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THE NEXT NVM IS HERE

ReRAM:
The Next NVM is Here

US roadshow

February/March 2023

Who we are

Leading developer of innovative memory technologies
Bringing to market Weebit ReRAM – next-generation NVM[1] technology

Enabling a new era of intelligent connected devices

Founded: 2015
Located in Israel & France
ASX: WBT

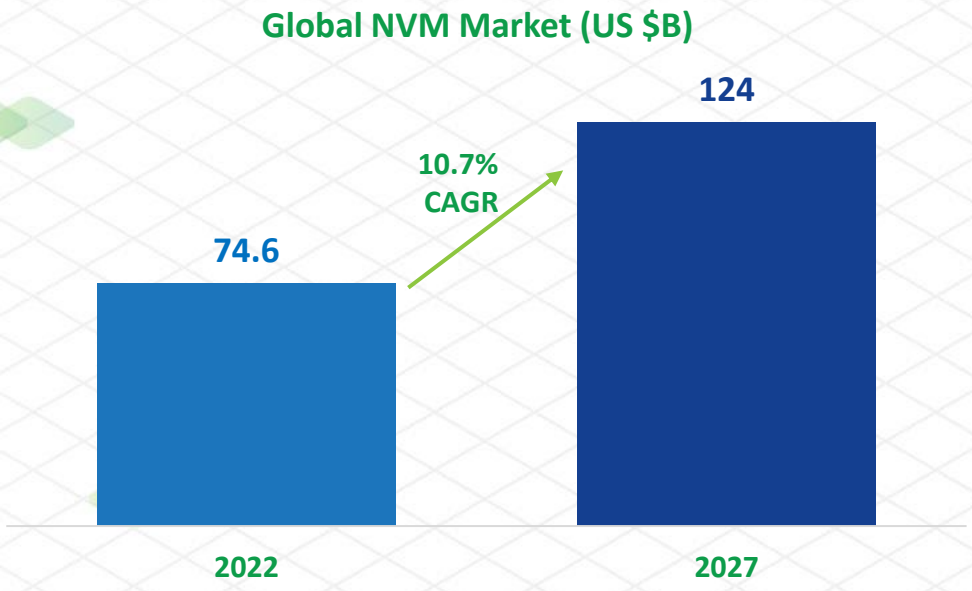
Signed 1st commercial deal
Ongoing discussions / evaluations with additional fabs & customers

World-leading team
50 personnel[2] (90% engineers/ scientists)

Business model
Product & IP licensing to semiconductor companies & fabs

R&D partner
CEA-Leti, leading micro-electronics research institute

Proven, protected technology
Fully qualified (130nm); >1K wafers to-date; 47 patents & applications



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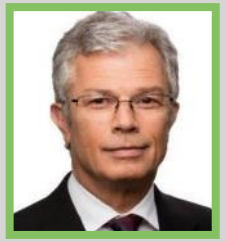
Source: MarketsandMarkets, December 2022
(1) NVM = Non-Volatile Memory
(2) Includes employees and full-time contractors

World-renowned leadership

BOARD

David Perlmutter
CHAIRMAN

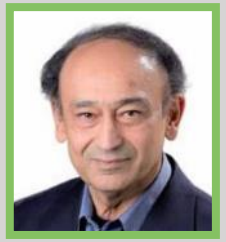


Served as Executive Vice President and General Manager at the Intel Architecture Group and Chief Product Officer of Intel Corporation

Dr. Yoav Nissan-Cohen
EXEC. DIRECTOR

Received his PhD researching non-volatile memories; Founder and CEO of Tower Semi; Co-Founder of Saifun Semi

Atiq Raza
NON-EXEC. DIRECTOR



Served as President and COO of Advanced Micro Devices (AMD); Chairman and CEO of RMI

Coby Hanoch
CEO

Semiconductor veteran; Co-founder of Verisity, VP Sales at Jasper, both acquired by Cadence; CEO of PacketLight

MANAGEMENT

Ishai Naveh
CTO

Industry veteran, co-founder of Adesto, a pioneer of ReRAM technologies. Leader of NVM tech at Tower Semiconductor

Amir Regev
VP Technology Development

Experienced specialist focused on NVM technologies, including Intel, Sandisk, Micron & Marvell

Ilan Sever
VP R&D

Experienced leader and innovator in the field of memory IP & mixed-signal SoC design from STM, Tower Semi and Dolphin Design

Eran Briman
VP Marketing & BD

Seasoned technologist turning ideas into business; IP licensing expert from CEVA & Corephotonics (acquired by Samsung)

Alla Felder
CFO

Senior manager at PWC Israel, active board member of multiple companies in TASE & NASDAQ

Memory at the forefront of global investment in semiconductors

- Geopolitics driving countries to invest locally in semiconductors
  - US CHIPS Act & EU Chips Act to boost new fab construction, advanced R&D in these regions
  - **Memory will be over a third of the spending**

