PITT STREET RESEARCH

Weebit Nano Ltd

In the driver's seat post cap raise

Share Price: A$0.32

ASX: WBT

Sector: Technology Hardware & Equipment

22 July 2020

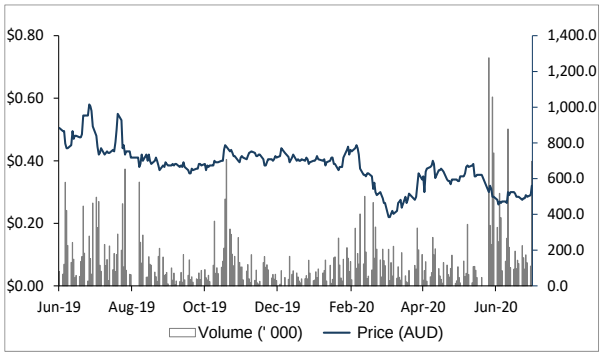
Weebit Nano (ASX:WBT) is focused on the commercialisation of its proprietary SiOx-based ReRAM (Resistive Random Access Memory) technology, which has applications in both the discrete and embedded memory markets. The company has signed collaboration agreements with potential customers across China (XTX Technology and SiEn Integrated Circuits) and South Korea and expects to sign commercial agreements with some of them before the end of Q2 2021.

Management has an impressive track record of meeting or exceeding development timelines. The ongoing COVID-19 crisis has impacted the operations of WBT, but the company is committed to not delaying the project timelines beyond the delays caused by COVID-19. WBT plans to demonstrate its ReRAM cell for the discrete memory market by mid-2021.

Market Cap. (A$ m)	25.9
# shares outstanding (m)	89.4
# share fully diluted	99.5
Market Cap Ful. Dil. (A$ m)	28.8
Free Float	100%
52-week high/low (A$)	0.59 / 0.20
Average daily volume (x1,000)	144.7
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

A$9m cap raise puts WBT in charge of own destiny

The company recently raised $9.1M from an institutional placement and a strongly oversubscribed SPP. The funds raised will be vital to simultaneously support the growth plans for the embedded and discrete memory modules. We believe tight budgets and a low share price have held back WBT's progress in recent months. The fresh funds should help the company drive its development programs full speed ahead.

Promising market for ReRAM applications

We expect that embedded ReRAM applications will present the first commercialisation opportunities for WBT. The market for embedded ReRAM is expected to post strong, long-term growth as it starts complementing some of today's mainstream memory technologies, such as NOR Flash and SRAM with the potential to replace NOR Flash in certain applications. Additionally, we believe entry into the discrete memory segment, driven by the XTX Technology collaboration, has exponentially expanded WBT's total addressable market.

Valuation metrics	
Valuation per share (A$)	1.36

Source: Pitt Street Research

Valuation of A$1.36 per share

WBT is moving rapidly towards commercialisation, with the expected delivery of its first memory module by end-2020. Its strong partnerships and focus on continuous technical refinement through its French development Partner Leti, strengthen the investment case. Following WBT's recent capital raise and share issue, we adjust our valuation to A$1.36 per share (A$1.65 previously).

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Weathering the COVID-19 impact

The ongoing COVID-19 crisis has impacted the operations of Weebit Nano (WBT), and the shutdown of the Leti facility cause some delays in the project plan. The company has also bolstered its financial resources to ensure that it has sufficient funds to support both its key projects that have reached a critical juncture.

Impact on key project timelines

In Q4 2019, the resources for development of the embedded memory module were temporarily reallocated, when the company was focusing on external validation activities with XTX Technology for the discrete/ standalone memory module. However, management remains committed to the embedded memory project and is aiming for the first commercial or strategic agreement before the end of Q2 2021.

On the other hand, WBT initially aimed to demonstrate Resistive Random Access Memory (ReRAM) for the stand-alone (discrete) memory market by mid-2021. However, development work has been delayed by a quarter due to the temporary shutdown of Leti's (WBT's French development partner) operations in light of COVID-19. Management is actively discussing ways to cover lost ground with Leti.

Management aims to reach commercialisation stage with some of its key customers by Q1 2021

Currently, following the government's directives, WBT's operations in Israel and France (Leti) are continuing remotely. In addition, operations at partner firms in China (XTX Technology and SiEn Integrated Circuits) have resumed after months of lockdown.

Overall, we believe that WBT is in a strong position operationally as it has a track record of meeting or exceeding development timelines. We expect limited impact on planned milestones, given the fact that management has been proactively optimizing its operations during the current crisis.

