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Weebit Nano Ltd.

A$35.6m raised to expedite growth

Share Price: A$2.66

ASX: WBT

Sector: Technology Hardware & Equipment

16 December 2021

Weebit Nano raised an amount of A$25.7m from major Israeli investors through a private placement and A$9.9m from an oversubscribed entitlement offer. The company plans to utilise this capital towards the growth opportunities planned in the last two years and commercialise its ReRAM technology.

Successful scaling of ReRAM arrays at 28nm

Weebit and CEA-Leti have jointly demonstrated excellent results from the functionality of 1 Mb ReRAM arrays in 28nm technology on 300mm wafers. The technology can be used in a number of applications and may replace existing embedded flash memory wherever it faces challenges below 40nm.

Commercial integration with Leti's selector

Weebit and CEA-Leti have also successfully displayed the commercial integration of an oxide-based ReRAM (OxRAM) cell with an ovonic threshold switching (OTS) selector. The milestone was achieved three months ahead of target. It is the industry's first commercial integration of this sort and is a significant step towards broadening WBT's target market beyond embedded memory to include discrete memory technology, i.e. standalone memory chips that could be used in Storage Class Memory applications, such as storage on mobile phones and laptops as well as in data centers.

Scope of partnership with CEA-Leti expanded

As WBT sees value in its association with CEA-Leti, it has expanded the scope of its strategic development partnership with the organisation. The combination of CEA-Leti's extensive memory research and technical expertise with WBT's cutting-edge technology should help to further enhance its ReRAM technology and support its commercialisation in the next few years.

Valuation of A$4.75 per share

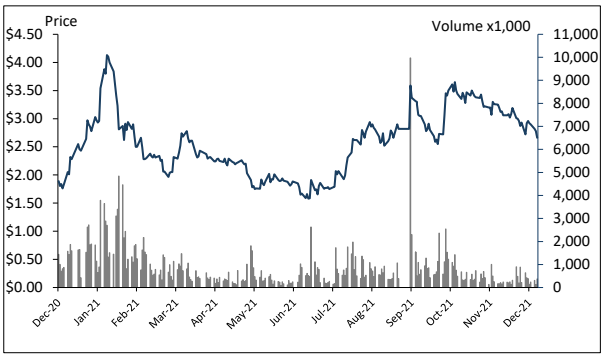
In our research update on WBT from January 2021, available *here*, we valued the company at A$4.75 per share. Despite the increase in the number of shares outstanding, we reiterate our valuation for WBT, specifically because it's closest ASX-listed peer when it comes to commercialisation, BrainChip (ASX:BRN), has seen a strong uplift in valuation recently, helped by a new commercial agreement it just signed with MegaChips in Japan. We believe momentum for the ASX-listed semiconductor stocks that are now commercialising their technology has markedly improved in the course of 2021.

Please see page 6 for an overview of key investment risks.

Market Cap. (A$ m)	400.8
# shares outstanding (m)	150.7
# share fully diluted	206.8
Market Cap Ful. Dil. (A$ m)	550.1
Free Float	100%
52-week high/low (A$)	$4.50 / $1.56
Average daily volume (x1,000)	868
Website	www.weebit-nano.com

Source: Company, Pitt Street Research

SHARE PRICE (A$) AND AVG. DAILY VOLUME (K, R.H.S.)



Source: Refinitiv, Pitt Street Research

Valuation metrics	
Valuation per share (A$)	4.75

Source: Pitt Street Research

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Disclosure: Pitt Street Research directors own shares in Weebit Nano Ltd.

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Raising funds to accelerate growth

Weebit has recently concluded another capital raising, bringing in A$35.6m. A$25.7m of this was raised via a private placement to four Israel-based institutional investors and pension funds, who have substantial technology investment experience. For instance, Meitav Dash, a well-known investor in Israel, has been a key investor in this round. The fact that Weebit has managed to receive funding from Israeli institutional investors shows increasing investor confidence in the company and its technology, in our view.

WBT also raised A$9.9m through an oversubscribed entitlement offer to retail investors. The company issued 3.5m fully paid ordinary shares at an issue price of A$2.84 per share. A sum of A$4.4m was received through entitlements, while the remaining A$5.5m was raised through a shortfall facility available under the offer.