US CHIPS Act

- Semiconductor companies announce capacity investments over time, mostly in US & EU

	TSMC	Intel	Samsung	Micron
Announced Fab CapEx:	**$100B**	**$40B**	**$345B**	**$150B**

EETimes 07.22.2022 SkyWater to Build $1.8 Billion Fab in Indiana

Government Investments & Incentives		
	$52B +	8 new fabs
	$43B +	4 new fabs
	$150B +	10 new fabs
	$260B +	5 new fabs
	$120B +	10 new fabs
	$6B +	5 new fabs
	$10B +	1 new fab
	$5B +	1 new fab

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Sources: SIA 2/2022, EE Times, 5/2022; Android Headlines 6/2022, FIERCE Electronics 7/2022 and 8/2022; Brookings.edu 8/2022Tom's Hardware 8/2022; WSJ 8/2022

Weebit ReRAM memory has inherent advantages vs. Flash memory

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

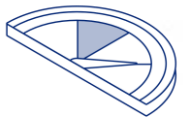
More energy efficient vs. flash

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

<40nm

Scales to processes far below limits of flash

- ✓ Proven @ 28nm
- ✓ Scaling to 22nm **& below**



~100x

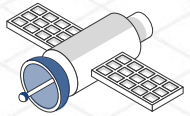
Faster programming time than flash

- ✓ Bit/byte addressable

150°C

Reliability for up to 10 years

- ✓ Endures 9 SMT reflow cycles



~350x

Better radiation tolerance vs. flash(1)

- ✓ Also tolerant to EMI

0

Interference w/ analog & power devices

- ✓ Best NVM for PMIC & mixed-signal

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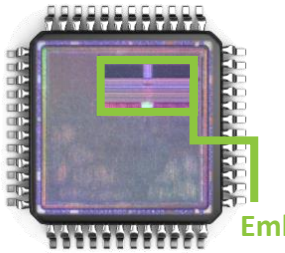
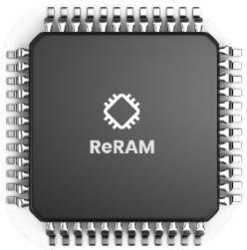
(1) Refers to ReRAM cell array

Weebit is addressing both segments of the Non-Volatile Memory market



Embedded Memory
Part of an SoC
(System-on-a-Chip)



Discrete Memory Chip
Contains only memory

- Embedded memory modules (with ReRAM IP): immediate opportunity
- Discrete (stand-alone) memory chips: short/mid-term opportunity

Volatile Memory *(Erased when power removed)*	SRAM	DRAM
Non-Volatile Memory (NVM) *(Retained when power removed)*	eFlash **ReRAM** MRAM OTP/MTP	NAND Flash NOR Flash **ReRAM** MRAM EEPROM
Business Model	Licensing License fees + NRE + Royalties	Product Sell chips

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Embedded ReRAM market segment – approaching the tipping point

The embedded emerging NVM market is expected to reach $3B by 2027[1]

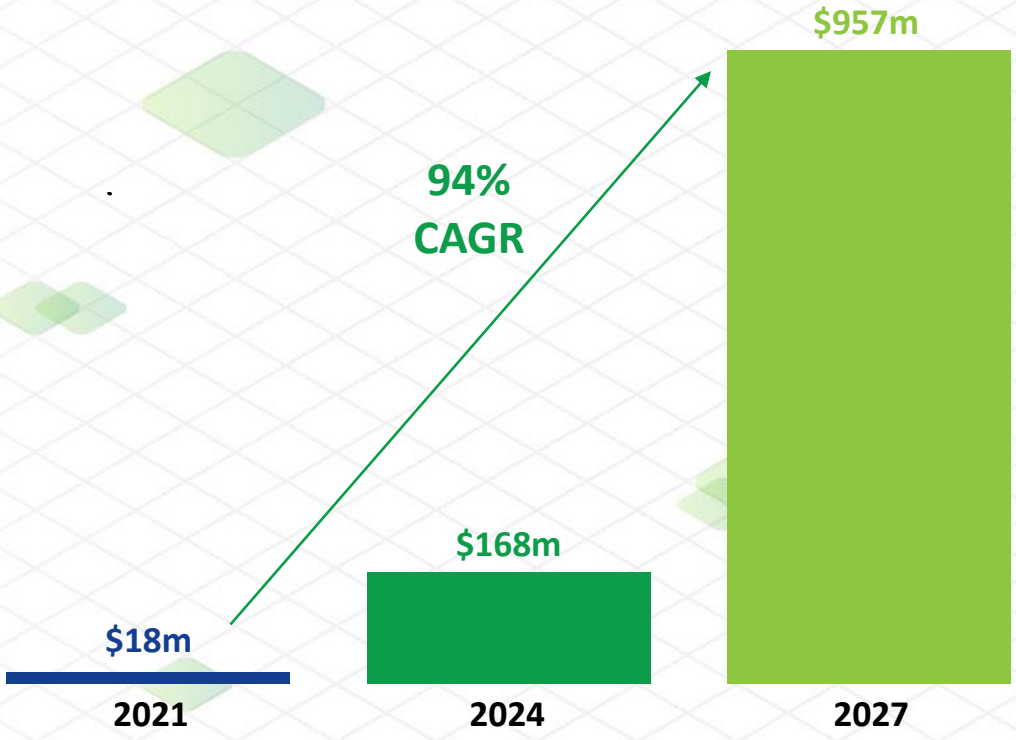
- ReRAM expected to capture 33% market share

