1414 Degrees Limited

Initiation: innovative silicon-based thermal energy storage system to harness low-cost renewable power

We initiate coverage of 1414 Degrees ltd. (ASX: 14D, "14D") with a risked target valuation of A$0.175/sh, offering 303% upside from the current share price. 14D is an industrial technology company aiming to deliver decarbonised high-temperature heat energy which can displace the burning of fossil fuels across multiple applications. Industrial heat accounts for ~20% of global energy-related CO2 emissions, often involving "hard-to-abate" processes, making the sector a high-priority for innovative solutions to cut its carbon-footprint. 14D has developed a silicon-based thermal energy storage technology, SiBrick™, which allows heat to be sourced from low-cost renewable electricity and stored for later use. The SiBricks will be used in the SiBox® thermal energy storage system, which exploits the high melting point and latent heat capacity of silicon, delivering carbon-free, reliable, high-temperature industrial heat supply. Based on real-world electricity prices, 14D estimates its system could deliver a levelised cost of heat ("LCOH") of ~US$50/MWh, making it competitive with burning gas, before considering carbon savings.

Long Duration Energy Storage opportunity; renewable energy price disparity

As the world shifts from fossil fuel-based energy systems to low-carbon alternatives, long duration energy storage ("LDES") technology is expected to play a pivotal role in addressing the variability of renewable energy generation, enhancing grid reliability, and capturing power price arbitrage opportunities, whilst supporting the decarbonisation of the energy system. In our view, 14D stands out amongst its Thermal Energy Storage ("TES") peers due to its ability to deliver consistent, very hot air, making it applicable to a broad range of industrial processes such as cement, alumina and steel production.

Milestones on path to commercialisation could catalyse share price

The Company has made significant progress in the development of the SiBox technology over the last decade, evidenced by the commissioning of a 1 MWh SiBox demonstration module ("SDM") in 2023. 14D has partnered with Woodside Energy Technologies, a wholly owned subsidiary of the Australian oil and gas company, Woodside Energy, which will co-fund the SDM and pay A$2m at project milestones. Additionally, 14D has secured a A$2.2m grant from the Australian Government, to accelerate the commercialisation of its SiBox technology. These partners also offer potential future funding opportunities, thereby limiting 14D's R&D and capex burden. The successful delivery of the SDM will, in our view, validate the technology's viability and should expedite commercialisation.

Aurora a potential valuation kicker, pending transmission line access

Alongside its core TES business, 14D is joint owner of the Aurora Energy Project ("Aurora"), a proposed hybrid renewable power plant in South Australia, supported by LDES capacity. While Aurora is 14D's most immediate prospect for revenue generation, the project is dependent on approvals from BHP Group Limited ("BHP") for transmission line access and financial projections have not been disclosed. As such, our 14D valuation does not include Aurora, despite clearly offering upside potential.

Valuation: A$0.175/sh target price for 303% upside potential

While 14D has developed valuable intellectual property ("IP") in the design of the SiBrick, the manufacture of the bricks should be simple and scalable through existing refractory producers. The modular SiBox system is also engineered to be right-sized and retro-fitted into existing industrial facilities. We therefore believe 14D's IP and technical knowledge will allow it to pursue a "capex-light" growth model with two key revenue-streams: licence fees for SiBox systems and royalties on SiBrick sales. Based on our DCF model, including the roll-out of 1 GWh per annum of SiBox storage by 2031, we derive an $NPV_{10\%}$ for 14D of A$118m, to which we apply a target P/NPV of 0.3x giving a risked value of A$0.175/sh, 303% above the current share price. Please see Investment Risks on pg 28.

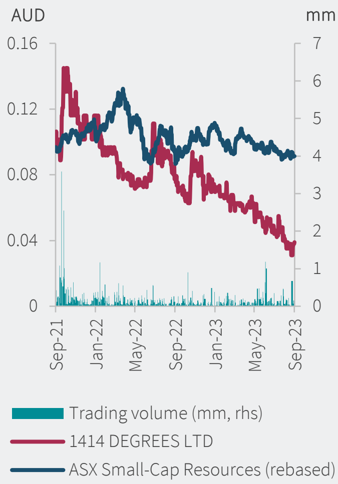
GICS Sector	Materials
Ticker	ASX: 14D
Market cap 2-Oct-23 (US$m)	6.57
Share price 2-Oct-23 (A$)	0.043
Target price 31-Jun-24 (A$)	0.175

+303%

Upside from current share price to our A$0.175/sh risked NPV

8,000 TWh

SiBox's addressable market size



The cost of producing this material has been covered by 1414 Degrees Limited as part of a contractual engagement with H&P Advisory Ltd.

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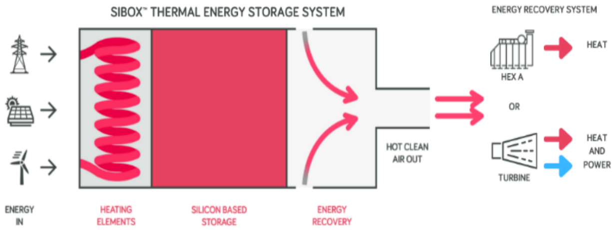
Contents

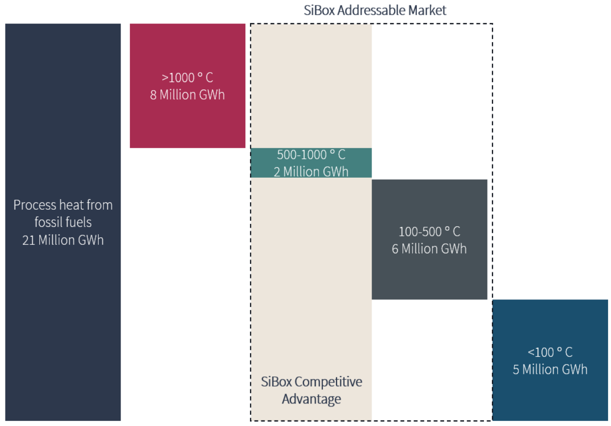
Key Charts

1414's SiBox Thermal Energy Storage System Process



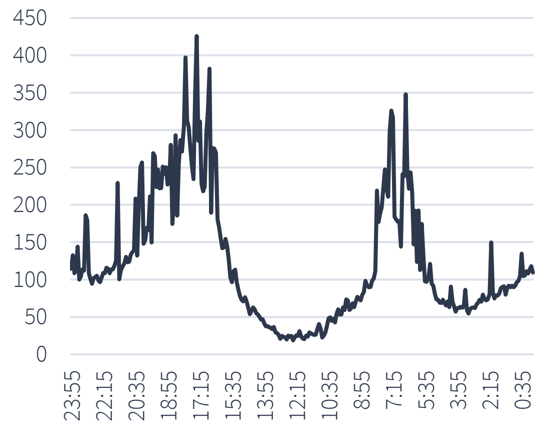
Source: Company reports

SiBox Addressable Market



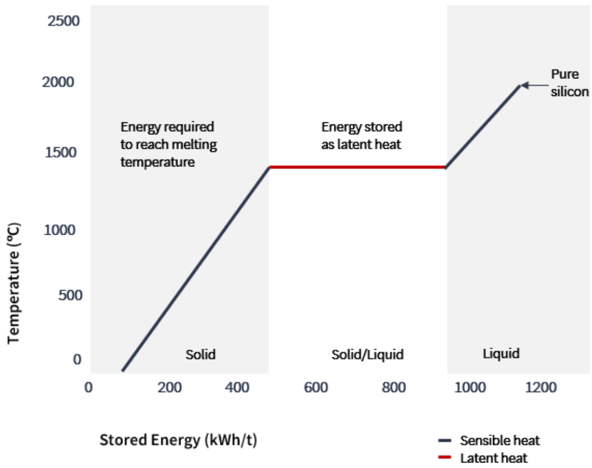
Source: Company reports

South Australia average intraday wholesale electricity pricing from Dec'22 to Aug'23 (A$/MWh)



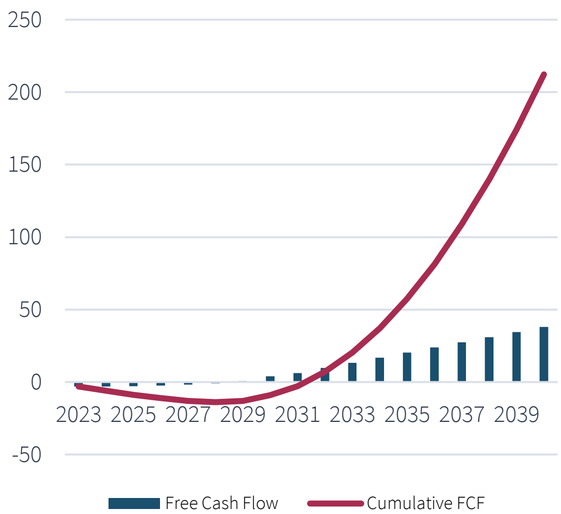
Source: H&P estimates

Process of latent heat storage



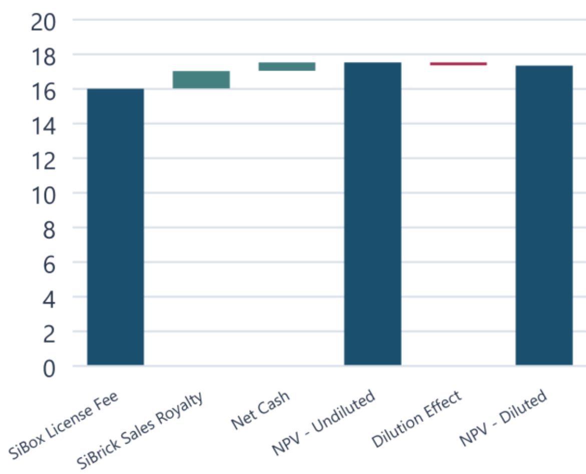
Source: Company reports

FCF and cumulative FCF



Source: H&P estimates

SOTP Valuation: A0.175/sh target price



Source: H&P estimates

Company Overview

1414 Degrees – Decarbonised heat for industrial processes

1414 Degrees Limited (ASX:14D, "14D") is an ASX-listed public company, with a mission to deliver decarbonised high-temperature heat energy for industrial applications. The Company has developed a silicon-based thermal energy storage technology, the SiBrick™, which allows heat to be sourced from low-cost renewable electricity, contributing to the decarbonisation of the global energy system. The SiBricks will be used in the SiBox® thermal energy storage system, designed to harness the high latent heat capacity of silicon, delivering carbon-free, reliable industrial heat supply. Silicon's high melting point – 1,414 °C – allows the system to supply very hot air, hot enough to be used as an alternative to burning fossil fuels.

