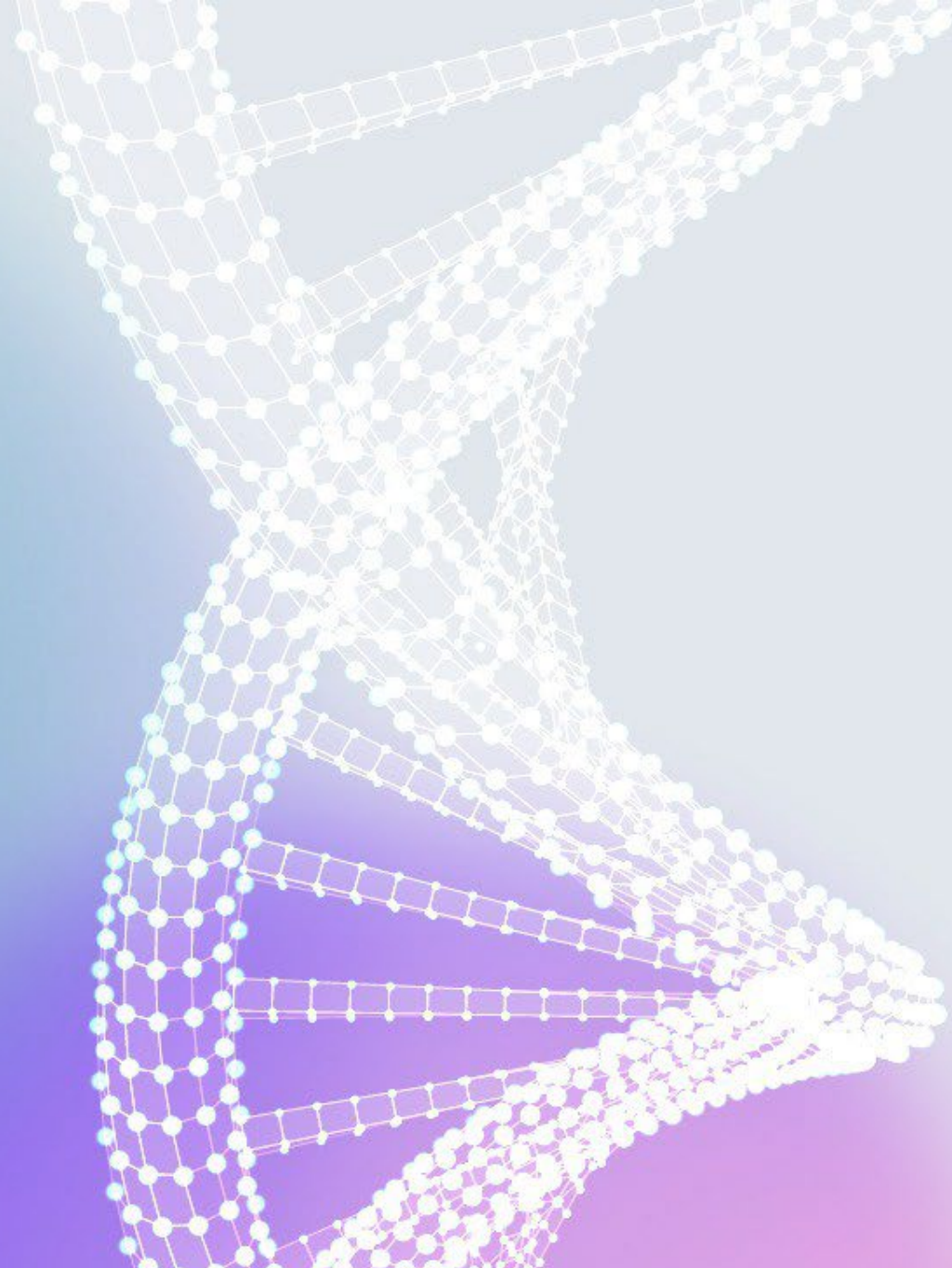




# DNA Data Storage

**Bill Banyai**

**GM Data Storage**





## Legal Disclaimer

This presentation contains forward-looking statements. All statements other than statements of historical facts contained herein are forward-looking statements reflecting the current beliefs and expectations of management made pursuant to the safe harbor provisions of the Private Securities Litigation Reform Act of 1995, including, but not limited to statements regarding anticipated growth in demand for data storage; timing of the early access launch of Twist Bioscience's first DNA data storage solution; and the ability of Twist Bioscience's DNA data storage solution to enable cost-effective, scalable and sustainable archive storage. Forward-looking statements involve known and unknown risks, uncertainties, and other important factors that may cause Twist Bioscience's actual results, performance, or achievements to be materially different from any future results, performance, or achievements expressed or implied by the forward-looking statements. Such risks and uncertainties include, among others, the risks and uncertainties relating to COVID-19; the ability to attract new customers and retain and grow sales from existing customers; risks and uncertainties of rapidly changing technologies and extensive competition in synthetic biology that could make the products Twist Bioscience is developing obsolete or non-competitive; uncertainties of the retention of significant customers; the ability of Twist Bioscience to successfully integrate acquired companies, including Abveris, and to achieve expected benefits from acquisitions; supply chain and other disruptions caused by the COVID-19 pandemic or otherwise; risks of third party claims alleging infringement of patents and proprietary rights or seeking to invalidate Twist Bioscience's patents or proprietary rights; and the risk that Twist Bioscience's proprietary rights may be insufficient to protect its technologies. For a description of the risks and uncertainties that could cause actual results to differ from those expressed in these forward-looking statements, as well as risks relating to Twist Bioscience's business in general, see Twist Bioscience's risk factors set forth in Twist Bioscience's Quarterly Report on Form 10-Q filed with the Securities and Exchange Commission on February 7, 2023 and subsequent filings with the SEC. Any forward-looking statements contained in this presentation speak only as of the date hereof, and Twist Bioscience specifically disclaims any obligation to update any forward-looking statement, whether as a result of new information, future events or otherwise.