This estimate is **solely based on the embedded NVM within the MCU market**

Does NOT account for:

- Other target markets apart from embedded MCU market
- Up-front license/use fees
- NRE (non-recurring engineering) fees
- Fab transfer fees
- Revenues from discrete ReRAM products

Embedded ReRAM Market Size 2021 - 2027

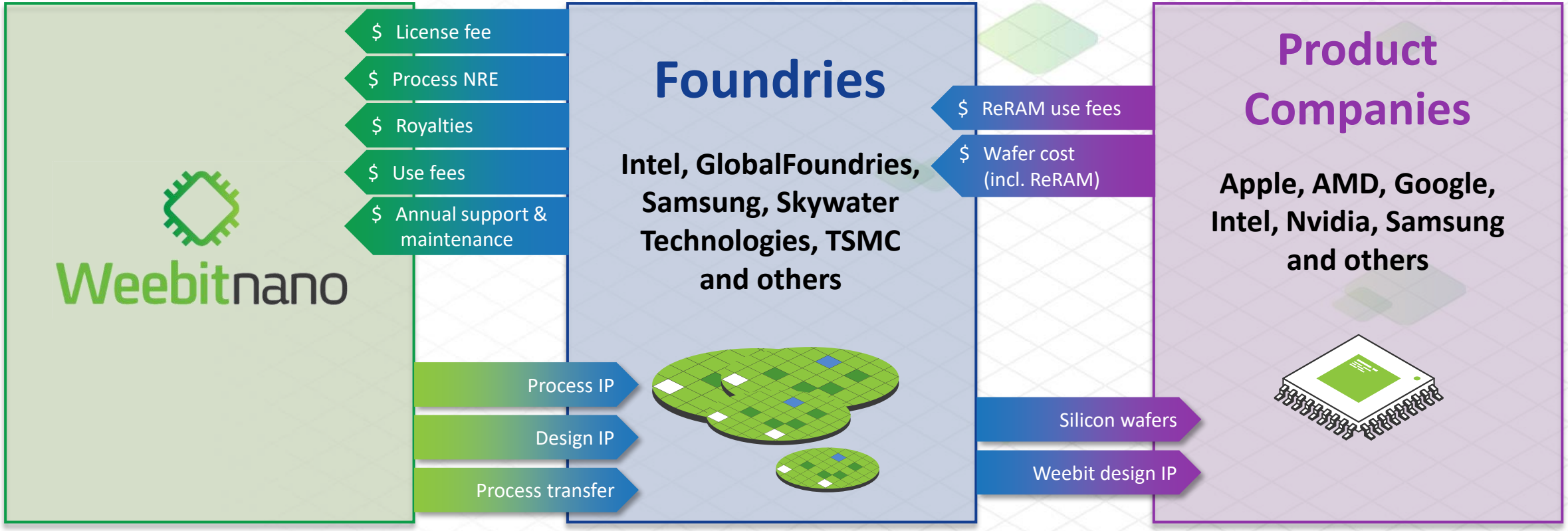


Source: Yole Emerging Non-Volatile Memory 2022

(1) Yole estimates embedded ReRAM market potential based on size of MCU market, adoption rate of ReRAM within the MCU market and average chip area occupied by ReRAM in the respective year

Foundry-centric IP business model for embedded market

- Foundry offers the IP to customers; collects up-front use fees from customers
- Foundry pays royalties based on % of wafer price



Discrete market segment opportunity

The discrete (standalone chips) NVM market is very broad; numerous opportunities for Weebit ReRAM

Market	Applications	Opportunity	Weebit Advantages	Timeline
EEPROM[1]	IoT, Medical, A&D	**$2B in 2021** *1% CAGR 2021-2027*	✓ Die size ✓ Cost	Short-term
NOR Flash	Consumer, automotive & industrial	**$3.5B forecast in 2022** *63% growth in 2021* *6% CAGR 2021-2027*	✓ Ultra-low-power operation ✓ Ultra-low standby current ✓ Die size ✓ Cost	Low densities: short-term Med/high densities: mid-term
NAND Flash	Data storage: on-device or cloud-based	**$67B in 2021** *6% CAGR 2021-2027*	✓ Ultra-low power consumption ✓ Endurance ✓ Cost	Multi Gb dies: longer term
Storage Class Memory (SCM)	Emerging market filling gap between DRAM & NAND storage	**~$925m in 2027** *16% CAGR 2021-2027*		

