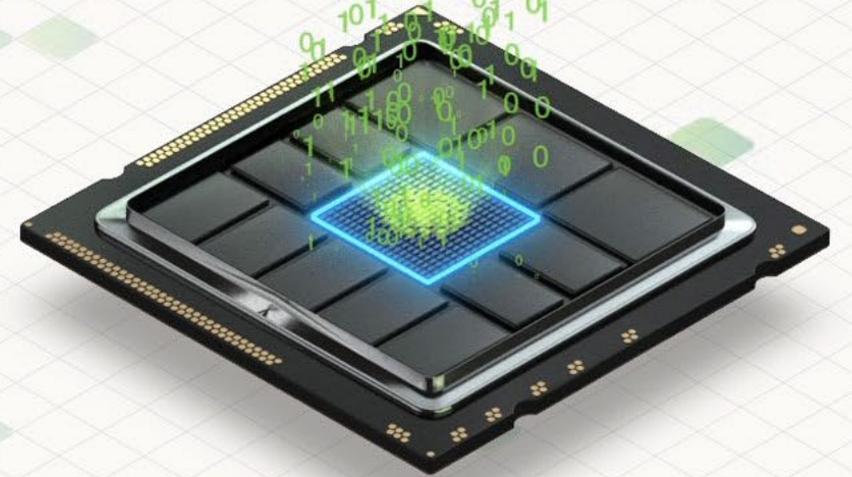




# ReRAM: Approaching the Tipping Point

Goldman Sachs 6<sup>th</sup> Annual Emerging Technology Conference

October 2022



# Who We Are

## Leading developer of innovative memory technologies Bringing to market Weebit ReRAM – next-generation NVM technology

Enabling a new era of intelligent connected devices



### Founded: 2015

Located in Israel & France  
ASX: WBT



### Signed 1st commercial deal

Ongoing discussions with  
additional fabs and customers



### Current business model

IP licensing to semiconductor  
companies & fabs



### World-leading team

50 personnel\* (90%  
engineers/ scientists)