# Twist Bioscience: Synthetic Biology, Biopharma & Data Storage



Founded in 2013 to make synthetic DNA to improve health & sustainability

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Went public on October 31, 2018  
(NASDAQ: TWST)

1,000+ employees, FY22 \$200M+,  
HQ in SSF with offices around the globe

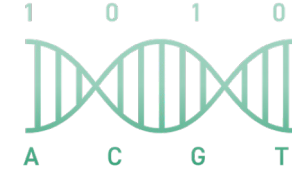


Advanced DNA  
synthesis platform

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Disruptive silicon-based synthesis platform  
offers scale to accelerate customer objectives

Serving > 3,000 customers including healthcare,  
diagnostics, therapeutics, and industrial biotech



Pioneers in DNA  
Data Storage

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High-density CMOS-based synthesis  
platform optimized for data storage

Developing data storage solutions  
addressing archiving demands at scale



# DNA Data Storage Emerging as Long-Term Archive Storage Solution

	<i>Access Time</i>	<i>Capacity</i>	<i>Durability</i>
Flash	$\mu$ s-ms	TBs	~5 yrs
HDD	10s ms	100s TBs	~5 yrs
Tape	minutes	PBs	~10s yrs
DNA	hours	ZBs	~100s yrs

Source: <https://pdfs.semanticscholar.org/7b06/ba3effa9fc7b2f194a355bcb69601ef1ea56.pdf>



# DNA Data Storage Workflow





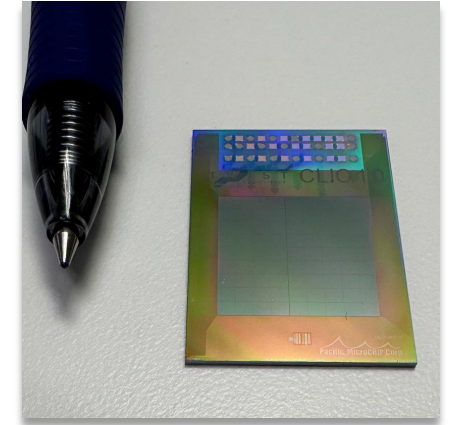
# DNA Archive Storage Key Features / Benefits

Feature	Benefit
Format independent	<ul style="list-style-type: none"><li>• No migration</li><li>• Low TCO</li></ul>
Resilient	<ul style="list-style-type: none"><li>• Robust to shipping and handling</li><li>• Withstands humidity or water exposure</li><li>• Withstands normal temperature swings</li><li>• Immune to electromagnetic pulse interference</li></ul>
Compact	<ul style="list-style-type: none"><li>• High storage capacity</li><li>• Flexible packaging</li></ul>
Multiple copies produced	<ul style="list-style-type: none"><li>• Multiple copies stored</li><li>• Distribute across physical sites</li></ul>



# DNA Synthesis & Storage

- DNA is synthesized on a CMOS chip
  - The chip controls the electrochemistry of fluids that flow in and out of the chip during synthesis
  - After synthesis, DNA is transferred from the chip to a storage capsule and the chip is reused to make more DNA
- DNA is stored in a hermetic capsule
  - Amount of DNA per capsule is configurable
  - Capsule arrays scale the capacity





# Massively Parallel DNA Synthesis

- It takes ~ 24 hrs to synthesize the DNA molecules that store the data
- A write system can support multiple chips
- The 24 hr throughput is configurable → # chips x bytes / chip





## DNA Data Storage Vault / Time Capsule

- Offline / offsite / air-gapped archiving solution
- Small footprint
- **Expect to introduce GB-class pilots late CY23**
- **Plan for TB-class solutions in the future**



# Conclusions

- Throughput achieved with high-density chips operated in parallel
  - Chips are reusable to keep making more DNA
- Demonstrating GB-class workflow at end of the CY23
  - Codec, chips, storage, and third-party sequencing
- Designing TB-class workflow
  - Successful product introduction requires customer input to define
    - Product features
    - Qualification procedure, and
    - Acceptance testing



CAAGCAAGGATACGATATGACGAGGATGGCATGGACTACAGGATC  
CTACAGCTACGACTAGATATCTACACGAGCATAATCATAGACTA  
AGAGAGAGCGGATGAGGGATTACTAGCATCATAGATAAGCTAGC  
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