Weebit has various commercial routes to address the discrete market

- Development / commercialization of own memory chips
- Strategic partnerships with discrete foundries
- Licensing technology to Tier-1 / Tier-2 silicon vendors

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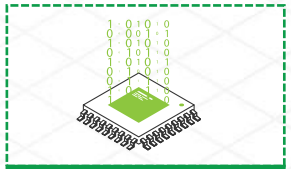
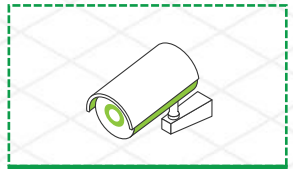
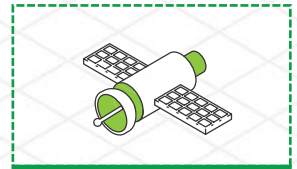
Sources:
https://www.yolegroup.com/product/report/status-of-the-memory-industry-2022/
https://www.yolegroup.com/product/report/emerging-non-volatile-memory-2022/
https://www.electronicsweekly.com/news/business/2021-market-63-2022-06/

(1) EEPROM = Electrically erasable programmable read-only memory

Weebit ReRAM addresses a broad range of application requirements

	 Mixed-Signal / Power Mgmt	 IoT / MCUs	 Edge AI	 Automotive	 Aerospace & Defense
Example Applications	Wireless charging; Motor control	Wearables; Smart cards	Security cameras, Industrial	ECUs for sensors & controllers	Flight safety systems; Satellites
Back-end-of-line tech for easy analog integration	✓				
Cost-efficiency	✓	✓	✓	✓	
Ultra-low power consumption	✓	✓	✓		
Robustness in high temp / extreme environments	✓	✓		✓	✓
Scaling advantage at 28nm and below		✓	✓	✓	
High endurance		✓		✓	✓
Small footprint to store very large arrays			✓	✓	
Longevity		✓		✓	✓
Roadmap to neuromorphic computing			✓		

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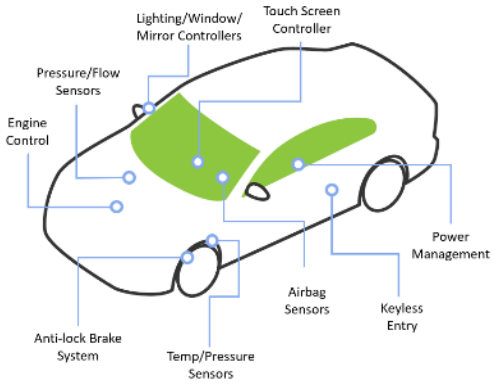
ReRAM adoption is underway in large end markets

Automotive ICs

Weebit ReRAM Advantages vs Flash

- ✓ Safety, security, longevity
- ✓ Reliable in extreme temps, EMI, vibration, humidity, etc.
- ✓ Support fast boot, instant response, frequent OTA updates

Example: Infineon will use ReRAM in its automotive MCUs



Automotive semiconductors: $70 billion by 2027

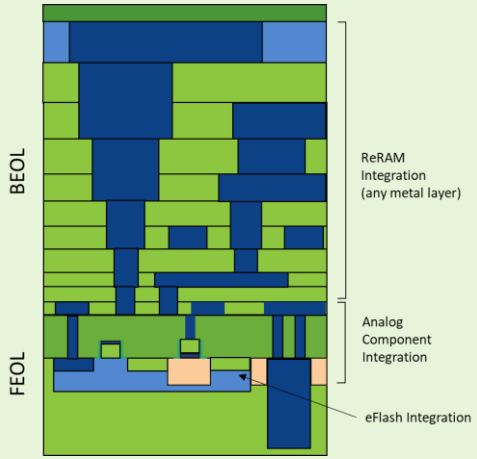
Power Management chips (PMICs)

Wireless charging, motor control, and others

Weebit ReRAM Advantages vs. Flash

- ✓ Embedded flash requires ~10 masks → too expensive
- ✓ ReRAM only 2 added masks → cheap to manufacture
- ✓ ReRAM: No interference with analog integration (embedded flash too difficult to integrate

Example: Call phone and laptop chargers



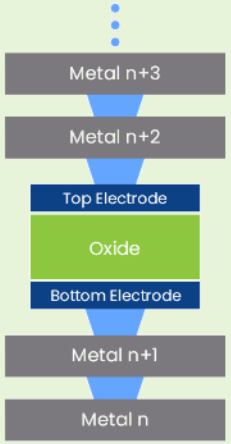
PMICs: $25.5 billion by 2026

Smart Cards / Mobile payments

Weebit ReRAM Advantages vs Flash

- ✓ Embedded flash too expensive to manufacture
- ✓ ReRAM most cost-effective NVM
- ✓ ReRAM deeply embedded within metal stacks
- ✓ MRAM not an option due to EMI
- ✓ Ultra-low power, low voltage