### R&D partner

CEA-Leti, leading micro-  
electronics research institute

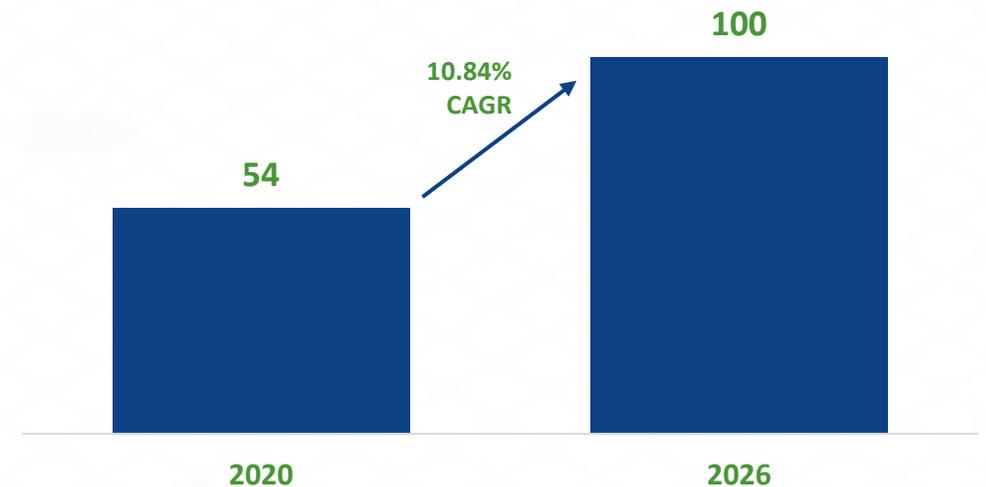


### Silicon-proven technology

Proven in >1000 wafers to-date  
Volume production expected 2023

\* Includes employees and full-time contractors

### Global NVM Market (US\$B)\*



NVM = Non-Volatile Memory

\* Source: MarketsandMarkets; company data

# Strong Board with World-renowned Semiconductor Industry Experience

David (Dadi) Perlmutter  
CHAIRMAN



Dr. Yoav Nissan-Cohen  
EXEC. DIRECTOR



Atiq Raza  
NON-EXEC. DIRECTOR



Fred Bart  
NON-EXEC. DIRECTOR



Ashley Krongold  
NON-EXEC. DIRECTOR



Coby Hanoch  
CEO



# Strong and Experienced Management

**Coby Hanoch**  
CEO



**Ishai Naveh**  
CTO



**Amir Regev**  
VP TECH.  
DEVELOPMENT



**Ilan Sever**  
VP R&D



**Eran Briman**  
VP MARKETING &  
BUSINESS DEV.



**Alla Felder**  
CFO



# Increasing Global Semiconductor R&D Investment

- ❖ Geopolitics driving countries to invest locally in semiconductor R&D
  - ◆ US CHIPS Act / EU Chips Act to boost new fab construction & advanced R&D in these regions
  - ◆ NVM a key area of investment globally



- ❖ Semiconductor companies & foundries announce capacity investments over time

TSMC	Intel	Samsung	Micron
\$100B	\$40B	\$345B	\$150B

**EE Times** SkyWater to Build \$1.8 Billion Fab  
07.22.2022

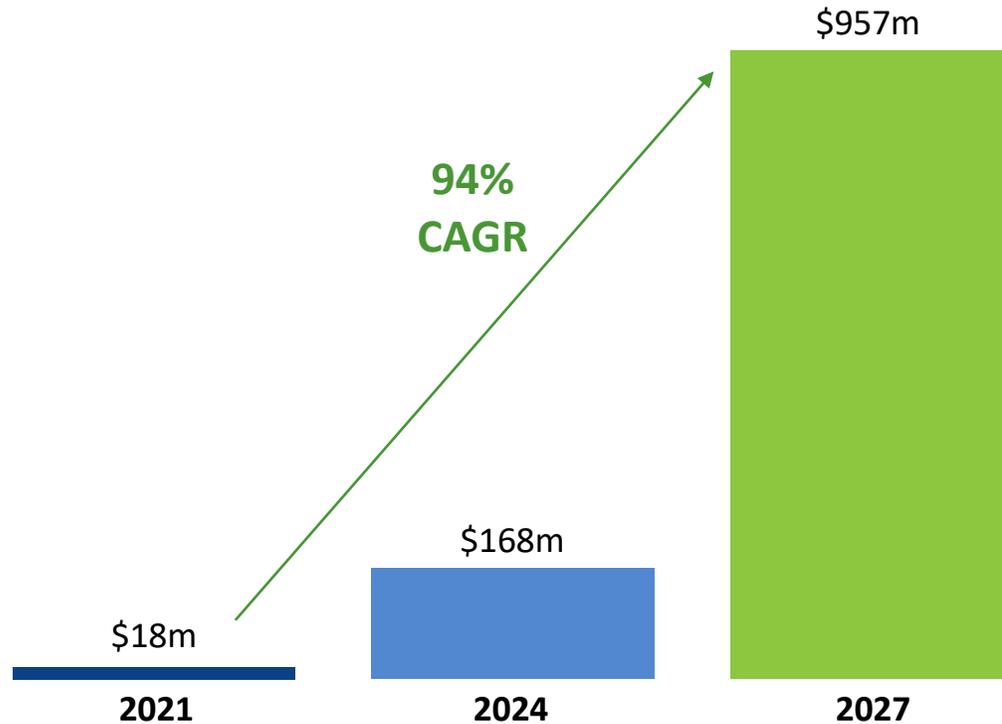
**IC Insights** 08.23.2022 First 3-year period of double-digit CapEx growth in semi industry since 1995

Government Investments & Incentives		
United States	\$52B +	8 new fabs
European Union	\$43B +	4 new fabs
China	\$150B +	10 new fabs
Korea	\$260B +	5 new fabs
Taiwan	\$120B +	10 new fabs
Japan	\$6B +	5 new fabs
India	\$10B +	1 new fab
Singapore	\$5B +	1 new fab

- ◆ **Memory = 35% of fab equipment spending 2022-2023**
- ◆ **Memory + foundry represent most of the capacity increases** – SEMI, March 2022

# Embedded ReRAM Market – Approaching the Tipping Point

## Embedded ReRAM Market Size 2021 - 2027



Source: Yole Emerging Non-Volatile Memory 2022

Note: The embedded emerging NVM market size is evaluated based on assumptions of the average chip area occupied by a given memory technology (Yole)

- ❖ Embedded emerging NVM market expected to reach \$2.9B by 2027
  - ◆ ReRAM expected market share: 33%
- ❖ Embedded memory is a clear differentiator for semiconductor companies

**Electronics Weekly.com**

8th July 2022

**Nordic to buy its embedded memory supplier, Mobile Semi**

Norwegian RF chip maker Nordic Semiconductor is to acquire US embedded memory IP supplier Mobile Semiconductor.

