PITT STREET RESEARCH

Weebit Nano Ltd.

Pivotal deal with SkyWater

Share Price: A$3.05

ASX: WBT

Sector: Technology Hardware & Equipment

20 September 2021

Weebit Nano (ASX:WBT), developer of an emerging Non-Volatile Memory technology, called Resistive RAM (ReRAM), announced its first commercial deal with US-based foundry SkyWater Technology (NASDAQ:SKYT).

Broken through the vicious circle

We believe this deal will turn out to be pivotal for WBT given that the company has now broken out of a vicious circle typical for semiconductor development companies, i.e. many potential customers for WBT's ReRAM technology would have said that although the technology is extremely interesting, there was no fab where it could be manufactured. Similarly, foundries like SkyWater would have told WBT that while they like the technology, there were no customers for it just yet.

This circle has now been broken and the SkyWater deal opens up to path to revenue generation for WBT.

Now the hard work starts

On the road to monetisation, WBT will now start with the technology transfer from Leti's facilities to SkyWater's fab and the subsequent qualification process, which should take about twelve months. Once qualified, WBT's ReRAM technology can be sold commercially to SkyWater's customers as well as customers referred to SkyWater by WBT. This should drive additional license fees and, more importantly, recurring revenues from royalties.

We expect additional customers in the medium term

Although it will be all hands on deck for WBT to work through the technology qualification process with SkyWater, we believe the company will have the capacity to execute multiple onboarding programs simultaneously. In other words, we expect WBT's commercialisation efforts to continue unabatedly, which may result in additional customers in the next twelve months.

Valuation of A$4.75 per share

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

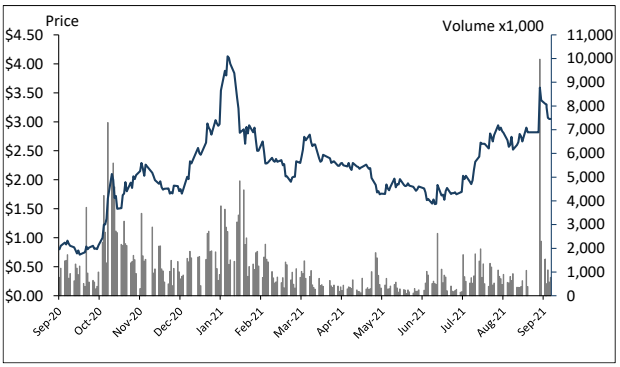
Following the commercial agreement with SkyWater, we reiterate our $4.75 per share valuation.

Please see page 7 for an overview of key investment risks.

Market Cap. (A$ m)	376.1
# shares outstanding (m)	123.3
# share fully diluted	171.5
Market Cap Ful. Dil. (A$ m)	523.0
Free Float	100%
52-week high/low (A$)	$4.50 / $0.69
Average daily volume (x1,000)	1,143
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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First deal brings validation and revenues

SkyWater licenses WBT's technology and will transfer the technology to its fab

On 9 September 2021, Weebit Nano (ASX:WBT) signed it's first commercial aggreement to bring its Resistive RAM (ReRAM) technology to market. NASDAQ-listed semiconductor foundry SkyWater Technology (NASDAQ: SKYT) has licensed WBT's technology in order to use it with its customers' designs. Additionally, WBT's technology will be transferred to SkyWater's fabrication facility (Fab) in the US state of Minnesota to qualify it for volume production in SkyWater's 130nm Complementary Metal-Oxide Seminconductor (CMOS) process.

We believe this first commercial deal is pivotal for WBT as it provides third-party validation of the technology, which will likely attract more semiconductor companies, i.e. potential customers. Additionally, the deal provides WBT with a first pathway to revenues.

What is a foundry?

SkyWater Technology is based in Minneapolis, Minnesota (USA) and operates a semiconductor foundry. Foundries manufacture computer chips for third-parties, such as electronics companies and fabless chip companies. This latter group consists of companies that design computer chips, but don't own their own manufacturing facilities. Examples include Nvidia and Broadcom that sell their designs to a range of different verticals within the electronics industry, such as Telecom, Industrial and Automotive.