Example: Credit cards



Smart card ICs: $3.9 billion by 2027

Internet of Things (IoT) MCUs

Weebit ReRAM Advantages vs Flash

- Market transition to 22nm and below
  - ✓ Better cost structure and lower power as market transitions to 22nm and below
  - ✓ Maximum system integration; flash must be external below 28nm; ReRAM scales below
  - ✓ External NVM compromises power, speed, security

Example: Wearables, hearing aids, medical devices

Ultra-low-power MCUs: $7.9 billion by 2027

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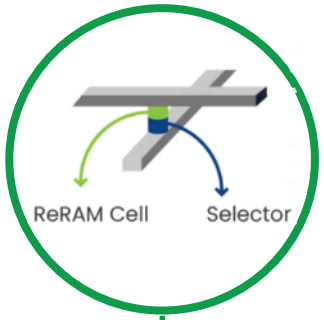
Sources: https://www.marketsandmarkets.com/Market-Reports/automotive-semiconductor-195.html# ; https://www.yolegroup.com/strategy-insights/power-ics-a-21b-market-evident-in-all-applications; https://www.marketsandmarkets.com/Market-Reports/smart-card-ic-market-29374723.html# ; https://www.marketsandmarkets.com/Market-Reports/ultra-low-power-microcontroller-market-206772623.html; https://www.eenewseurope.com/en/fujitsu-takes-nuvoton-reram-to-12mbit/; https://www.tsmc.com/english/dedicatedFoundry/technology/platform_mobile_tech_BCD

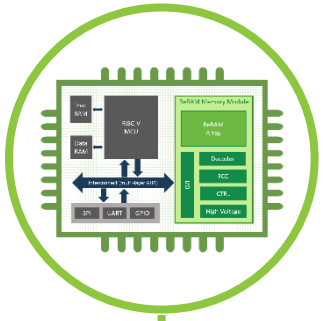
Significant recent progress

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

JUN 2022
ReRAM IP module fully functional, live demonstration



OCT 2022
ReRAM selector can achieve high densities needed for discrete & <u>embedded</u> applications



OCT 2022
Final qualification of ReRAM IP module. Industrial-grade temperatures

skywater TECHNOLOGY

NOV 2022
First production-fab wafers integrating Weebit IP

JAN 2023
Taped out first demo chip in advanced 22nm FD-SOI process

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Successfully completed ReRAM memory module qualification

Qualification is a key step for every semiconductor product on each new target process

Major milestone using Weebit's ReRAM memory module produced at CEA-Leti

Qualified wafers to industry standards

- Endurance
- Industrial robustness

Results driving interest from foundries and customers

- Repeatability
- Uniformity
- Maturity of Weebit's embedded ReRAM

EE News ANALOG

Weebit qualifies ReRAM for production on 130nm process

Technology News | October 31, 2022

By Peter Clarke

Weebit Nano Ltd. (Hod Hasharon, Israel) has qualified its Resistive Random-Access Memory (ReRAM) technology to JEDEC guidelines on a 130nm bulk-CMOS manufacturing process provided by R&D partner CEA-Leti.

The qualification on Weebit demo chips incorporating its ReRAM, was performed based on well-known JEDEC industry standards for non-volatile memories (NVMs). It confirmed the suitability of Weebit's embedded technology for volume production as embedded IP. This is the first full qualification of Weebit ReRAM technology, a key step that must be completed for every semiconductor product on each target process.

Commercial Traction

Based on results, Weebit ReRAM is **being evaluated by several Tier-1 fabs and customers**

Weebit and CEA-Leti are now **qualifying ReRAM** module at higher temperatures and endurance levels – **for advanced applications**

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

September 2021
Signed agreement

June 2022
Completed technology transfer to US production fab

July 2022
Tape-out of memory module

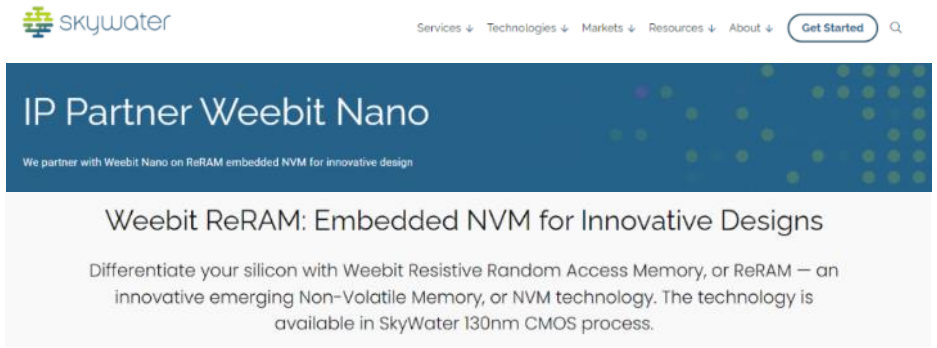
First Weebit ReRAM wafers from a production fab