The Company has made significant progress in the development and commercialisation of the SiBox technology, evidenced by the commissioning of a 1 MWh SiBox demonstration module ("SDM") in 2023. The successful delivery of the SDM will validate the technology's viability and should expedite commercialisation. Aside from the SiBox, 14D purchased the Aurora Energy Project ("AEP"), Australia in 2019. The primary focus of the project is to establish a hybrid renewable energy power plant, ensuring a reliable electricity supply to the region and the national electricity market ("NEM").

The development of long-duration energy storage ("LDES") solutions will be a key pillar of the energy transition, in our view, enabling the rollout of renewable power and the capture of arbitrage opportunities presented by fluctuations in electricity pricing. 14D stands out amongst its Thermal Energy Storage ("TES") peers due to its ability to deliver high and consistent temperatures, making it applicable to a broad range of "hard-to-abate" industrial processes, such as cement, steel and alumina production. Based on real-world electricity prices in South Australia the company has estimated its system could deliver energy at a levelised cost of heat ("LCOH") of US$~50/MWh, making it competitive with burning gas, before considering potential carbon cost savings.

While 14D has developed valuable intellectual property ("IP") in the design of the SiBrick, the manufacture of the bricks should be simple and scalable through existing refractory producers. The modular SiBox system is also engineered to be right-sized and retro-fitted into existing industrial facilities. We believe 14D's IP and technical knowledge will allow it to pursue a "capex-light" growth model with two key revenue-streams: licensing fees for SiBox systems (with third-party EPCMs managing the actual installation) and royalties on SiBrick sales.

Based on our DCF model, using highly provisional – but in our view achievable – assumptions, including the roll-out of 1 GWh of SiBox storage by 2031, we derive an unrisked NPV for 14D of A$58m to which we apply a target P/NPV of 0.3x to give a risked target of A$0.175/sh, 303% above the current share price.

Decarbonising the Global Energy System

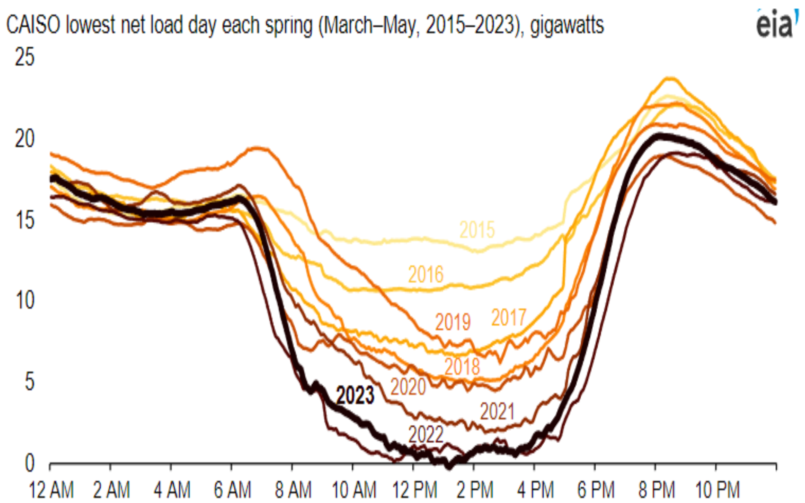
Eight years after the Paris Agreement, the world is falling short of its climate goals to hold temperature rises "well below 2˚C", while "pursuing efforts" to keep them below 1.5˚C. Despite mounting pressure for nations to reduce emissions, the International Energy Agency ("IEA"), reported that global energy-related emissions of CO2 hit a record high last year. Achieving net-zero emissions by 2050 necessitates a transformation of the energy sector, driven by greater development and integration of renewable energy sources.

Intermittency and the Duck Curve create arbitrage opportunity

However, increasing the share of renewables in the energy mix presents certain challenges and opportunities. Notably, renewable energy sources are inherently unpredictable, intermittent, and non-dispatchable, creating a mismatch in energy supply and demand over multiple timescales, albeit with a fairly predictable daily pattern. Unlike conventional energy sources, such as fossil fuels, renewable sources cannot be readily adjusted to balance fluctuating demand. This divergence in dispatchability can result in energy waste, grid instability, and reliance on backup power sources – limiting the ability to shift away from the burning of fossil fuels.

Illustrating this challenge, the 'Duck Curve' below shows intra-day fluctuations in power demand net of low-cost renewable supply, which in effect equates to the demand for reactive fossil-fuel based power. This creates large swings in whole-sale power prices on a predictable daily cycle (albeit with seasonal variations in amplitude). The shape of the curve tracks diurnal energy demand, with a peak at the beginning of the day, followed by a significant drop in demand around noon, when solar power generation is at its peak. As the renewable curve drops off during the evening hours, demand ramps up and fast reacting solutions (likely fossil fuels) are required to maintain grid frequency and fill the gap. Conversely, during periods of high production or low demand, renewables are curtailed, to maintain the balance between supply and demand.

As solar capacity grows, duck curves are getting deeper in California



Source: California Independent System Operator (CAISO)

Electricity arbitrage involves buying or storing electricity when prices are low and selling or using it when prices are high. During the midday period when solar generation exceeds demand, electricity prices may be low or even negative due to oversupply, the optimal time to buy and store excess electricity. During the evening peak when electricity prices surge, stored electricity can be used or sold at a premium. The duck curve's daily fluctuations create opportunities for energy storage and price-based trading. By strategically storing and releasing electricity to align with the duck curve, renewable energy use is optimised, reliance on fossil fuels is reduced, costs savings can be realised, whilst the integration of renewable energy sources into the energy mix is supported.

Thermal Energy Storage: a critical piece of the LDES landscape

Various promising, flexible Long Duration Energy Storage ("LDES") solutions have emerged to address major energy transition challenges and balance the future energy system. These technologies are designed to store energy in various forms and, when required, provide a continuous supply of electricity or heat over timeframes spanning hours, days, or seasons. 14D's SiBox sits within the Thermal Energy Storage ("TES") category; we address the remaining three broad categories of LDES - chemical, electrochemical, and mechanical - from page 35. Each offers versatile solutions to address different energy storage requirements. We view the development of LDES, alongside the widespread adoption of renewable energy sources, as a critical solution for the transformation of the global energy system.

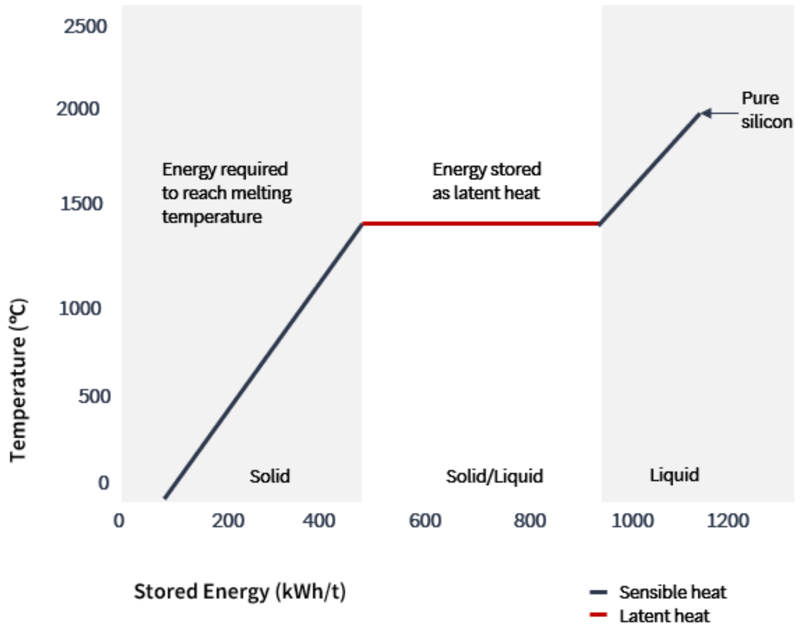
Decarbonisation of Industrial Heat required to meet Net Zero goals

TES addresses both power and heat decarbonisation, delivering electricity or heat at its rated capacity for extended durations. Utilising renewable energy sources to heat or cool a storage medium, TES systems store thermal energy to be discharged at a later time for heating or cooling applications and power generation. TES applications enable the storage of heat over varying time scales, ranging from intra-day, daily, weekly, to even inter-seasonal storage and operate across a large temperature spectrum.

Latent heat storage

The three subtypes of thermal heat storage systems are sensible heat storage, thermochemical heat storage and latent heat storage. Latent heat storage centres on the use of Phase-Change Materials ("PCM"). PCMs store and release thermal energy during the phase transition (e.g. from solid to liquid and vice versa), without a change in temperature. Latent heat provides high energy storage density, able to store more energy, with a smaller footprint. It also has the advantage of remaining at a consistent temperature as energy is added to or discharged from the system.