# The Weebit ReRAM Advantage



**3-4x**

**Lower** added wafer **cost** vs. flash

- ✓ 2-mask adder
- ✓ Standard materials



**>100x**

Better **endurance**  
Vs. flash

- ✓  $10^5$ - $10^6$  P/E cycles



**~100x**

More **energy efficient**  
vs. flash

- ✓ Low voltage, low currents
- ✓ Zero standby power



**<40nm**

**Scales** to processes far  
below limits of flash

- ✓ Proven @ 28nm
- ✓ Scaling to 22nm



**~100x**

Faster **access**  
**time** than flash

- ✓ Bit/byte addressable



**175°C**

**Reliability** for  
up to 10 years

- ✓ Endures 9 SMT  
reflow cycles



**~350x**

Better **radiation**  
**tolerance** vs. flash<sup>1</sup>

- ✓ Also tolerant to EMI



**0**

Interference w/ analog  
& power devices

- ✓ Best NVM for PMIC &  
mixed-signal

# Targeting Growing Markets



## Analog/Mixed Signal & Power Management

Analog Semiconductors  
2020-2022 \$57B → **\$83B** (20.7% CAGR)



## Automotive Applications

Automotive Semiconductors  
2020-2026 \$34B → **\$78B** (14.75% CAGR)



## Internet of Things

IoT Semiconductors  
2020-2025 \$33B → **\$80B** (19% CAGR)



## Edge AI Applications

Edge AI Chipsets  
2021-2026 \$8B → **\$28B** (28% CAGR)

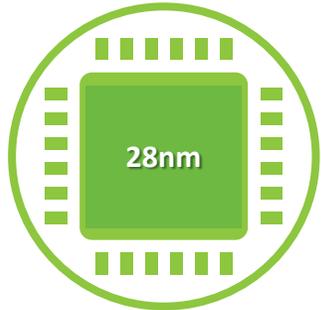


## Aerospace & Defense

Aerospace & Defense Semiconductors  
2019-2027 \$5.8B → **\$8.6B** (5% CAGR)

\* Sources (in order top to bottom): [IC Insights 2022](#); [Yole 2021 \(CASE Semiconductors\)](#); [IoT Analytics Feb 2021](#); [ABI Research June 2021](#); [Transparency Market Research 2019](#)

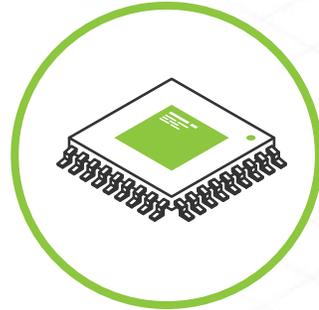
# Significant Progress in Last 12 Months



**OCT 2021**  
Demonstrated 1Mb ReRAM arrays in 28nm FD-SOI



**NOV 2021**  
Raised further A\$35m; well funded to 2024



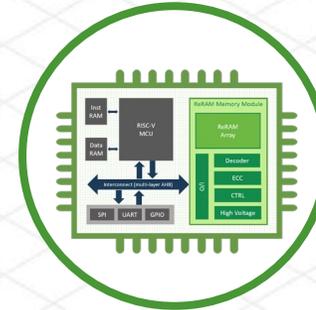
**MAR 2022**  
Scaling the technology to 22nm FD-SOI



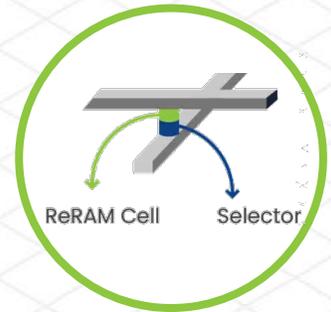
**JUN 2022**  
ReRAM IP module fully functional, live demonstration