In the early days of semiconductor foundries, i.e. the 1980's and early 1990's, these companies were typically not operating at the leading-edge of chip design. However, the world's largest semiconductor foundry, Taiwan-based TSMC, pioneered a model whereby the foundry would become increasingly sophisticated in terms of in-house design capabilities. Foundries started to spend more money on R&D and, over the years, built up very elaborate portfolios of intellectual property (IP) so that customers could increasingly rely on their foundry partner to provide IP blocks for their designs.

Foundries have evolved into full-blown technology partners

Consequently, these days, foundries are much more than just an outsourcing partner for chip production. They enable customers to develop and test new chip designs that can subsequently be brought to market much faster than in the past. In order to do that, a foundry requires an elaborate IP library, top notch customer IP security and constant innovation in order to stay relevant in the market place. Enter Weebit Nano.

Who is SkyWater Technology?

Foundries have evolved into full-blown technology partners

SkyWater was spun-off from Cypress Semiconductor, a leading US semiconductor manufacturer, in 2017. Cypress itself was acquired by Infineon in 2019 in the great semiconductor consolidation wave of the last several years. The company listed on NASDAQ in April of this year at US$14 per share and is currently trading around US$30, which gives it a market capitalisation of US$1.2BN. It is expected to generate US$176m in revenues in FY21 (ending December).

SkyWater operates two 200mm facilities, in Minnesota and Florida, and positions itself as a Technology Foundry, offering its customers ways to incorporate new manufacturing materials, packaging techniques and technologies as well as agile manufacturing capabilities to bring it all together. Because of the way it has developed and secured its infrastructure and business processes to secure customer IP, the company is Defense Microelectronics Activity (DMEA) certified. This means that it can tailor to US Aerospace and Defence customers that in turn sell to the US military.

Friends in high places

The United States has lost its lead in chip manufacturing

Over the last 30 years, the center of gravity of the global semiconductor industry has increasingly shifted to Asia, with a large role currently being played by the Taiwanese semiconductor industry. Currently, the US accounts for just 12% of global semiconductor manufacturing, compared to 37% in 1990. On top of that, with China trying to assert more control over Asia in recent years, the big fear is that Taiwan will, at some point, lose its independence from China.

The US is too dependent on Asian manufacturing

In order to preempt the massive fallout that will present to the global semiconductor industry and to make the US generally less dependent on non-US semiconductor manufacturing capabilities, the United States has embarked on a US$52bn investment plan backed by Presidential Executive Order, for US-based semiconductor research, design and manufacturing[1].

As one of less than 100 DMEA accredited companies, we believe SkyWater is very well-positioned to benefit from these investments, both on the R&D and the manufacturing side. Case in point is the SkyWater-manufactured semiconductor wafer US President Biden showed while he unveiled his plans (Figure 1). In other words, we believe WBT couldn't have picked a better partner to do its first commercial deal with.

Figure 1: US President Biden showing a SkyWater manufactured wafer

Source: Associated Press

Deal consists of various elements

There are several elements to the agreement between WBT and SkyWater, which are all standard in the semiconductor industry.

License fees

Firstly, there is a license fee that SkyWater will pay to WBT to use WBT's IP. This is a fee that is typically paid at the start of a commercial relationship and usually varies between a few hundred thousand dollars to anywhere between

[1] National Defense Authorization Act (2021) effectively funds the CHIPS for America Act (2019)

$1m and $2m, depending on the type of technology and the scope of the license agreement.

The second element is the transfer of WBT's technology from WBT's and Leti's development environment to the production environment of SkyWater's fab in Minnesota. This transfer basically involves making sure that the production recipe and manufacturing process steps that were followed in Leti's fab are replicated in a way that leads to the exact same outcome in SkyWater's fab. And because SkyWater will likely use a slightly different tool setup compared to Leti, this may mean that WBT and SkyWater will need to tweak the recipe a little bit.