The process of latent heat storage



Source: Company reports

The physical and chemical properties of silicon are particularly useful in the design of a latent heat-based system, due to its ability to store a significant amount of energy during the phase change from solid to liquid – as illustrated by the flat portion of the chart above. Silicon's high melting-point also means energy can be delivered at a consistently high temperature, comparable to that generated by burning fossil fuels, making it appropriate for industrial applications. This contrasts with sensible heat-based systems – i.e., systems where changes in energy can be "sensed" in the form of a change in temperature – which by definition will deliver heat at varying temperatures depending on where they are in their charging/discharging cycles.

Carbon-free Heat On Demand

14D's thermal energy storage system is the renewable-powered SiBox. The SiBox is designed to convert electrical energy into heat energy which can be stored for later use, exploiting the high latent heat capacity of silicon. The ability to charge and discharge the system at the same time offers significant flexibility in use, allowing excess renewable energy to be consumed while it is cheap, and provide carbon-free, consistent, and high temperature heat on demand. This innovative technology offers a breakthrough in decarbonising industrial processes which currently rely on burning fossil fuels. The SiBrick is the core of the SiBox technology, both modular and scalable in design, with high energy density and efficient heat transfer properties. The SiBox, as a complete TES system, incorporates the proprietary SiBrick technology and is designed to retrofit into industrial processes and used for new systems going forwards. The current SiBox can be set to deliver constant, hot clean air, up to 900°C and with expected efficiency >90%. Reaching such temperatures is critical in decarbonising hard to abate sectors, including cement, alumina, and iron/steel.

Multiple revenue stream, capex-light model for industrial clients

14D's' business model is built on a strategic licensing framework, licensing its innovative technology to existing refractory plants and third-party engineering companies. In our view, this model will allow the Company to scale production capacity without significant upfront capital exposure, whilst receiving a steady cash flow from the licensing fee, as well as benefiting from the existing infrastructure and expertise of its partners. It also enables 14D to remain focused on research and development, driving continuous enhancements to its product offerings.

Refractory plants

14D signed a strategic partnership agreement with leading European developer and manufacturer of refractory products for high temperature industrial processes, Refratechnik-Steel GmbH ("Refratechnik"), in Jul'23. Refratechnik will trial mass manufacture 600 SiBricks, with each brick storing at least 1 kWh of usable energy at maximum output temperature. Following manufacturing, the bricks will undergo rigorous cycling in air at 14D's facilities, to ensure adequate performance. Refratechnik will have first right to manufacturing SiBricks for commercial scale SiBox installations. This approach eliminates the need to build production facilities, thereby removing a significant scale-up barrier to manufacturing large storage capacity.

In exchange for the use of 14D's proprietary SiBrick formulation, it is anticipated that refractory makers would pay a royalty to 14D on the sale of each brick. This should provide upfront revenue for 14D, as the bricks are produced and sold to end customers for use in the SiBox system; the delivery of replacement bricks could also provide a follow-on revenue stream, although 14D currently estimates each SiBrick could have an impressive useful lifespan of 20-25 years.

Third-party engineering companies

14D's business strategy entails licencing its SiBox technology to third-party engineering supply companies, responsible for the construction and maintenance of industrial plants. By doing so, the Company will expand its market reach and foster partnerships to drive the widespread adoption of its technology. A key design advantage of the SiBox is its ability to be retrofitted to existing industry processes.

This optionality minimises disruptions during the transition to the new technology, whilst also permitting industries to retain gas burning as a backup or adjunct to the SiBox technology. We anticipate the industrial user would pay an annual, capacity-linked licence fee for the use of the SiBox system, potentially directly to 14D or via the engineering contractor. This would provide a steady revenue stream to 14D with limited upfront investment or working capital required.

We believe 14D's business model gives the Company an excellent opportunity to leverage its technical skills and allow its experienced licensing partners to focus on the manufacturing and fitting of the technology. 14D's adoption of the capital-efficient approach not only minimises significant upfront capital exposure but also drives the pathway to commercialisation.

The Benefits of SiBox

While the technology remains at a relatively early stage of development and commerciality has yet to be fully demonstrated (see Investment Risks on pg. 28), the SiBox offers a range of compelling benefits over the use of fossil fuels, positioning itself as a reliable and efficient solution for providing clean heat to industrial sectors.

- High and stable temperature heat: The SiBox's high operating temperature exceeds the capabilities of current commercial alternatives (>800°C). Notably, the SiBox stands out for its capability to deliver high-temperature heat continuously, utilising the latent heat of silicon. These high temperatures are a requirement for several industrial processes. The SiBox can also be charged and discharged simultaneously, ensuring 24/7 high-temperature energy supply.

- Secure energy supply: The inherent variability of wind and solar power creates imbalances in the power system, and the SiBox's ability to store energy for prolonged periods addresses these fluctuations. TES ensures a reliable source of energy during periods of high demand or energy supply disruptions, safeguarding against price volatility and supply shortages.

- Longevity: The silicon-based storage media is designed for a life expectancy of 20-25 years, without any significant degradation in capacity over time – providing a truly reliable and sustainable solution.

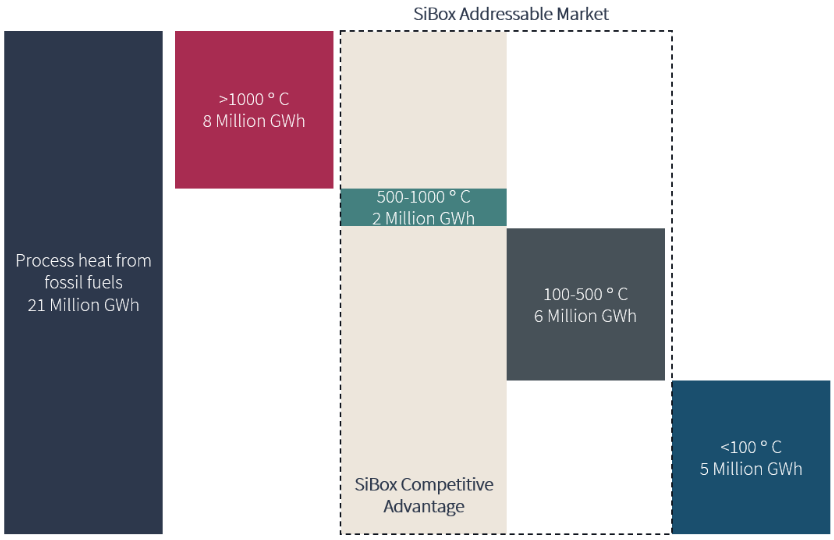
- Cost saving: Charging during periods of lower electricity prices allows the SiBox, in theory, to reduce the cost of industrial process heat and capture the upside of electricity price disparity, establishing its economic viability as a replacement for fossil fuels. As discussed further below, 14D estimates SiBox could already deliver a levelised cost of heat below that of natural gas in several jurisdictions, before taking into account additional savings such as carbon taxes and emissions trading schemes / carbon credits.

- Efficient: The SiBox is expected to deliver thermal efficiency exceeding 90% based on one cycle per day.

- Scalable and Flexible: The modular and scalable nature ensures flexibility and adaptability, allowing customers to optimise their energy systems, which hare flexibly configured to suit a wide variety of applications.

Market Size: Industrial High Temperature Heat

SiBox Addressable Market



Source: Company reports

Industrial energy consumption is still dominated by fossil fuels such as natural gas, coal, and diesel, and in 2022, the industry sector accounted for about a quarter of energy-related CO2 emissions. A key challenge lies in decarbonising high-temperature industrial heat, which currently lacks commercially viable alternatives to fossil fuels. However, 14D's TES system offers a unique solution to the challenge of decarbonising heat. The SiBox's addressable market is a substantial 8 million GWh, with the technology holding a competitive advantage in temperatures ranging from 500 – 1,000°C, an annual market size of 2 million GWh. The TES system has the potential to replace a significant amount of fossil fuel consumed by global heat-related industries by enabling a shift to electrical heating.

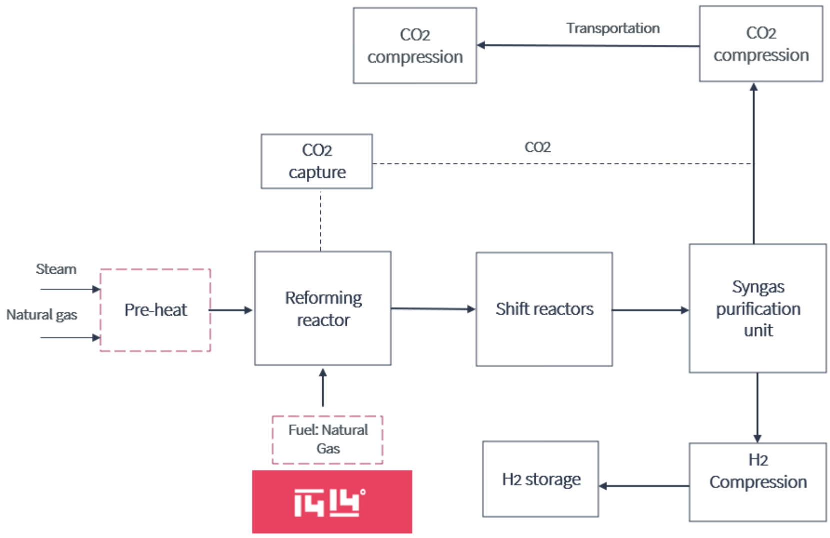
Target Markets

Low-Carbon Hydrogen	Alumina	Cement	Direct Reduced Iron
• Natural gas steam methane reforming (SMR)	• Bauxite —BAYERS→ Alumina —HALL HEROULT→ Aluminium	• 4.1bt produced in 2022	• Iron ore → Direct Reduced Iron → Steel
• 70mt produced in 2022	• 140mt produced in 2022	• 4,300 TWh of thermal energy required	• 150mt produced in 2022
• 900 TWh of thermal energy required	• 440k GWh of thermal energy required	• Up to 5% thermal energy provided by SiBox	• 100 TWh of thermal energy required
• Up to 100% thermal energy provided by SiBox	• Up to 75% (100% digestion, 37% calcination) thermal energy provided by SiBox	• ~115 MW SiBox per million tonne of clinker produced	• Up to 100% thermal energy provided by SiBox
	• ~250 MW SiBox per million tonne produced		• ~75 – 100 MW SiBox per million tonne produced

Source: Company reports

Potential use cases

Low-Carbon Hydrogen



Source: Company reports

Low Carbon Hydrogen

Steam methane reforming ("SMR") is a process in which methane from natural gas, reacts with high-temperature steam to produce hydrogen and carbon dioxide as a waste product. This is known as 'grey' hydrogen. While this process generates significant carbon emissions, carbon capture and storage ("CCS") technology can be implemented to store produced CO2 underground. The product is then known as 'blue' hydrogen; however, this comes with a significant extra cost.