**JUL 2022**  
Tape-out of IP module to SkyWater foundry; first tape-out to commercial fab

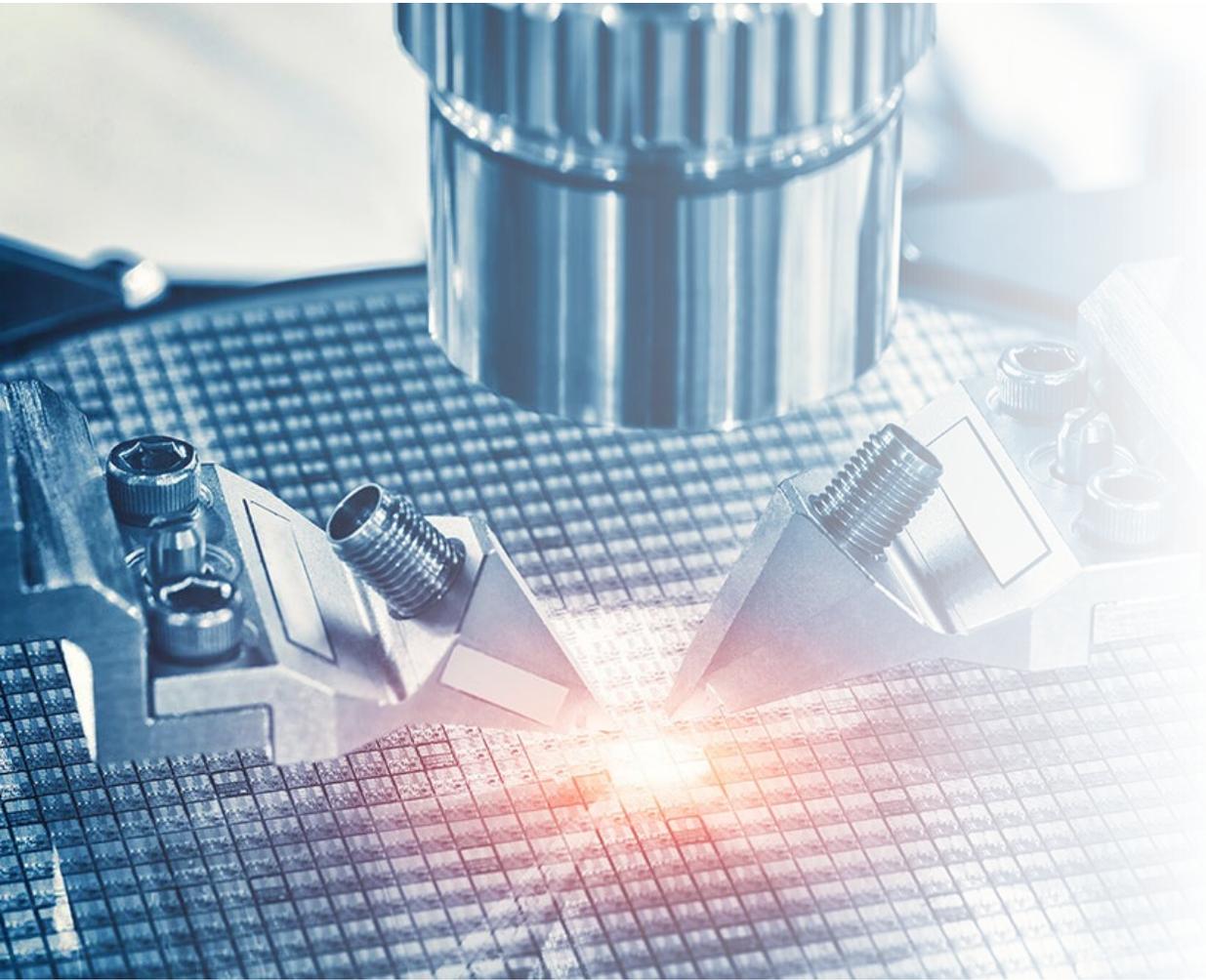


**AUG 2022**  
Good initial qual results of ReRAM IP module



**OCT 2022**  
ReRAM selector can achieve high densities needed for discrete & embedded applications

# ReRAM Modules Now in Qualification



**Qualification is a formal testing sequence to show technology maturity, defined by industry bodies**

- ◆ Key requirement before mass production

**Weebit now qualifying its first ReRAM module**

- ◆ Demo chip implemented in actual silicon

**Initial results are better than normally expected at this phase**

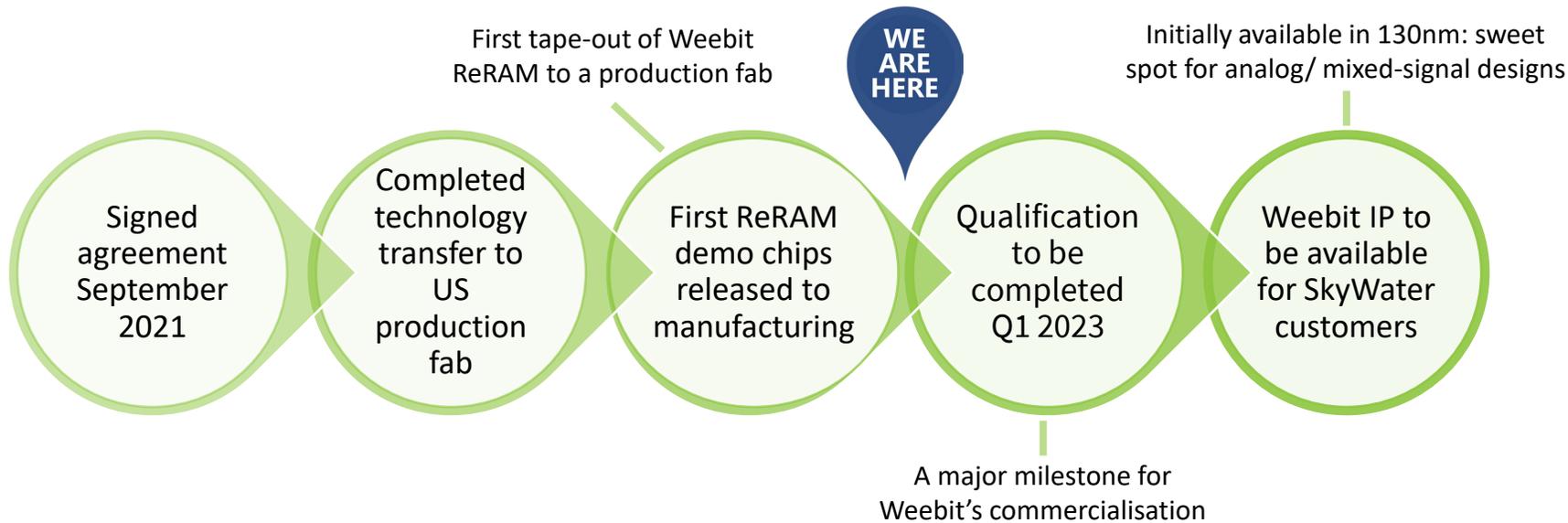
- ◆ Good data retention before and after cycling
- ◆ Endurance test results up to spec
- ◆ Demonstrating high temp stability by passing 3x SMT

**Positive industry reaction to initial qual results**

**Final qualification results expected by end 2022**

# Significant Milestones Toward Commercialisation

SkyWater Technology (Nasdaq:SKYT) – only US-owned pure-play silicon foundry – taking Weebit ReRAM to volume production



President Biden holding a SkyWater wafer; Source: NBC News, April 12, 2021

- ❖ Once chips are received back from the fab, SkyWater customers can use them for testing & prototyping ahead of qualification
- ❖ After qualification, SkyWater customers can embed Weebit ReRAM IP in new product designs