Capital raising will help WBT to enhance its existing technology and capitalise on new commercial opportunities

Weebit plans to use these funds to undertake the growth initiatives that it has been planning for over the last two years. Furthermore, the company will be further enhancing its current technology and capitalise on current and future commercial opportunities. To be more specific, WBT aims to utilise the newly raised funds to:

- Scale its ReRAM technology to smaller geometries (below 28nm),
- Continue development of the discrete memory module,
- Keep improving embedded ReRAM to make it more robust,
- Expedite commercial initiatives, i.e. to speed up new commercial deals,
- Use as general working capital.

Recall that Weebit had raised A$15m in November 2020 to accelerate development of the embedded memory module and commercial activities for the embedded memory market. Over the last year, the company has executed a number of strategic objectives and achieved milestones, including:

- Securing the first commercial deal to license ReRAM technology for volume production with SkyWater Technology,
- Demonstrating excellent results for ReRAM technology at 28nm on 300mm wafers,
- Expansion of the strategic development partnership with CEA-Leti to enhance the ReRAM technology and support its commercialisation.

Given that Weebit has managed to achieve a number of milestones ahead of its targets and competitors, we believe that this recent round of funding will expedite WBT's plans to capitalise on new opportunities and enhance its existing offering, thereby creating value for its investors.

Successful demonstration of ReRAM technology at 28nm with CEA-Leti partnership

Weebit, along with its strategic development partner CEA-Leti, has successfully demonstrated production-level parameters of its ReRAM technology at 28nm. The new 28nm ReRAM arrays can be implemented using a small and power-efficient switching device, with low power and voltage capabilities that can enable an increase in memory density of up to four times.

Successful scaling of ReRAM technology will allow WBT to offer highly competitive embedded memory solutions and address new high-volume markets

This is an important step towards productisation of embedded NVM in different applications, such as artificial intelligence (AI), autonomous driving, 5G and advanced Internet of things (IoT) processors. Since existing flash memory technology has scaling challenges below 40nm, the successful demonstration of production-level parameters at 28nm will allow WBT to offer highly competitive embedded memory solutions that can replace flash memory technology wherever not technically or economically feasible. Also, these improvements will enable WBT to enter and address new high-volume markets that require high-temperature reliability and compatibility for wafer-level packaging.

Successful integration with Leti's selector

Expansion of scope of strategic development partnership with CEA-Leti will be vital in the future enhancement of ReRAM technology and its commercialization

Weebit and CEA-Leti have also successfully displayed the commercial integration of an oxide-based ReRAM cell with an OTS selector. A selector is a key element of a memory chip, which enables optimised cell access within a memory array. It assists in isolating memory cells so that only the specific cells that should be accessed are indeed accessed and all the other cells are not impacted.

This is the industry's first commercial integration of this sort and is a significant step towards broadening WBT's target market beyond NVM to include discrete memory technology. The company managed to achieve this milestone three months ahead of schedule. This underscores that WBT and CEA-Leti have been progressing well in achieving important milestones.

Expanding the scope of the partnership with CEA-Leti

Since Weebit's association with CEA-Leti has been instrumental in the achievement of its recent milestones ahead of schedule, it makes perfect business sense for the company to expand its strategic development partnership with CEA-Leti. Under a new agreement, Weebit will be licensing additional IP from CEA-Leti to continue to enhance the endurance, retention and robustness of its ReRAM technology.

The integration of CEA-Leti's IP has not only improved Weebit's array-level endurance by an order of magnitude, it has also led to an twofold increase in data retention compared to previous results under the same conditions. Furthermore, this partnership will support Weebit's commercialisation activities, while expanding its target and addressable markets. Thus, we expect the expanded scope of IP cooperation between the two companies to play a crucial role in the successful commercialisation of Weebit's technology.

SkyWater to take ReRAM technology to market

With the first commercial deal to mass produce ReRAM technology at SkyWater's fab, WBT is on the path to revenue generation from 2023

Weebit's first commercial deal with SkyWater is a major milestone for the company, providing commercial validation to its innovative technology. This will be the first time the company's cutting-edge ReRAM technology will reach the actual customers and will be mass produced at 130nm. Under the terms of the deal, Weebit's technology will be transferred to SkyWater's fab in the US State of Minnesota to qualify it for volume production. This process will take around 12 months to be completed, post which the technology will be commercially sold to customers. SkyWater will have the license to manufacture WBT's technology and will be able to embed it into the customer's new designs manufactured at the fab. This will ensure a regular stream of revenue for Weebit in the form of royalties and license fees.