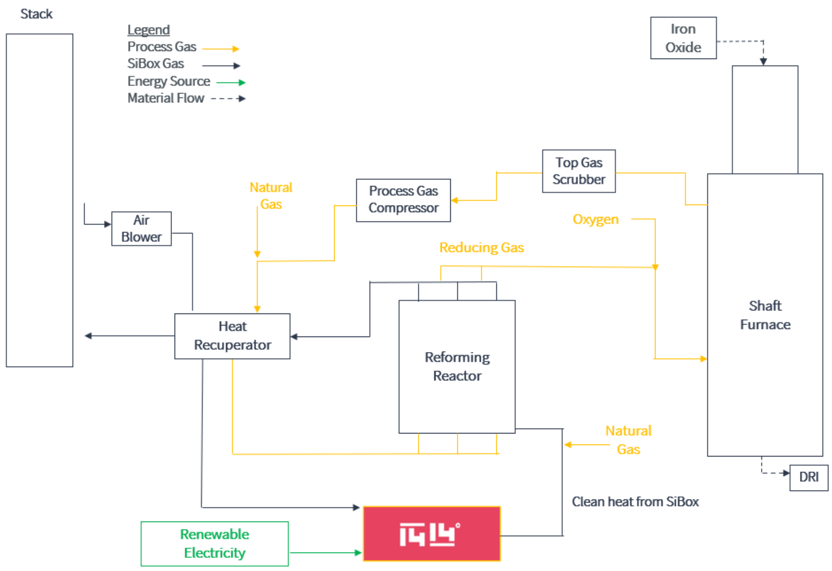
In SMR, methane is fed into a processing unit called a reforming reactor, where it reacts with high-temperature steam and usually a nickel-based catalyst, to form hydrogen and carbon monoxide ("CO"). The resulting gas mix is then fed into the shift reactor, where the CO is converted to more hydrogen, plus carbon dioxide ("CO2"), referred to as syngas. The hydrogen and CO2 are then sent to a pressure swing adsorption ("PSA") unit, where the CO2 and other gas impurities are removed from the hydrogen.

Addition of the SiBox

The SiBox has two potential applications in the SMR process. Firstly, the SiBox can pre heat the steam to high temperatures, instead of using an external fossil fuel driven heat source. The SMR is an endothermic reaction which requires a large amount of energy input to achieve the desired temperature conditions. As such, the SiBox can also be used to heat the reforming tubes in the reactor, to high temperatures, enabling the conversion of steam and methane feedstock into hydrogen and CO. A reforming reactor powered by SiBox heat will reduce the need to capture CO2 during the CCS process, due to the SiBox producing zero emissions. Up to 100% of the thermal energy required in the SMR could be provided by SiBox, reducing CO2 emissions, whilst providing cost savings.

Alongside the production of 'blue' hydrogen through SMR, new hydrogen production routes, such as methane pyrolysis, are being developed. Methane pyrolysis is an alternative low-emission process, applying heat in the absence of oxygen to split natural gas into hydrogen and carbon, creating a fraction of the CO2 of SMR. A further potential application of the SiBox technology is in these innovative, carbon free hydrogen processes, as the SiBox is compatible with a few of these hydrogen production routes.

Direct Reduction of Iron Process



Source: Company reports; MIDREX flowsheet

DRI Process

The DRI process uses pelletised iron ore (iron oxide), which is reacted with reducing agents (carbon monoxide and hydrogen) to remove the oxygen, resulting in a solid sponge iron product. These reduction gases can be produced from the combustion of coke or from natural gas.

In the gas-based process, which uses a shaft furnace as shown above, the exhaust gas (top gas), containing CO2 and H20 is pressurised by a compressor, mixed with natural gas, preheated, and fed into the reforming reactor. The mixture is reformed to produce reductant gas consisting of carbon monoxide and hydrogen. The shaft furnace operates on the counter current principle whereby the iron ore descends in the furnace due to gravity, whilst undergoing reduction through the upward flow of the reducing gases.

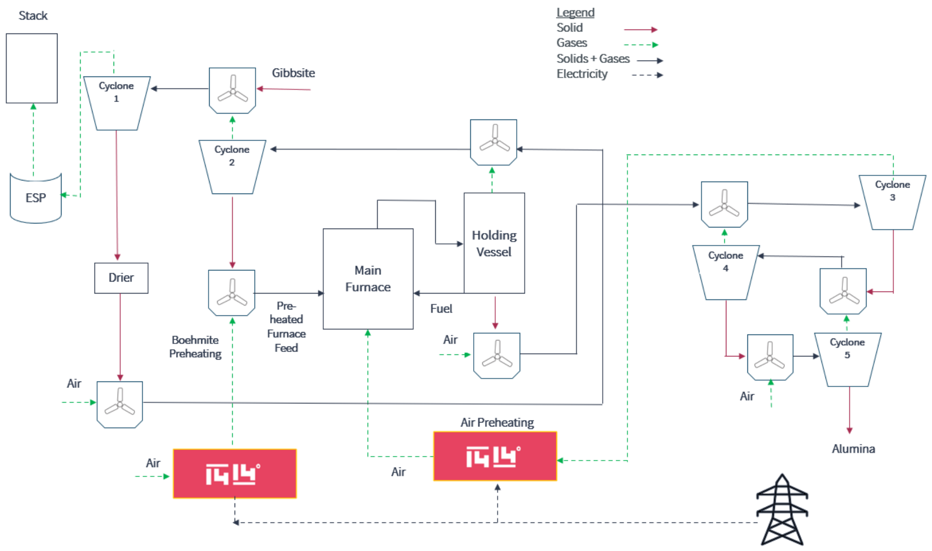
Addition of the SiBox

The SiBox can be integrated into the conventional DRI gas-based process. The SiBox will charge with electricity from renewable source and convert the electrical energy into heat energy, which can be stored for future use. The clean heat will be directly used to power the reforming reactor and reduce the reliance on natural gas as the heat source for the reaction, leading to considerable energy cost savings and lower CO2 emissions. Up to 100% thermal energy could be provided by the SiBox. The SiBox will also be able to capture excess heat produced during the DRI process and store it for later use.

The DRI end-market has attractive growth prospects as an increasingly popular alternative to the traditional Blast Furnace-Basic Oxygen Furnace ("BF-BOF") steel production route. The BF-BOF route covers almost three-quarters of today's steel production market but is also the most polluting in terms of CO2 emissions. In the drive to decarbonise steel production, the BF-BOF route will likely lose market share over the more environmentally friendly Electric Arc Furnace ("EAF) route. Direct-reduced iron can be used as a feedstock in EAFs and will likely be required as the supply of steel scrap is limited.

The combined DRI-EAF currently accounts for approximately 5% of global steel production. BCG estimates that by 2050, the three routes BF-BOF, DRI-EAF, and EAF will each cover roughly a third of global steel production, implying a DRI-EAF CAGR of 6.6%. However, the latter includes one of the most promising technologies to decarbonise the steel industry today and is a form of DRI-EAF called hydrogen DRI ("H-DRI"), where hydrogen is used instead of coal or natural gas. As the SiBox is also compatible with the H-DRI technology, the company could join the green steel wave, set to play a crucial role in the steel industry in the coming decades.

Alumina Refining Process



Source: Company reports

Alumina Refining Process

There are typically four stages to the alumina refining process and all of them usually require heating applications. Once the bauxite (aluminium ore) is mined, crushed, and ground into a powder like substance, it is subjected to high-heat and pressure digestion with sodium hydroxide (NaOH). The resulting solution goes through a process of clarification and precipitation to separate any forms of solid impurities and leave behind aluminium hydroxide (Al(OH)3).

The treated aluminium hydroxide solution then goes through the most critical step called calcination. The solution is put through a drier to remove any remnants of moisture in a rotatory kiln; heating application at this step is called "air pre-heating". The next and most crucial step is dehydroxylation, where any hydroxyl groups (OH compounds) are removed to form pure alumina or aluminium oxide (Al2O3). As the temperature is increased to ~900-1100°C, the hydroxyl groups are broken off to form pure alumina, and water vapor is released as a by-product. The chemical reaction can be represented as follows: Al(OH)3 → Al2O3 + 3H2O.