A$9.1M equity injection to fund growth plans

WBT has taken several steps to increase its financial flexibility in these uncertain times. Management has rationalised operating expenses, which has included Directors not drawing salaries, travel freeze, employee salary cuts and all bonuses being put on hold. As at 31 May 2020, the firm had a sufficient cash balance of A$2.4m to support three quarters of business activity.

A$9.1M capital raise will allow supporting both memory projects simultaneously

More importantly, on 15 June 2020, WBT has secured commitments from existing and new sophisticated and institutional investors to raise approximately A$6.6M via a two-tranche placement. Tranche One has recently been completed and resulted in the company having raised approximately A$2.2M before costs. Tranche Two shares are expected to be issued on 24 July 2020. Investors will also receive one placement option for each placement share. The placement options will be exercisable at $0.45 each with an expiry date of 18 months from issue.

In conjunction with its A$6.6M placement to institutional and sophisticated investors, WBT has also successfully undertaken a Share Purchase Plan (SPP) to raise approximately A$2.5M. The SPP was initially envisaged to offer each of its existing eligible shareholders an opportunity to subscribe for up to $30,000 of SPP shares at the same issue price of $0.28 per share as the placement to raise $500,000, with the attaching options under the same terms as the placement options. However, on 20 July 2020, WBT announced that its SPP was oversubscribed due to strong shareholder support, with receipt of around A$2.75M from eligible shareholders. As a result, the company has resolved to increase the amount raised under the SPP from its

original A$500,000 mark to approximately A$2.5M. Following the SPP, around 9 million of new shares with attaching options are expected to be issued on 24 July 2020.

The combined A$9.1M raised from the institutional placement and the SPP will be utilised for accelerating the development of the memory module, including hiring more engineers and marketing staff. We believe the capital raise will be a critical steppingstone to achieve the management's target of signing commercial agreements with key customers before Q2 2021.

SiOx ReRAM demonstrates its capability in AI applications

On 21 July 2020, WBT announced that it has presented a joint research paper with Politecnico di Milano (Polimi), a leading European university in Italy at a premier global semiconductor conference in June. The joint research paper outlines an Artificial Intelligence (AI) system that combines Polimi's software design and WBT's SiOx ReRAM, the outcome of which enables the hardware to learn new things without forgetting previously acquired information. Effectively, this AI system, which is built on WBT's SiOx ReRAM technology, is capable of transforming Polimi's design into a brain-like product. Further, the high accuracy of the system has been validated by standard databases.

New ReRAM simulator model to expedite lab to fab process

WBT, in partnership with Silvaco, aims to aims to accelerate the integration of its memory modules to more advanced semiconductor designs. With the release of Silvaco's advanced Technology Computer-Aided Design (TCAD) solution 'Victory Device', the process of transferring WBT's technology to production fabs will be significantly simplified through the elimination of expensive and time-consuming experimental wafers.

Further, it enables original equipment manufacturers (OEM) to embed ReRAM technology more efficiently in their designs, leading to shorter product development schedules and reduced technology testing stages. We believe this is another important step by WBT to accelerate the incorporation of ReRAM technology by a larger number of OEM customers.

High potential for emerging memory technologies

The market for emerging memory technologies is forecasted to reach ~US$36bn in 2030 as per research firm Objective Analysis and Coughlin Associates. This represents growth of ~12 times as compared with the ~$US3bn market size in 2018. The advent of artificial intelligence and the Internet of Things necessitates higher bandwidth, more power efficiency and scalable memory to process the dense and complex data. Newer technologies such as 3D XPoint, MRAM and ReRAM are expected to gradually complement and, in some cases, even replace traditional storage technologies such as NOR flash and SRAM.

Many advantages to ReRAM over traditional memory and storage technologies

ReRAM is also often cited as a logical replacement in Solid State Drive (SSD) and Non-Volatile Dual In-line Memory Modules (NVDIMMs) because of its high storage density. The other benefits of ReRAM include 3D packing, allowing large numbers of memory cells layers to be coordinated and organised in one chip, fast switching for quick exchange of information and using less energy per switching cycle.