November 2022
Received 1st wafers from manufacturing

We are here

1H 2023
Fully qualified memory module

Customer wafers with Weebit ReRAM in mass production



www.skywatertechnology.com/ip-partner-weebit-nano

CEO Coby Hanoch holding a SkyWater wafer November 8, 2022

Selector technology development: key for high-density NVMs

Selector is a strategic R&D effort for Weebit and CEA-Leti

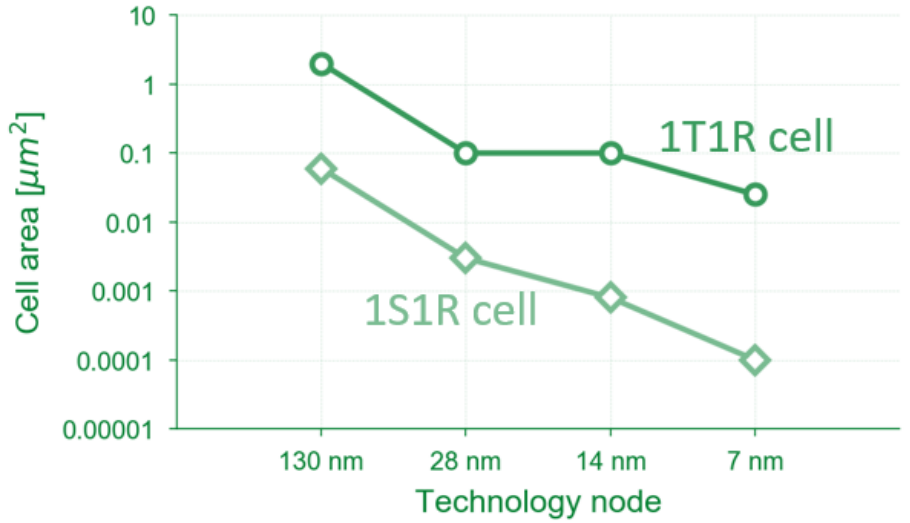
- Enabling high-capacity memory arrays while keeping size and power requirements to a minimum
- Will enable 3D ReRAM in the future

Discrete chips need higher densities than can be achieved with a transistor (1T1R)

- Purpose-built selector (1S1R) enables optimized cell access within a memory array
- Enabling discrete chips while using fab-friendly materials and standard tools

Recent milestone: Weebit ReRAM selector now also suitable for embedded applications

- Opens up new opportunities in areas including AI and automotive



A selector is necessary to scale ReRAM cells

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Taped out Weebit ReRAM demo chip to GF 22nm

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

On-time tape-out of ReRAM IP module in GlobalFoundries' 22FDX™ FD-SOI (fully depleted silicon on insulator) platform

- FD-SOI: high performance at very low voltage/ low leakage; broadly adopted by the industry
- Weebit ReRAM + FD-SOI is ideal for low-power embedded devices

Clear opportunities for NVM at 22nm and below

- Existing embedded flash technology is not a viable option
- Serving various applications including IoT, 5G and AI

Scaling Weebit ReRAM technology to advanced nodes – now targeting sub-22nm

- Weebit is already working on smaller geometries with Tier-1 fabs
- Benefits in terms of memory density

> "The work Weebit and CEA-Leti are doing to make Weebit ReRAM available on GlobalFoundries' 22FDX is a welcome development as we continue to expand the ecosystem around this platform. Embedded NVM is a key element of our customers' designs, but since embedded flash is difficult to scale below 28nm, many customers are looking to NVM solutions such as embedded ReRAM."
>
> – Mike Hogan, Chief Business Officer
>
> GlobalFoundries™

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Weebit is engaged with most top-10 foundries and IDMs

- In different levels of discussion/ evaluation with most of the top fabs
- Expect to sign an agreement with a top fab by mid-year

Top-10 Foundries*

1. TSMC
2. Samsung
3. UMC
4. GlobalFoundries
5. SMIC
6. Hua Hong (HLMC)
7. PSMC
8. VIS
9. Tower
10. DB HiTek

Top-10 Integrated Device Manufacturers (IDMs)(1)

1. Samsung
2. Intel
3. SK Hynix
4. Micron
5. Texas Instruments
6. Western Digital
7. Infineon
8. STMicroelectronics
9. NXP
10. Analog Devices