Addition of the Sibox

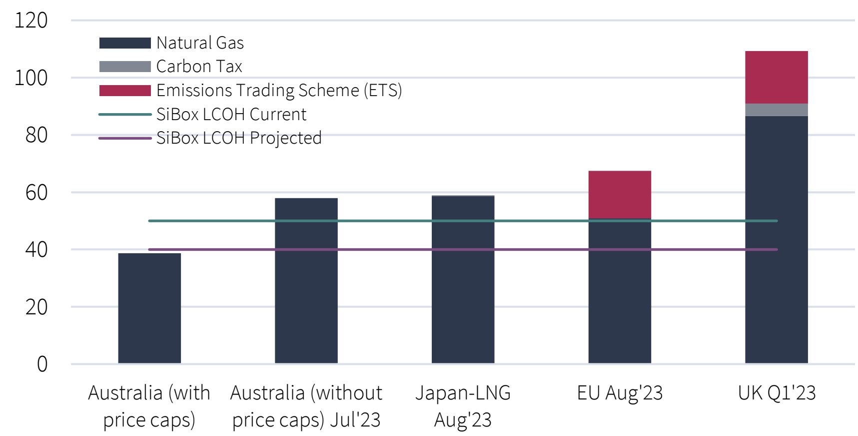
The SiBox has two potential applications in the alumina refining process. Firstly, the SiBox can provide 100% of the heat energy for the digestion process as temperatures are in a much lower range (~220°C) than what the SiBox is capable of providing. The more efficient application of the SiBox is in the calcination stage where it can provide up to ~37% of the heat energy. Here, the SiBox can be installed at two points – the air and solid feedstock preheating steps, up to the furnace inlet temperature of 950°C. Integration of green heat from 14D's SiBox can help displace a significant amount of natural gas used in the alumina refining process leading to considerable cost savings and lower carbon emissions.

Aluminium's low-density, recyclability and corrosion resistance has made it increasingly popular in high-end transportation applications such as aviation and electric vehicles. However, while its light weight reduces fuel consumption during the lifetime of a vehicle, its relatively energy-intensive production process can make its carbon footprint comparable to that of steel alloys over the lifecycle of certain components. By helping to further de-carbonise the alumina production process, the SiBox could cement the advantage of using aluminium in these applications, driving demand for 14D's solution.

Sibox: Competitive with Fossil Fuels

As noted, the Sibox offers a range of benefits, ensuring the technology's competitiveness with fossil fuels. However, analysis completed by 14D in April 2023 and more recently, by Hannam in September 2023, utilising Natural Gas Fuel Prices, indicated that the technology will be a competitive substitute for gas earlier than anticipated. Higher gas prices, coupled with the implementation of carbon pricing mechanisms serve as catalysts to the competitiveness of 14D's technology, as shown in the chart below. At the current levelised cost of heat (LCOH) of US$50/MWh, the SiBox is competitive in a range of geographies simply by looking at natural gas cost savings. Once the emissions trading scheme (ETS) and carbon taxes are accounted for, there are further savings of 15-50% depending on the geography. The SiBox's ability to address the unique challenges of decarbonising high-temperature industrial processes while remaining cost competitive reinforce its long-term economic viability, in our view.

SiBox levelised cost of heat versus costs of natural gas (including efficiency losses of 75%) in US$/MWh



Note: gas operating overheads (Opex) and gas Capex are not included in gas cost whereas Opex and Capex are factored into SiBox LCOH.

Source: Company reports and H&Pe

Commercialisation Pathway

As shown below, 14D's technology is currently undergoing rigorous trials, with a 1 MWh SiBox Demonstration Module having been constructed in 2022 and commissioned earlier this year. Upon successful completion of test work, the process is expected to be scaled up to a 100 MWh pilot facility in 2024+. Assuming this phase is successful, the commercial rollout of a full GWh-scale SiBox – targeted by 2026 at the earliest - will require the ability to mass produce SiBricks by partnering with refractory producers.

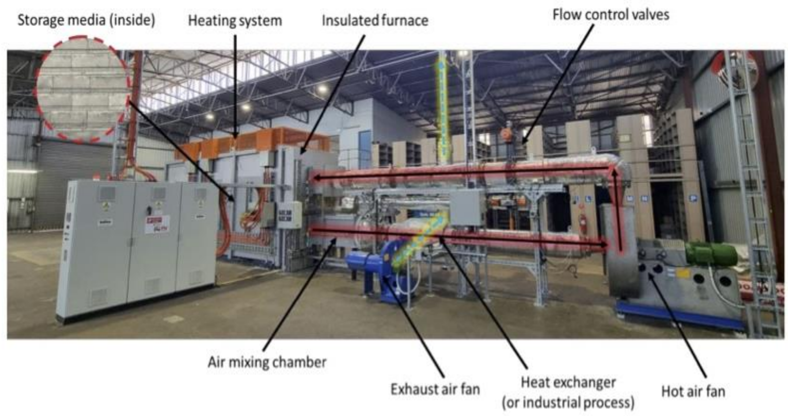
Anticipated steps to Commercial SiBox

Source: Company reports

SiBox Demonstration Module

During 2023, 14D successfully commissioned the 1MWh SiBox Demonstration Module ("SDM"), a key milestone towards the commercialisation of the SiBox as a competitive clean energy technology. The SDM consists of an insulated heat store built from walls of 14D Bricks, an electrical heating system, and an energy recovery system, designed to replicate commercial applications. 14D has successfully heated the silicon-based storage media in the SiBox to 1,414°C, and upon inspection and analysis, the material proved to be in excellent condition, implying little to no degradation of the brick.

Components of SiBox Demonstration Module



Source: Company reports

Extensive trials during the commissioning process confirmed the excellent energy storage capacity of the SiBricks, successfully undergoing 32 cycles of phase change. The SDM's operational flexibility across outlet temperatures ranging from 700°C to 900°C, showcased its suitability for diverse industries. Additionally, the system provided 6-12 hours of continuous output at each set point. Having completed commissioning, the SDM is now operating autonomously. Over the next 9 months, the SDM will undergo continuous cycling and discharge testing at temperatures ranging from 600°C to 900°C to complete the validation phase, ensuring the thorough assessment of the SiBox system performance and thermal storage media.

Given the progress made by 14D on the SDM, we estimate the technology readiness level (TRL) score to be 6. This level is indicated by the verification of the prototype system, which 14D had achieved ahead of the SDM construction. Once the SDM has successfully completed the validation phase, 14D should reach TRL 7.

Looking to commercialisation, the equipment specifications, and designs for the SDM can be readily scaled to build long duration thermal storage solutions for industrial applications. The SiBox pilot will be 20-100x larger than the SDM, supplying heat to an industrial process. As such, the Company is currently in discussions with end users in the minerals and cement production industry to determine process design requirements.

Commercialisation Partners

Partnership agreements are a key element of 14D's commercial model and these strategic partnerships represent a significant step towards achieving 14D's goals of expanding market reach and commercialising its technology.

Refratechnik

For several years, Refratechnik has partnered with 14D to develop and commercialise the silicon storage media. Following the partnership agreement in July 2023, Refratechnik is now set to commence trial manufacturing of 600 SiBricks, with subsequent rigorous cycling in air at 14D's facilities to evaluate their performance. Each brick is expected to store at least 1 kWh of usable energy at maximum output temperature. The IP pertaining to the storage media is owned by 14D, while the manufacturing process IP is held by Refratechnik.

Woodside Energy Technologies

In October 2021, 14D executed agreements with Woodside Energy Technologies ("Woodside"), a global energy Company with a focus on providing low-cost, lower carbon energy, to develop the SDM and provide up to A$2m of funding. Contributions by Woodside will be made on the completion of specific project milestones by 14D. The collaboration with Woodside entails a two-stage process.

In stage one, Woodside will co-fund the SDM, in conjunction with the Australian Government. Upon reaching stage two, following successful validation and a commercialisation plan, Woodside will evaluate providing further funding, including potentially acquiring an equity interest in the business.

Management structure to drive pathway to commercialisation

In late 2022, the management team was restructured, with the aim of fostering growth in key projects, while optimising overhead costs. 14D is led by Dr Kevin Moriarty, with over 40 years of mining and oil exploration and development experience and over 30 years of corporate experience. Chief Technology Officer, Mahesh Venkataraman leads the Company's key mission to validate the SiBox technology for commercial use and advance the next generation of silicon energy storage. The management group also includes SiBox Development Manager, Josh Zowtyj, Company Secretary, Katelyn Adams, and Communications and Engagement Lead, Maretta Layton. Together, the management team combines diverse skills in engineering, research, marketing, and finance, leveraging their skills to steer the Company's profitable future. In June 2023, it was announced that Graham Davies had taken over from Tom Thwaites, as General Manager- Aurora for 14D and is focused on obtaining transmission line connection for the Aurora Energy Project initiatives.

Funding opportunities from Woodside and potential future grants

The Company has received support from Woodside and the Australian Government to fund its R&D activities, reflecting the confidence in 14D and its technology solutions. Woodside will contribute up to A$2m towards the SDM and the contributions will be made on the completion of specific project milestones by 14D. Following a review of the results of the SDM validation phase, Woodside will have the option to provide further funding, including potentially acquiring an equity interest in the business.

14D was also successful in its application for a A$2.2m grant from the Australian Federal Government Modern Manufacturing Initiative (MMI), to accelerate the commercialisation of its SiBox technology.

14D ended the Jun'23 quarter with A$1.95m in cash, a decrease of A$755,000 from the previous quarter. Following the end of the quarter, we note an additional A$1.47m was raised in August, via an Entitlement Offer. Funds raised will primarily be used to drive product development. In line with the support provided by the Australian Government, we expect there to be the possibility of further grants in the future.

Aurora Energy Project; near term cash flow or potential sale

Alongside 14D's core TES technology business, the Company is joint owner of the Aurora Energy Project ("Aurora"), a hybrid renewable power plant near Port Augusta, in South Australia, designed to deliver renewable electricity to the National Electricity Market ("NEM"), supported by LDES output. Situated on a 1,000-hectare site with excellent solar insolation and proximity to major transmission infrastructure, the Aurora Project is well-positioned to leverage the growing demand for renewable energy in the region.