ReRAM has the potential to replace flash memory used in mobile phones and other consumer electronics, such as MP3 players. However, it is still very

much in the research and development phase.[1] Apart from WBT, other small companies working to commercialise ReRAM include Crossbar[2]. According to a report by Objective Analysis and Coughlin Associates entitled "*Emerging Memories Ramp Up*", emerging memory market is expected to reach $20 billion by 2029, largely by displacing today's less efficient memory technologies such as NOR flash and static random-access memory (SRAM).[3]

SiOx ReRAM can be easily integrated into existing processes

Another major advantage, specifically of SiOx ReRAM, is the fact that all materials used in the manufacturing process are already being used by semiconductor fabs today. There is no need to introduce new materials to the production process that would potentially require a redesign of existing products or their production process because of interference or "side effects" caused by the new materials in the chip.

Conclusion and Valuation

WBT is progressing well on commercialisation of its SiOx ReRAM technology, with multiple collaboration agreements in place for embedded as well as discrete memory segments. The company's recent capital raising will provide funds to support both its memory programmes and will be an important milestone to reach commercialisation before Q1 2021.

Importantly, we believe a major hurdle in WBT's development timelines, i.e. tightness of funds, has been removed.

Additionally, the continuous technical refinements being made with Leti provide a solid foundation for WBT. A potential earlier entry into the stand-alone memory segment has also exponentially expanded WBT's total addressable market, while the collaboration with SiEn Integrated Circuits may lead to joint manufacturing by the end of this year.

Following WBT's recent capital raise and new shares being issued as a result, we adjust our valuation to A$1.36 per share (previous: A$1.65 per share). We expect the share price to be re-rated when the company succeeds in closing its initial commercial agreements.

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

[1] https://www.eetasia.com/is-reram-ready/
[2] A company based in Santa Clara, California. Crossbar develops a class of non-volatile resistive random-access memory technology.
[3] https://www.eetimes.com/are-emerging-memories-finally-emerging/

Appendix I – 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 equities 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.

Appendix II – SiOx ReRAM technology

ReRAM technology: The right balance between Flash memory and DRAM

ReRAM is a fast, cost-effective and energy-efficient non-volatile memory (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 silicon oxide (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). 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.

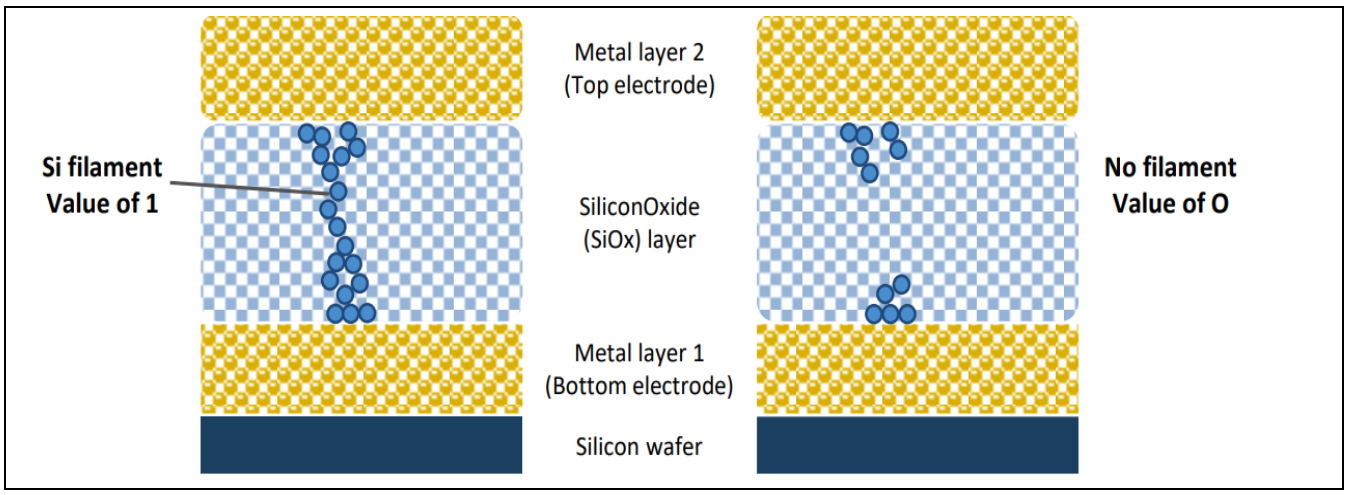
There are two ways of changing the resistance level of a ReRAM cell.

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

SiOx 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). 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 approximately 5 nanometer (nm) to 7nm in diameter.

WBT uses SiOx in its ReRAM cells, a material that is well understood 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 manufacturers and foundries.

SiOx 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 automotive/electric vehicles.

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