Tweaking the manufacturing process during the transfer

For instance, because Leti and SkyWater may use deposition tools from different suppliers, gas exposure times and/or gas quantities in the vaccuum chambers may need to be slightly different in each production line to grow the exact same layer on the wafers. We estimate that this technology transfer could take a few months.

The qualification process will take about 12 months

Once the technology is transferred to SkyWater, the company will need to qualify it in its fab. This means WBT's ReRAM technology will need to be designed into a test-chip. SkyWater will then need to manufacture dozens of semiconductor wafers in order to verify that the dies (chips) on those wafers are functional and within specifications. On top of that, all chips need to demonstrate uniform, predictable, performance with a minimal failure rates. This will like take several iterations in which constant improvements will be made until the desired results are achieved. Given that it typically takes several months for a semiconductor wafer to be manufactured, WBT aims to have the entire qualification process completed by the end of 2022.

This qualification process will need to be done once per fab. After that, the process can be used for all production runs in that fab, regardless of who the customer is. In other words, SkyWater will be able to use the process for all of its customers unless they want significant changes to the design in which case that new design will need to be requalified.

If and when WBT signs an agreement with another foundry or chip manufacturer, the entire process will need to be qualified in that company's fab though.

Breaking the vicious circle and industry capacity shortages

Royalties from volume production

Once the qualification process is complete, the technology is ready for volume production, which is when the company will be able to generate recurring royalties from each chip that is sold and that uses WBT's technology. WBT has already stated it has started talking to prospective customers about using its technology in their designs and manufacturing at SkyWater. We believe that SkyWater and WBT will now actively start selling the technology to prospective customers so they will be ready to manufacture when qualification ends at the end of 2022.

This deal is pivotal for WBT

And this is why WBT's deal with SkyWater is pivotal for WBT. Up to the moment that SkyWater signed the deal with WBT, many potential customers for WBT's ReRAM technology would have said that although the technology is extremely interesting, there wasn't a fab where it could be manufactured. Similarly, foundries like SkyWater would have told WBT that while they like the technology, there were no customers for it just yet. This is a vicious circle that many semiconductor development companies struggle with.

Additionally, The extreme COVID-induced shortage of semiconductor manufacturing capacity globally has made actual production capacity very valuable to chip manufacturers. Rather than qualify a new technology in their

fab, they would rather be running their production lines at full speed and continue to print money while the good times last.

Breaking through the vicious circle and overcoming capacity shortages

Through the deal with SkyWater, WBT has broken through the vicious circle of customers versus production while overcoming the reluctance of a foundry to give up production capacity to qualify a new technology. Now both companies can cooperate in selling WBT's technology to SkyWater's customers as well as potential customers WBT approaches on its own.

The pathway to revenues from this deal

Summarising the various commercial elements of the SkyWater deal, WBT should see the following revenue components going forward:

- License fee from SkyWater in payments based on milestones defined between the companies
- License fees from customers who want to use WBT's technology in their products
- Non Recurring Engineering fees from customers who want tailored memory modules, potentially starting late 2022.
- Royalties from customer product sales starting in 2023

Next steps in the commercial rollout

Conversations with other potential customers to continue unabated

Even though WBT's first technology transfer and qualification process will take time and will require a certain amount of staff to complete, we believe there's room for the company to potentially run multiple of these processes simultaneously. In other words, we expect WBT to go full steam ahead with its commercial conversations with other potential customers. We expect additional commercial deals may eventuate between now and the completion of the SkyWater qualification process.

Interview with WBT CEO Coby Hanoch

We recently spoke to WBT CEO Coby Hanoch about the SkyWater deal and the timelines to get to commercial production. Please see the entire interview through the link below.

Valuation for WBT of $4.75 per share

Fair value of $4.75 per share reiterated

In our research update on WBT from January 2021, available here, we valued the company at $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, we reiterate our $4.75 per share valuation.

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 Internet of Things (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, 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 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 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 2). 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.