Vast Solar

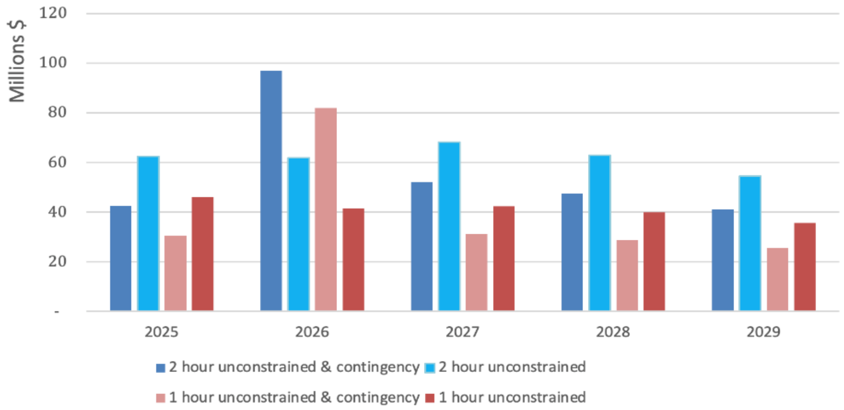
In Jun'22, 14D executed an agreement with Vast Solar ("Vast"), a world-leader in concentrated solar thermal power ("CSP"), to create a joint venture at the Aurora Project. Vast acquired 50% of the shares in Silicon Aurora Pty Ltd from 14D for A$2.5m. Payment is to be completed in two stages-the initial A$1m was paid in July 2022 and the second A$1.5m payment is conditional upon the execution of the connection agreement.

The staged approach

Initially, a 140MW/ 280MWh battery energy storage system ("BESS") will be connected to a 275kV transmission line, connected to the NEM. A letter of intent has been secured with a major battery supplier, to provide the project's equipment. In the longer-term, Aurora also provides the opportunity to deploy 70MW of solar photovoltaics, Vast's CSP technology and a pilot of the SiBox TES, all of which have regulatory approval.

Revenue generation

Projected first 5 years net revenue for modelled scenarios- 1 and 2 hours of storage- fast payback projected



Source: Cornwall Insight Australia; Company reports

As of Feb'22, Consultants, Cornwall Insights Australia projected net revenue under various scenarios for a 140MW BESS connected to the 275kV transmission line at the site, based on charging from the grid, sale of grid stability services and arbitrage for one and two hours of storage capacity over 20 years from the end of 2023. The Aurora BESS is still the most immediate prospect for generating net revenue for 14D, however, the timing of the project is dependent on approvals from BHP for transmission line access. Site works are now scheduled to commence early 2024, with BESS commissioning to start late 2024.

IP Protection

A portfolio of patents, registered brands, provisional patent applications and trade secrets protect 14D's technology. The Company's intellectual property ("IP") includes the patents for its thermal energy storage systems and storage media, its trademarks and domain names. All intellectual property remains under active management, to ensure its protection.

Refratechnik Agreement

The storage media IP is owned by 14D and the manufacturing process IP owned by refractory maker.

Woodside Agreement

Following a review of the results of the SDM validation phase, Woodside will have the option to provide further funding, including potentially acquiring an equity interest in the business. In this instance, a special purpose vehicle (SiBox SPV) will be created to house the SiBox IP for future development and commercialisation. Woodside's ownership stake in the SPV will be proportional to its investment and the assessed fair value of the SPV upon completion of the validation project. However, 14D will retain an ownership interest in the SPV of no less than 51%.

Valuation

1414 Degrees' strategic business model

14D has developed a capital-light business model, sharing a portion of the technology development expenses. The company anticipates two potential revenue streams: firstly, it will accrue royalties from the annual sales of SiBricks from its refractory manufacturing partner, and secondly, it will generate licensing fees from SiBox installations throughout the SiBox's operational lifespan, paid by end-users.

We believe that 14D's adoption of this capital-efficient approach positions it ahead of its industry peers who are trying to retain the manufacturing of the energy storage units. This not only allows 14D to avoid the huge initial capex but also speeds up the process to commercialisation. By partnering with Refratechnik and Woodside, the company does not need to worry about the manufacturing or funding for the initial development of the project.

Assumptions and methodology

We expect 14D's business model to be driven by annual technology licence fees based on the installed capacity of SiBox systems. 14D has stated a target of producing 1 million SiBricks per year in partnership with refractory manufacturers by the end of this decade. With each brick equivalent to 1kWh in energy storage, this amounts to 1GWh per year in aggregate SiBox capacity installations; in our model, we assume this level is reached from 2031 onwards.

In order to generate our base case assumption of US$4,675 per MWh of capacity installed for the licence fee, we have first built models to estimate the net annual cost savings generated for an end-user by installing a SiBox. This allows us to estimate a reasonable license fee rate which would allow the end user to retain a portion of the benefits sufficient to deliver an attractive IRR on the upfront investment in a SiBox.

The purpose of installing a SiBox is to replace gas consumption with electricity during periods when power prices are low, delivering a heat cost saving, as well as reduce CO2 emissions. We estimate the gas cost saving for different factory configurations where 14D could install its SiBox, such as cement, alumina, or iron manufacturers. The company aims to build SiBoxes of various capacities although it expects to commission three types based on market research of its target audience – 80MWh storage with 10MW of power output, 800MWh with 100MW, and 1.5GWh with 187MW. (nb). In each case we have assumed 8-hours' worth of energy storage as this was deemed the optimal size to take advantage of the diurnal troughs in the duck curve). We have modelled out all cases separately to calculate the appropriate licence fee rates.

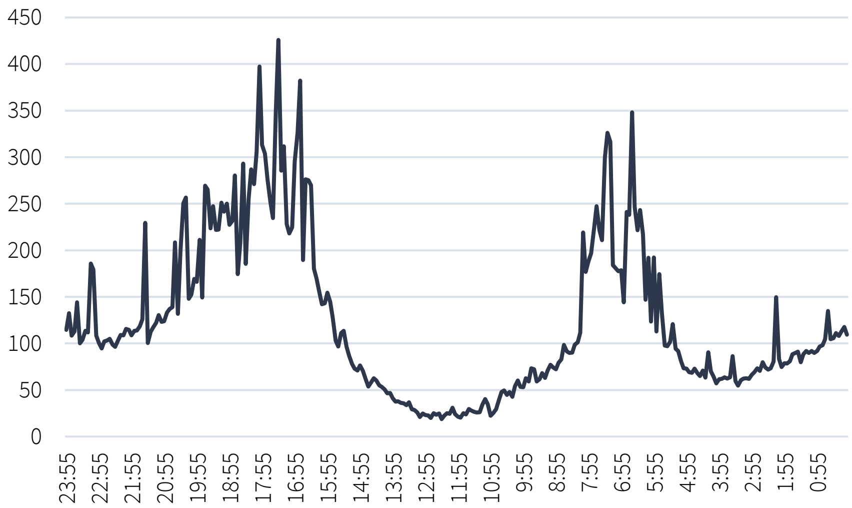
We estimate the potential heating gas cost saving based on the factory capacity in each case. The Australian LNG market is quite fragmented, and pricing is regional. In the last year, average Australian LNG prices have dropped from ~A$23/GJ to A$12/GJ in Aug'23 following a global trend. Aug'23 prices in the EU, Japan, and Australia average at A$12.4/GJ. We assume a gas price of A$14/GJ (A$50/MWh) based on the trends over the year such that the gas price is applicable to geographies outside Australia as well.

Additionally, we also consider the incremental carbon cost savings from replacing the burning of gas. Australia does not have a carbon tax. However, under the Safeguard Mechanism, big emitters (>100k tCO2 per annum) must be below a certain baseline according to their industry/operations. Any emission above the baseline needs to be compensated by buying Safeguard Mechanism Credits ("SMC"). Being lower than the benchmark earns you SMCs as well. This is essentially equivalent to an Emissions Trading Scheme ("ETS").

While we note SMC prices in Australia are currently trading at ~A$40, we believe the most developed carbon markets are in Europe where spot prices for ETS credits are currently A$138/tCO2 (EUR 84/tCO2). Although we recognise that comparisons across different jurisdictions are imperfect given differences in permitted emissions, we see Europe as showing the direction of travel for cap-and-trade schemes globally as targets become more stringent. However, we also note SMC prices in Australia are capped at A$75/tCO2, which is what we assume to calculate carbon cost savings.

We then need to consider the cost of charging the SiBox. The advantage of the independent charging and discharging SiBox system allows users to charge the SiBox at any time of the day. Users can benefit by charging during the afternoon and late-night periods when wholesale electricity prices fall. South Australia, for example, has a particularly low electricity prices during the afternoon, which can be seen in the duck curve below. We assume an average electricity price of A$67.5/MWh.

SAUP5MP Index South Australia daily average of 5-minute wholesale electricity pricing from Dec'22 to Aug'23 (A$/MWh)



Source: Bloomberg and H&Pe

The capex for installation is estimated by 14D in different scenarios based on the factory type and capacity and ranges between A$10m and A$200m. Using these inputs we estimate the end-user's net free cash flow savings, from which we derive an NPV and IRR quantifying the benefit of gas replacement with a SiBox system. These can then be used to calculate a reasonable license fee amount payable to 14D.

We take two approaches: first, we use scenarios ranging between 5-25% of our estimate of the end-user's net cost savings, which is the typical range for technology IP licensing, to calculate 14D's license fee. Using the total license fee and the factory's installed capacity, we arrive at a license fee per MWh. In the other approach, we start with a range of target IRRs for the end-user, ranging between 30-50%, and back-calculate the license fee required per MWh of factory capacity and in turn, a percentage of the net cost savings to generate that IRR. We have taken an average of the license fee percentage from both of these approaches to reach an assumed license fee per MWh of capacity installed. This comes out to A$4,675/MWh, which we have in turn used to drive our revenue forecasts for 14D.

1414 Degrees revenue forecasts

Having modelled the benefits of the SiBox system in a range of potential end use cases to derive an estimate of an appropriate licence fee per unit of installed capacity, we then use this input to generate a highly provisional estimate of 14D's future top-line revenue. To this we also add our estimate of the upfront royalties generated from SiBrick production.