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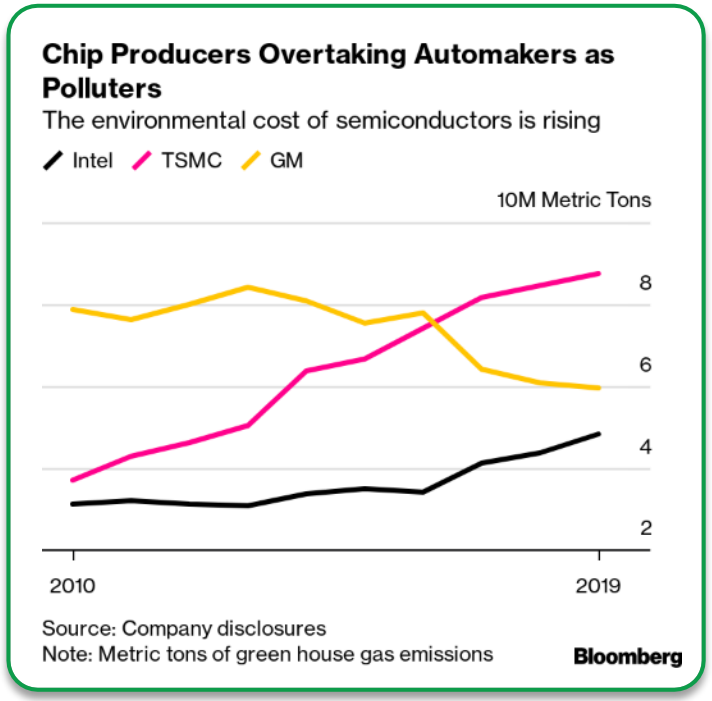
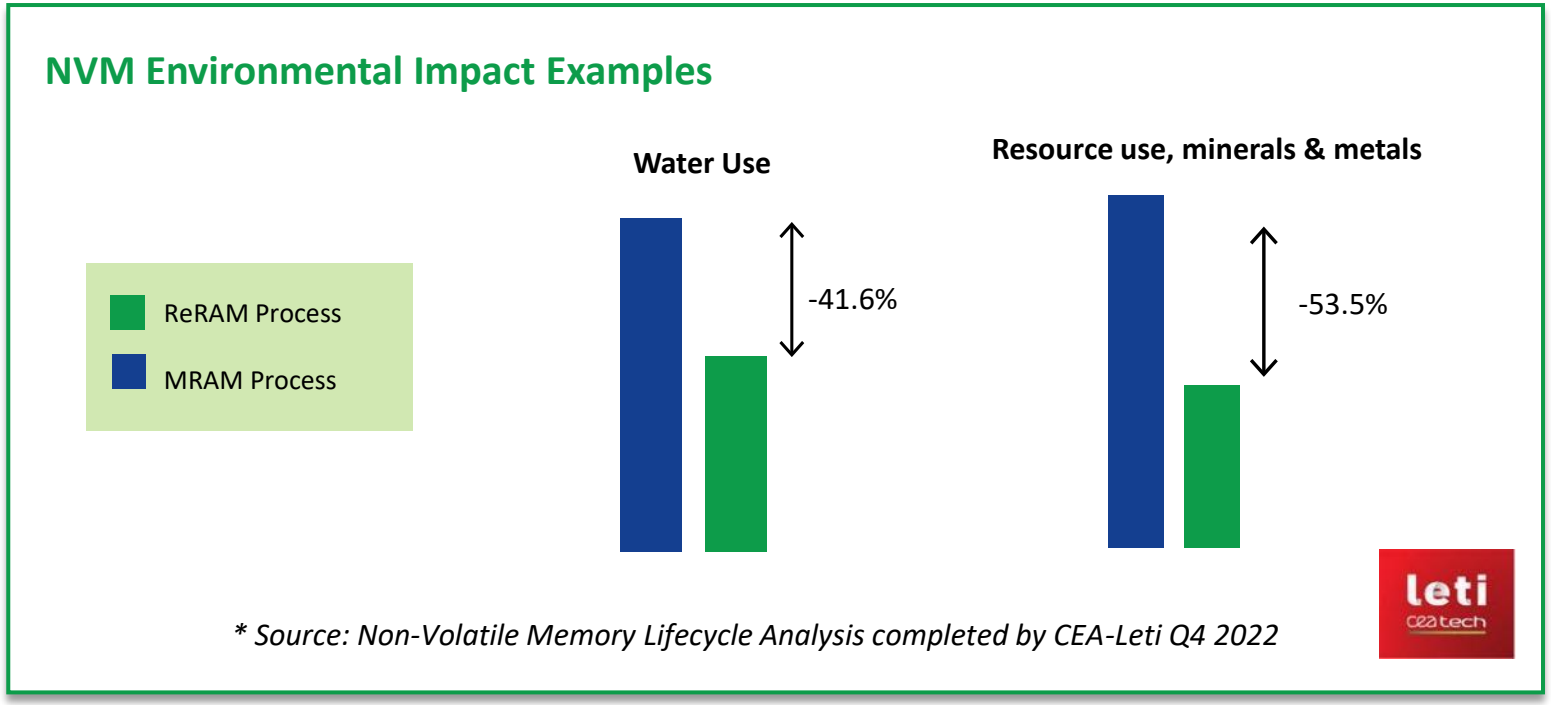
Sources: https://think.ing.com/articles/eu-chips-act-to-strengthen-europes-economy/; https://www.digitimes.com/news/a20220216VL200.html; https://www.gartner.com/en/newsroom/press-releases/2022-04-14-gartner-says-worldwide-semiconductor-revenue-grew-26-percent-in-2021; https://think.ing.com/articles/eu-chips-act-to-strengthen-europes-economy/; public data