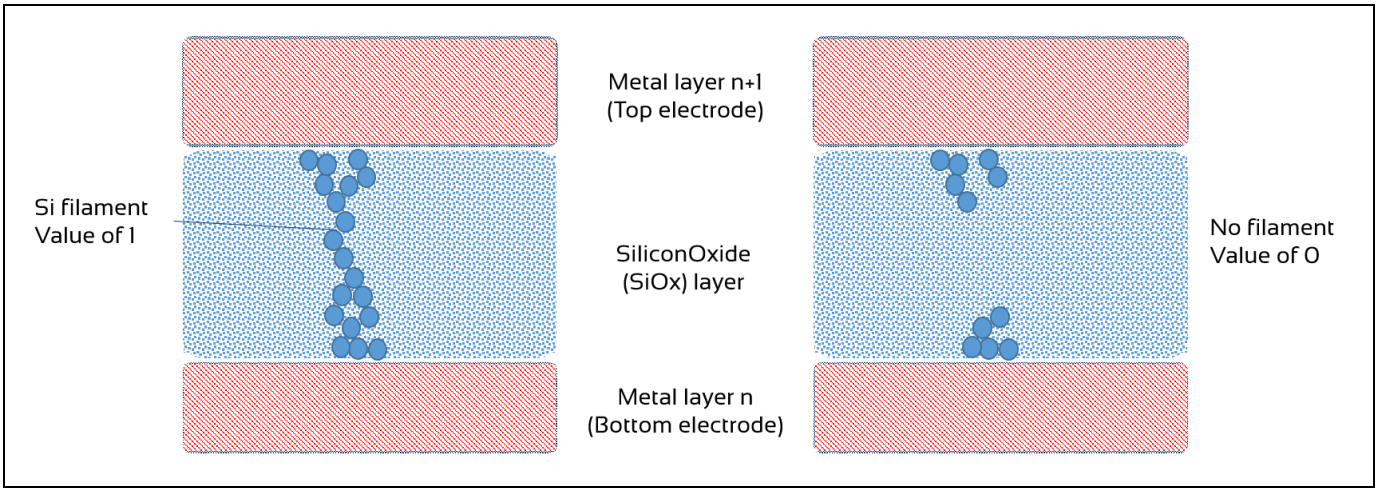
i) Through interface switching, which changes the resistivity of the entire layer between the electrodes or

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 2: 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 2). 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 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 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.

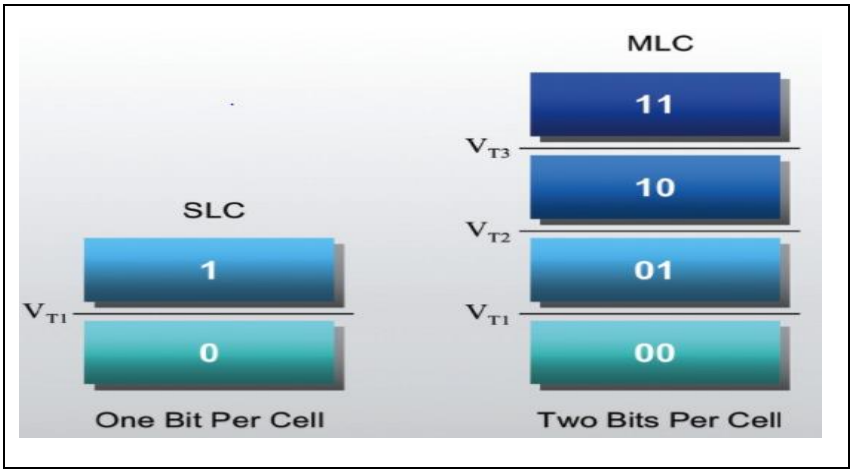
Appendix II – MLC technology

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 3). MLC technology thus allows more data per unit of area to be packed onto 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 center storage. However, MLCs are less expensive to manufacture per unit of storage and this makes MLC Flash the most commonly used Flash, especially in consumer electronics such as mobile phones, cameras and tablets.

Figure 3: 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 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.

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