14D has provided a comprehensive outline of its commercialisation strategy for SiBrick production, which entails a staged scale-up. This scaling trajectory involves an increase from 400 to 10,000 bricks by the year 2024, followed by a substantial growth to 100,000 bricks over the next two years, and a sustained production level of 1m bricks starting from 2027 and onward. In our model, we assume a more gradual approach, reaching 1m bricks by 2031. Notably, the estimated operational lifespan of the SiBox is 25 years, allowing for the calculation of cumulative installed capacity for each year.

We project that the company will continue adding 1 mm bricks annually until 2040. Beyond this point, we adopt a conservative approach, assuming no further capacity expansion. It is important to highlight that each SiBrick has a storage capacity of up to 1 kWh over a life of up to 25 years, suggesting new SiBox additions running at 1,000 MWh per annum from 2030-40E. This compares to 14D's estimate of the immediate global addressable market of ~1,500 TWh through its SiBox technology.

In addition to SiBox licencing fees, 14D plans to generate royalties, calculated as a percentage of the value of SiBrick sales. The SiBrick is a proprietary product of the company and we do not know the exact contents of it, although we do know that it is primarily composed of silicon. At 1,400°C, 1 kg of silicon can hold ~0.4 kWh of energy. We know that 1 SiBrick can hold ~1kWh of energy so we would need ~2.5kg of silicon to build a SiBrick. Australian trade flow pricing for silicon is quite variable and falls in the range of US$9-12/kg. We take a conservative approach to estimate the value of each SiBrick, assuming the lower end of the spectrum, US$9/kg. Considering 2.5kg of silicon, we reach a costing of ~US$22/SiBrick, or roughly A$35/SiBrick. Over and above this cost, the brick would also contain other materials and entail a manufacturing cost. Thus, we assume a range of A$35-45/SiBrick for our calculations and sensitise our results to this range.

These inputs enable us to estimate total SiBrick sales revenues, allowing the estimation of royalties accruing to 14D. Typical contracts of this nature command a royalty rate of 5%. The combination of these factors serves as the foundation for our projection of 14D's potential net revenue generation as shown below.

1414 Degrees cost projections

The primary expenditures for 14D can be categorised into two major components: general and administrative (G&A) costs and research and development (R&D) costs.

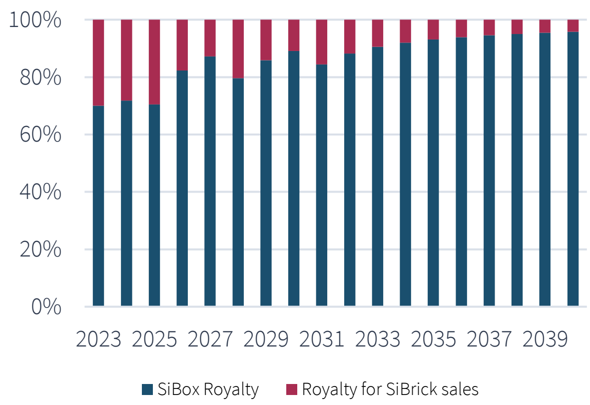
In terms of G&A costs, we have modelled fixed management expenses amounting to A$500k annually, with an additional a variable administrative cost component linked to the newly installed capacity. We project this variable cost to be A$5,000/MWh of capacity installed. As the company executes its growth strategy, this variable administrative cost will naturally increase in tandem with the expansion of capacity, reaching ~A$5m pa in our model from 2030+ when 14D hits it's assumed run rate of 1,000MWh pa of SiBox installations.

Regarding R&D expenses, we expect 14D to pursue an aggressive R&D agenda until it reaches its maximum installation capacity. During this period, we anticipate an annual R&D expense of A$2.5m. This commitment to R&D will be sustained until the year 2029, aligning with the company's growth trajectory.

Revenue generation (A$ m)

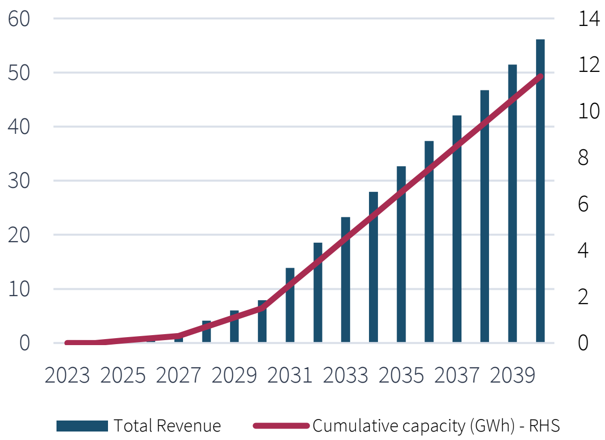
Source: H&Pe

Revenue generation breakdown by revenue stream (%)



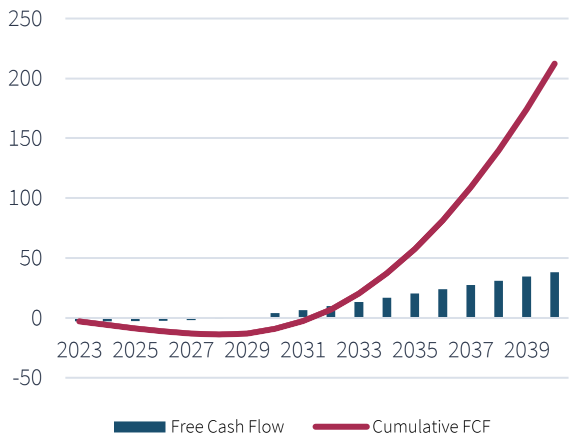
Source: H&Pe

Revenue (A$ m) vs Cumulative capacity installed (GWh)



Source: H&Pe

Growth in FCF to 2040 shows steady cash flow (A$ m)



Source: H&Pe

SOTP build up

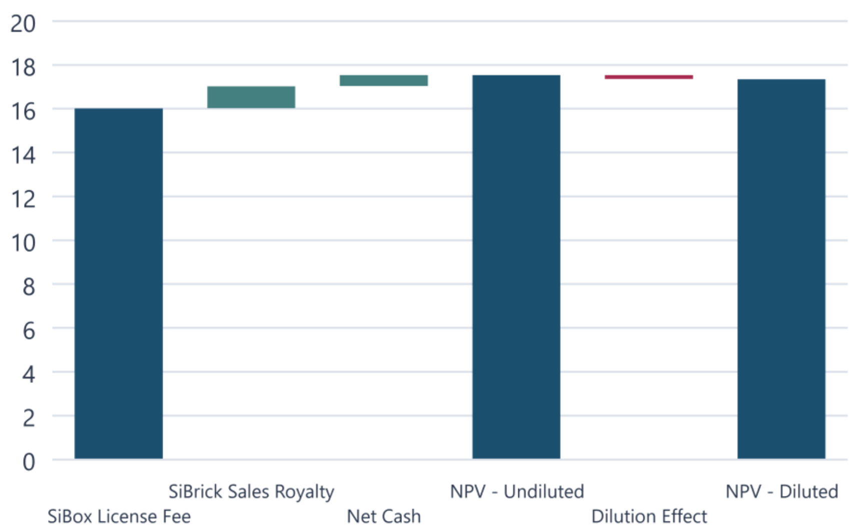
We have split out the NAVs for the SiBox licensing fees and SiBrick sales royalty. Given the TRL score of 6, 14D's technology is at a relatively early stage, implying risk to the full commercialisation of the SiBox system. We therefore apply a 0.3x target P/NAV multiple (aka chance of success [CoS]) in our SOTP calculation. This generates a risked NAV of A$36m. Including cash and cash equivalents, we arrive at a target price of A$0.175/sh, 303% above the current share price. We do not currently include any value for the Aurora BESS project due to a lack of clarity on timing and commercial terms, although we acknowledge this could drive a significant further uplift to our valuation.

Valuation / Price Target Derivation

AUD		Unrisked	CoS	Risked
SiBox License Fee	A$m	110	0.3	33
SiBrick Sales Royalty	A$m	7	0.3	2
Cash and cash equivalents	A$m	1	1.0	1
Total company value	A$m	118		36
Number of shares outstanding	m	205		205
NPV / Target Price per share - undiluted	A$ cents	57		17.5
Shares issued if options exercised	m	2		2
NPV / Target Price per share - diluted	A$ cents	57		17.4
Current share price	A$ cents	4.3		4.3
Upside/downside from current share price	*%*	*1218%*		*303%*

Source: H&Pe

SOTP waterfall chart



Source: H&Pe

Sensitivity Analysis

Given the early stage of both the technology and industry, as well as the business model, we have made highly provisional assumptions around key inputs such as licence fee amount and the SiBrick royalty rate. As summarised below, we have run a sensitivity analysis on our main assumptions in our model. We note that even with major cuts to our assumptions, we still see considerable upside potential to the current share price A$0.043/sh. We base this analysis on the upcoming results of the SDM and potential partnership opportunities with Refratechnik and Woodside to maintain a capital light approach. However, there is a great deal of upside potential if 14D is able to apply its technology more widely. In the scenario that the company is able to aggressively deploy 1m SiBricks by 2027 according to its commercialisation plan (fast than we currently assume), it would imply a risked diluted target price of A$0.254/sh, or 485% upside potential to the current share price.