# Scaling Weebit ReRAM to 22nm

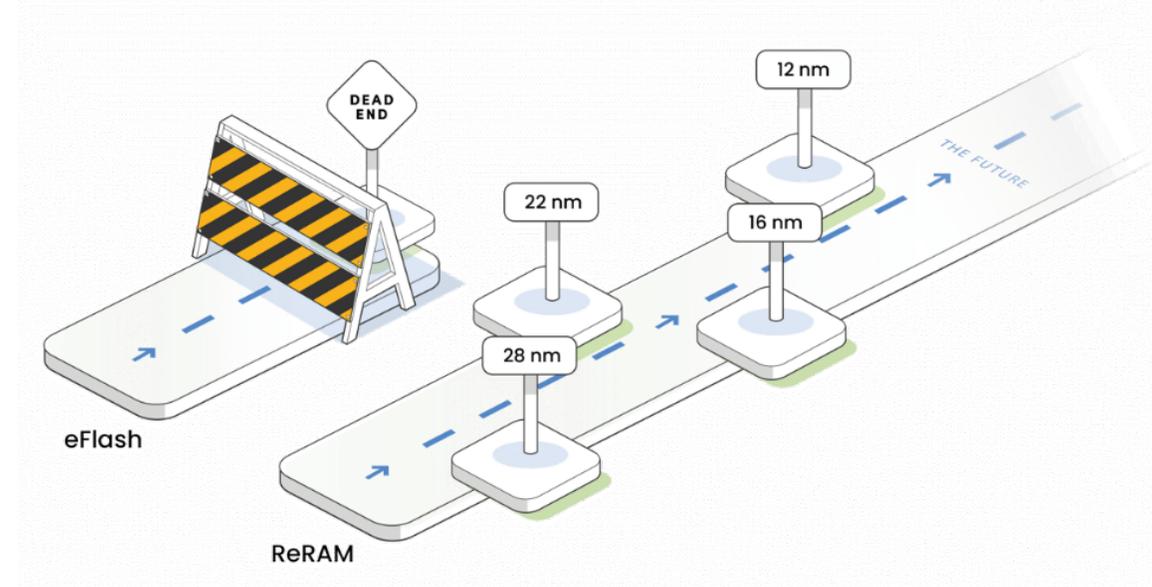
Addresses the need for new NVM at one of the industry's most common process nodes

Collaborating with CEA-Leti to design a full IP memory module targeting an advanced 22nm FD-SOI process

- ◆ FD-SOI: high performance at very low voltage/ low leakage; broadly adopted by the industry

Rapidly accelerating plans to scale Weebit ReRAM to advanced nodes

- ◆ Where existing embedded flash technology is no longer a viable option
- ◆ Serving applications including IoT, 5G and AI
- ◆ Weebit ReRAM + FD-SOI is ideal for low-power embedded devices



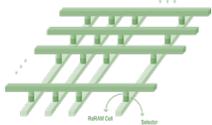
# Mid-Term Strategy: Discrete ReRAM Chips

Weebit is working with CEA-Leti to develop discrete (stand-alone) memory chips



## Co-developing specialised miniature selector technology

Small selector is needed to enable the smallest ReRAM cells  
→ highest density memory chips



## Achieved Weebit's first operational crossbar ReRAM array

Integrates Weebit ReRAM cell + specialised selector  
Crossbar arrays are needed for 3D stacked arrays → even higher densities



## Broad range of applications for stand-alone chips

Storage class memory (SCM), persistent memory, NOR flash replacement  
AI (in-memory & neuromorphic computing)



## New patents filed

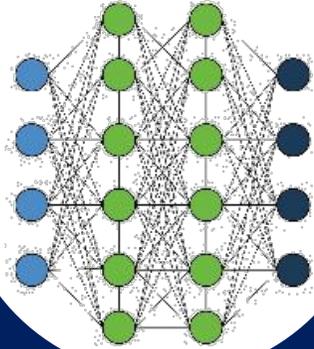
Protecting innovative selector technology and cell programming

### Recent News:

Progressed selector development to fit discrete & embedded applications with standard tools & materials

*Greatly increases the number of possible applications for Weebit ReRAM*

# Weebit ReRAM: Advantages for AI Applications



**Today:** A better solution for artificial neural networks (NNs)

- ◆ AI is bandwidth-intensive for memory usage in both inference and training
- ◆ Weebit ReRAM: scaling to 22nm/below allows significantly lower power and higher performance (flash cannot scale below 40nm)

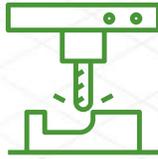


**Tomorrow:** Brain inspired AI systems enabling Neuromorphic Computing

- ◆ ReRAM physically resembles a biological brain synapse; has functional similarities
- ◆ Emulating NNs with ReRAM consumes orders of magnitude less power than today's NN simulations

# Looking Ahead

Milestones by the end of CY22



Proceeding with advanced qualification stages at SkyWater's U.S. fab



Provide qualification results of our embedded ReRAM module



Sign new agreements with partners and customers



Continue scaling down technology to smaller geometries

# Key Takeaways

The semiconductor industry is nearing the tipping point of moving to a new embedded NVM technology



The industry needs a new Non-Volatile Memory solution



Weebit ReRAM has unique advantages; well positioned to replace flash



Strong tech progress: first tape-out to production fab; tech proven across multiple geometries



Board & management have extensive semiconductor commercialisation experience



On track to deliver a production solution across a range of high-growth markets

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