(1) By 2021 revenue

Weebit ReRAM: Greener non-volatile memory





- ReRAM has a **lower carbon footprint** vs. flash and MRAM
- Consumes **less electric power** than flash
- Consumes **fewer resources** to manufacture than MRAM and flash
- No issues with materials scarcity; **no rare earth materials**
- Materials have **no contamination risk**
- **Not subject to international conflict**

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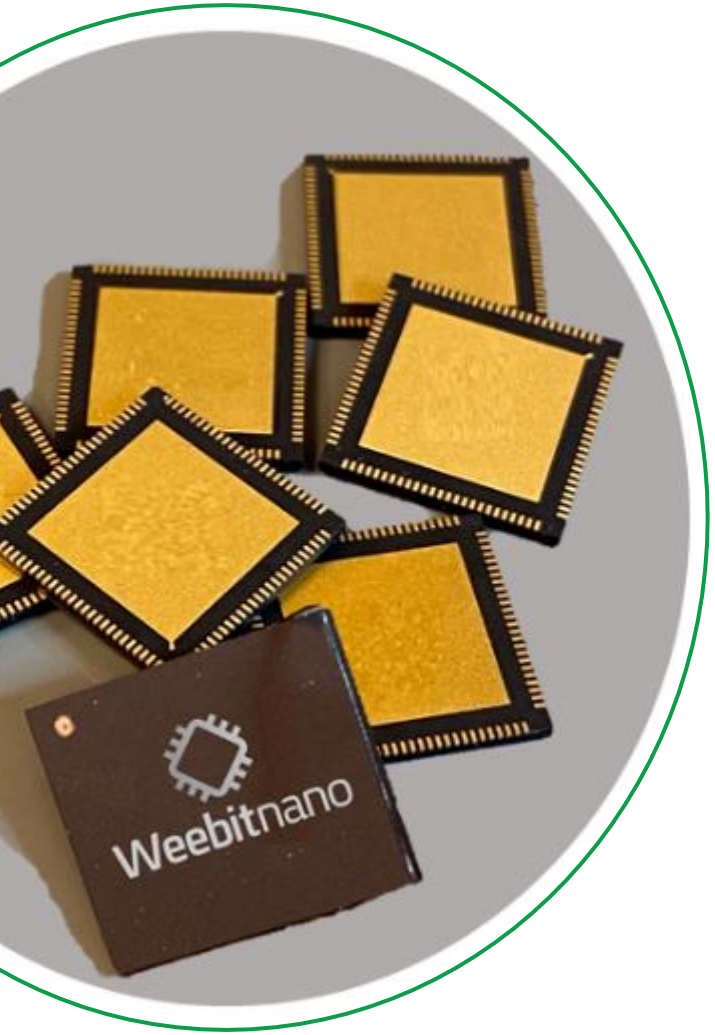
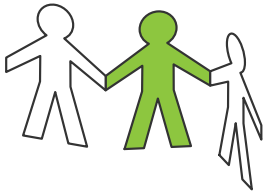
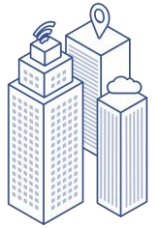
Weebit Nano key targets for 1H23





SkyWater

Conclude qualification of embedded ReRAM module

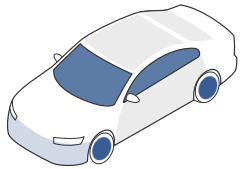


Fab Partners

Sign with a Tier-1 fab

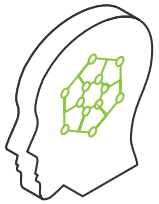
Customers

Close initial agreements



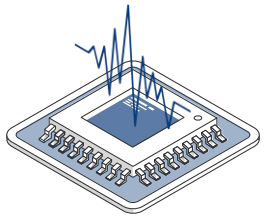
Automotive

Qualify the technology for automotive conditions



Continue R&D

Further technical enhancements to the ReRAM cell and selector technologies



Scaling 22nm

Continue scaling the technology

Key takeaways

Weebit ReRAM: The Next NVM is Here!

The industry needs a new Non-Volatile Memory solution

Weebit ReRAM has unique advantages; is well positioned to replace flash in various markets

Making strong tech progress: 1st wafers from a production fab; qualified based on JEDEC standards

Board & mgmt. have extensive semiconductor commercialisation experience

Weebit is on track to deliver a production solution across a range of high-growth markets

Weebitnano
THE NEXT NVM IS HERE

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