Portfolio of patents to protect ReRAM technology

Weebit continues to be focused on building a portfolio of patents to protect its IP. The company has published three scientific papers in association with its partners on ReRAM memory technology advancements. Additionally, the company has filed for eight patents over the last year, five of which are meant to protect its ReRAM device technologies, while the remaining three are aimed at protecting ReRAM design technologies. Of these, four patents have been filed solely by WBT, while the other four have been filed in partnership with the CEA-Leti. More recently, WBT has filed a new patent for optimising ReRAM power consumption.

The Way Forward

In addition to the milestones achieved thus far, the company intends to achieve the following by the end of CY2022:

- Complete the transfer of its embedded ReRAM technology to SkyWater's US production fab,
- Run the qualification process at SkyWater,
- Provide functional test results of its embedded ReRAM module,
- Sign new licensing agreements with customers,
- Continued development of a solution for the discrete memory market.

In short, WBT intends to complete the transfer and qualification process at SkyWater by the end of 2022 so as to start using its technology in SkyWater products, which will trigger the flow of royalties from customer product sales beginning in 2023. The company will also optimally utilise the raised capital to invest in high-end research and development and to improve technological parameters of ReRAM technology to make it more efficient and reliable.

Interview with WBT CEO Coby Hanoch

Weebit Nano CEO Coby Hanoch recently spoke at the Stocks Down Under ASX Semiconductor Conference. Please see the entire interview through the link below.

Valuation for WBT of A$4.75 per share

Fair value of A$4.75 per share reiterated

In our research update on WBT from January 2021, available here, we valued the company at A$4.75 per share using semiconductor industry M&A transactions and parallels to ASX-listed peer BrainChip (ASX:BRN).

Following the commercial agreement with SkyWater and despite the recent increase in the number of shares, we reiterate our A$4.75 per share valuation. WBT's closest ASX-listed peer when it comes to commercialisation, BrainChip (ASX:BRN), has seen a strong uplift in valuation recently, helped by a new commercial agreement it just signed with MegaChips in Japan.

We believe momentum for the ASX-listed semiconductor stocks that are now commercialising their technology has markedly improved in the course of 2021.

Key investment risks

- Although WBT is getting closer to commercialisation, the company has yet to qualify the technology in SkyWater's manufacturing facilities, which involves execution risk. Hence, there is a risk that the potential of WBT's technology may be delayed or may not eventuate.
- Alternative emerging memory technologies are being developed by WBT's competitors. These technologies could potentially be superior in nature and/or could be commercialized sooner than WBT's technology, which would inhibit the company's future growth. However, apart from 4DS Memory (ASX:4DS), we don't see the other ReRAM players (Crossbar and Adesto) as potential competitors. Crossbar seems to have "evaporated" with no significant business activity in the last 18 months, while Adesto was acquired by Dialog for an EV of US$500m (A$758m at the time), specifically for its IP in the IoT space. Its ReRAM technology is only used internally and not licensed out at this stage.
- Although WBT now seems adequately funded for the medium term, the company may need to raise further capital. That may be required, for instance, if its current development programs and technology transfer/qualification take longer than currently anticipated or multiple growth opportunities arise, resulting in dilution for existing shareholders (albeit at offer prices reflecting the company's progress).
- COVID-19 is still posing a risk to WBT's research partner Leti in France as new lockdowns may be needed to stem the renewed increase in the rate of infections in France. Additionally, potential inability to travel may pose challenges to WBT's technical and commercial people in its conversation with partners and prospects, which may slow down further commercialisation.

Please refer to www.pittstreetresearch.com for our initiating coverage report on WBT, including more elaborate risk assessments.

Appendix I – ReRAM technology

ReRAM technology: The right balance between Flash memory and DRAM

ReRAM is a fast, cost-effective and energy-efficient NVM technology. It can be considered a hybrid memory technology, as it is non-volatile like Flash memory and nearly as fast as DRAM, which is volatile, i.e., a DRAM cell will lose the value (1 or 0) that is stored if the power is switched off. WBT is developing SiOx ReRAM, which, in terms of performance metrics, sits right between Flash and DRAM.

How does it work?

Generally, in case of NAND Flash memory, the values of 1 and 0 are attributed on the basis of the trapped electrical charge present in the memory cell's floating gate. However, in case of a ReRAM cell, the values (1 and 0) are attributed based on the resistance level of the cell material sandwiched between the two electrodes (Figure 1). A value of 1 is attributed to a state of low resistivity, while a value of 0 is attributed to a state of high resistivity.

There are two ways of changing the resistance level of a ReRAM cell.

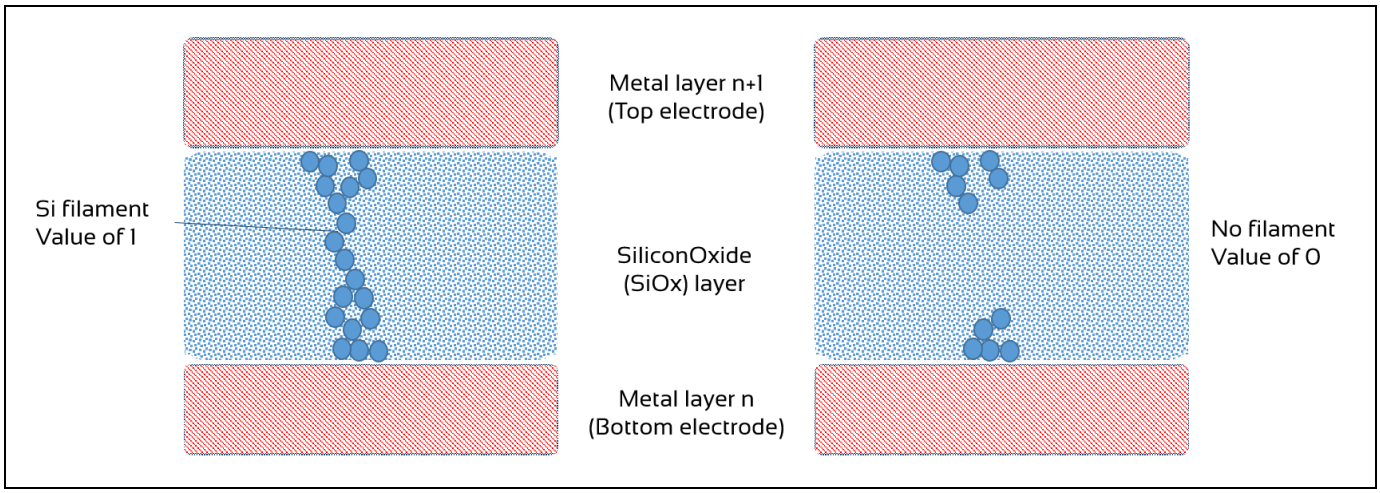
i) Through interface switching, which changes the resistivity of the entire layer between the electrodes or

ii) By creating a filament that connects the two electrodes.

WBT uses the latter.

The technology WBT is developing is based on the forming of a conductive channel between the two metal electrodes of a ReRAM cell. These electrodes are typically made of metals, such as titanium, tungsten, aluminium or copper. The conductive channel is formed inside a non-conductive SiOx layer.

Figure 1: Cell switching by forming and breaking a silicon filament in a SiOx switching layer



Source: Pitt Street Research

SiO_x has typically been used as an insulating component in semiconductor manufacturing. However, by applying a certain voltage to one of the electrodes, a switchable conductive pathway of silicon nanowires (filament) can be formed within the SiOx layer (Figure 1). In this high-conductivity, low-

resistance state, the cell value is 1. By subsequently applying a reverse voltage to the electrode, the filament can be broken down again, effectively switching the memory cell back to the original state of 0.

The actual filament is formed as the applied electrical voltage strips away some of the oxygen atoms in the SiOx layer, leaving the silicon atoms to cluster and form a conductive silicon pathway to the other electrode. The filament is ~5 nanometer (nm) to 7nm in diameter.

WBT uses SiOx in its ReRAM cells, a material that is understood well by the semiconductor industry and has been used in chip manufacturing for decades. We believe that the industry's familiarity with SiOx is a key factor in driving the adoption of WBT's technology among both semiconductor design houses and foundries.

ReRAM's technical parameters validate its commercial use

The endurance and retention levels demonstrated by WBT's technology open up many commercial opportunities

The key parameters for any non-volatile memory are retention and endurance. As demonstrated in the tests conducted by WBT's research partner Leti in May 2019, the company's ReRAM technology is at the forefront of the ReRAM market. The tests demonstrated data retention of over 10 years at 130-150°C, and endurance of a million cycles. Notably, these endurance levels are significantly higher than today's state-of-the-art Flash memory technologies.

Moreover, the retention levels that were achieved at these high temperatures have broadened the scope of potential commercial applications wherein WBT's technology can be used, including the most notable addressable market of electric vehicles.

Additionally, prospective customer XTX has independently verified and validated WBT's technology as well, providing sufficient validation of the technology, in our view.

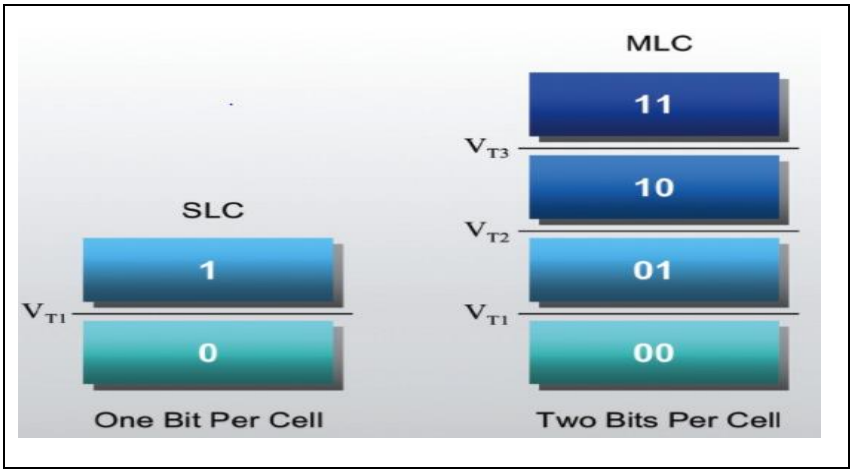
Appendix II – MLC technology

MLC technology: Putting more data in the same cell is another way to increase density

Traditionally, memory cells had two possible states, 1 and 0, and therefore could contain 1 bit of data. These cells are termed as single-level cells (SLC). However, now MLCs are available wherein the stored charge can be a variety of values and 2 bits of data can be stored in a single cell (Figure 2). MLC technology thus allows more data per unit of area to be packed on to a chip compared to SLC.

Typically, the cycling endurance and reliability required in end-user applications determine the appropriate storage technology to be used. SLCs have lower power consumption and therefore a longer lifespan compared to MLC (~100,000 cycles for SLC versus ~10,000 for MLC). Owing to higher reliability and faster speeds, SLC can be found in high-end storage applications, including data centre storage. However, MLCs are less expensive to manufacture per unit of storage and this makes MLC Flash the most used Flash, especially in consumer electronics such as mobile phones, cameras and tablets.

Figure 2: Relative voltage levels for SLC and MLC



Source: Pitt Street Research

Appendix III – Analyst Certification

Marc Kennis, lead analyst on this report, has been covering the semiconductor sector as an analyst since 1997.

- Marc obtained an MSc in Economics from Tilburg University, Netherlands, in 1996 and a post graduate degree in investment analysis in 2001.
- Since 1996, he has worked for a variety of brokers and banks in the Netherlands, including ING and Rabobank, where his main focus has been on the technology sector, including the semiconductor sector.
- After moving to Sydney in 2014, he worked for several Sydney-based brokers before setting up TMT Analytics Pty Ltd, an issuer-sponsored equity research firm.
- In July 2016, with Stuart Roberts, Marc co-founded Pitt Street Research Pty Ltd, which provides issuer-sponsored research on ASX-listed companies across the entire market, including technology companies.

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