SOTP valuation sensitivity analysis against the main DCF valuation assumptions (in A$ cents)

		SiBox License Fee				
		4000	4500	4675	5000	6000
Discount Rate	8%	21.1	24.2	25.3	27.3	33.6
	9%	17.5	20.1	21.0	22.7	28.0
	10%	14.5	16.8	17.5	19.0	23.5
	11%	12.1	14.0	14.7	15.9	19.8
	12%	10.2	11.8	12.4	13.4	16.7

		SiBrick Royalty Rate				
		2%	4%	5%	8%	10%
Discount Rate	8%	24.6	25.1	25.3	26.1	26.6
	9%	20.4	20.8	21.0	21.7	22.1
	10%	16.9	17.3	17.5	18.2	18.6
	11%	14.1	14.5	14.7	15.3	15.6
	12%	11.9	12.2	12.4	12.9	13.2

		SiBrick Cost				
		35	37.5	40	42.5	45
Discount Rate	8%	25.2	25.2	25.3	25.4	25.5
	9%	20.9	21.0	21.0	21.1	21.2
	10%	17.4	17.5	17.5	17.6	17.7
	11%	14.6	14.6	14.7	14.8	14.8
	12%	12.3	12.3	12.4	12.4	12.5

Source: H&Pe

Summary Financial Statements

Income statement							
Year end June (AUD m)		2023A	2024E	2025E	2026E	2027E	2028E
Other Income	A$m	0.1	-	-	-	-	-
Royalty from Sibrick Sales	A$m	-	0.0	0.2	0.2	0.2	0.8
Royalty from SiBox installations	A$m	-	0.0	0.5	0.9	1.4	3.3
Total Revenue	A$m	0.1	0.0	0.7	1.1	1.6	4.1
Research and Development Expenses	A$m	-	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)
G&A expenses	A$m	(1.2)	(0.0)	(0.5)	(0.5)	(0.5)	(2.0)
Depreciation	A$m	(0.0)	-	-	-	-	-
Directors Fees	A$m	-	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)
Other Expenses	A$m	(0.3)	-	-	-	-	-
Finance Costs	A$m	(0.0)	-	-	-	-	-
Earnings Before Tax	A$m	(1.5)	(3.0)	(2.8)	(2.4)	(1.9)	(0.9)
Income tax benefit / (expense)	A$m	-	-	-	-	-	-
Net Profit	A$m	(1.5)	(3.0)	(2.8)	(2.4)	(1.9)	(0.9)

Cash flow statement		2023A	2024E	2025E	2026E	2027E	2028E
Cash flow from operations	A$m	(2.0)	(3.0)	(2.8)	(2.4)	(1.9)	(0.9)
Cash flow from investing	A$m	0.7	-	-	-	-	-
Cash flow from financing	A$m	0.0	-	-	-	-	-
Net changes to cash	A$m	(1.3)	(3.0)	(2.8)	(2.4)	(1.9)	(0.9)
Forex adjustments	A$m	0.0	0.0	0.0	0.0	0.0	0.0
Cash at the beginning of the period	A$m	3.5	1.9	(1.0)	(3.9)	(6.2)	(8.1)
Cash at the end of the period	A$m	2.2	(1.0)	(3.9)	(6.2)	(8.1)	(9.0)

Balance sheet		2023A	2024E	2025E	2026E	2027E	2028E
Cash	A$m	1.9	(1.0)	(3.9)	(6.2)	(8.1)	(9.0)
Receivables	A$m	2.5	2.5	2.5	2.5	2.5	2.5
Other	A$m	0.2	0.2	0.2	0.2	0.2	0.2
Current Assets	A$m	4.6	1.6	(1.2)	(3.6)	(5.4)	(6.3)
PP&E and Investments	A$m	2.2	2.2	2.2	2.2	2.2	2.2
Others	A$m	2.9	2.9	2.9	2.9	2.9	2.9
Non-Current Assets	A$m	5.1	5.1	5.1	5.1	5.1	5.1
Total Assets	A$m	9.7	6.7	3.9	1.6	(0.3)	(1.2)
Trade payables and leases	A$m	0.5	0.5	0.5	0.5	0.5	0.5
Other current liabilities	A$m	0.2	0.2	0.2	0.2	0.2	0.2
Current Liabilities	A$m	0.6	0.6	0.6	0.6	0.6	0.6
Provisions	A$m	0.0	0.0	0.0	0.0	0.0	0.0
Leases	A$m	-	-	-	-	-	-
Non-Current Liabilities	A$m	0.0	0.0	0.0	0.0	0.0	0.0
Total Liabilities	A$m	0.7	0.7	0.7	0.7	0.7	0.7
Net Assets	A$m	9.1	6.1	3.2	0.9	(1.0)	(1.9)
Equity	A$m	33.0	33.0	33.0	33.0	33.0	33.0
Reserve	A$m	0.2	0.2	0.2	0.2	0.2	0.2
Accumulated losses	A$m	(24.3)	(27.3)	(30.2)	(32.5)	(34.4)	(35.3)
Total Equity	A$m	8.8	5.8	3.0	0.7	(1.2)	(2.1)

Source: H&Pe

Catalysts

We see several upcoming catalysts for 14D which could begin to close the significant gap between the current share price and our SOTP valuation:

- SiBox Demonstration Module: The SDM should demonstrate the technical and commercial viability of 14D's technology. The completion of the validation phase over the next 9 months will aid the de-risking of the technology and provide confidence to large scale industrial and utility customers, as to how the SiBox will deliver value to them.

- Potential new Partnership to maintain capital-light approach: Partnership agreements are a key element of 14D's commercial model. Licensing its technology to third parties to manufacture the SiBricks and deploy the SiBox, limits capital outlay, provides cash flow from licensing fees and underpin 14D's commercialisation timeline. In the future, the company's capital light approach could be supported by further potential partnerships with leading players across target industries.

- Trial with Refratechnik for mass production: In accordance with the partnership agreement announced Jul'23, Refratechnik is preparing to commence trial manufacturing in the next quarter of 600 SiBricks. Manufacturing and quality control testing is expected to be completed by year end. The trial aims to validate the feasibility of mass production, a factor pivotal in assessing 14D's ability to achieve economies of scale.

- Woodside funding: Woodside Energy has been an instrumental partner in advancing 14D's technology. The partnership was established to develop the SiBox, with Woodside contributing A$2m. Following successful validation of the SDM and review of the commercialisation plan, Woodside will have the option to secure up to a 49% stake in the SiBox IP, by providing funding for the commercial-scale pilot, set to be 20-100x larger than the SDM.

- Future additional grants: In line with the support provided by the Australian Government, we expect there to be the possibility of further grants in the future. 14D's partnerships and grants to date, in addition to future additional support, provides recognition of not only the SiBox technology but also the importance of LDES for the renewable energy transition.

- Decarbonisation Incentives: Strong policy support from governments worldwide is propelling the clean energy transition and offering support to innovative clean energy technologies. For instance, Australia's Safeguard Mechanism Amendment Act (reformed Mar'23) is exerting increased pressure on the country's largest polluters to cut emissions in line with decarbonisation targets. Similarly, measures such as the Inflation Reduction Act in the U.S, the European Commission's REPowerEU and Japan's GX Green Transformation program are also expected accelerate the deployment of renewable sources and allow for greater momentum of LDES projects. The SiBox technology will be further supported in locations with emissions penalties.

- Aurora Project: 14D is set to receive A$1.5m from Vast Solar, upon connection to the transmission line. The Aurora Energy project provides opportunities for development, and revenue generation – with strong estimated projections for 2025-2029 net revenue. In the future, we believe the possibility could exist for 14D to sell its portion of the project to Vast or a similar company. The Aurora project is not a core asset, and the potential sale would generate significant revenue.

- Pilot Plant: Engineers will use the performance results from the SDM to design a commercial scale SiBox of up to 100 MWh. Upon the successful verification of the SDM, Woodside has the option to fund the next stage commercial pilot and earn up to 49% of the SiBox IP. A commercial scale pilot plant will allow the Company to validate the scalability of its technology, with the increase in capacity driving down the cost per unit. 14D is currently looking to identify a site for the pilot plant.

Investment Risks

Investment in the Company should be considered speculative. Key risks to our valuation include:

- Technology Commercialisation: Successful testing of the SDM in the next 9 months is critical, not only to validate the commercial viability of the technology but also to ensure the completion of specific project milestones, as per the funding agreement with Woodside. Delays or difficulties in completing the comprehensive test programme could disrupt 14D's commercialisation plan and hinder its progress towards building the multi-module commercial pilot of up to 100 MWh.

- Competition and IP uncertainty: A portfolio of patents, registered brands, patent applications and trade secrets protect 14D's technology. To safeguard its position, the Company has invested significantly in an IP strategy, however, we note, there is an inherent risk in disruptive technology for a potential loss of IP.

- Core technology performance: Despite over 15 years of development, the core silicon-based thermal storage media's long-term operational viability remains unknown. There is a risk the storage media does not meet the expected 20–25-year operating lifetime or is not as efficient as expected at larger scales, which could significantly delay or even prevent the commercialisation of the SiBox technology.

- Business strategy and execution: 14D's business strategy outlines an ability to produce and sell 1m bricks/year after 2027, which corresponds to 1 GWh of annual SiBox capacity. Although we have assumed that the 1m capacity will be reached by 2031, it could be delayed or 14D may only be able to commercialise half the said capacity. If we assume a constant capacity of 500k bricks/year from 2031, it will give us a NAV of A$0.10/sh which is ~45% lower than our current estimate. There is also the risk that the technology will not be applicable to as many industries as modelled and fewer industry players would readily take up the TES technology for their heating operations.

- Competition risk: While currently not facing direct competition, the Company does operate in the developing renewable energy storage market. The emergence of globally focused competitors with greater resources or aggressive pricing strategies could impact the Company's performance and future prospects.

- The availability of low-cost renewable electricity: The SiBox use-case is predicated on the availability of low-cost electricity for long periods of the day. As wind and solar generation capacity continues to increase in proportion to base-load non-renewable sources, we expect the duck curve to remain a daily reality – potentially even increasing in amplitude in the short-term. However, over a longer time horizon as LDES solutions are developed to capture daily power price arbitrage opportunities, there is a risk of a flattening in the duck curve and a smoothing of the diurnal pattern of price troughs. To the extent that this makes electrical heating less attractive in comparison to fossil fuels, there is a risk this could undermine the case for installing TES solutions in the absence of a robust emissions tax / carbon pricing regime.

Technology Overview

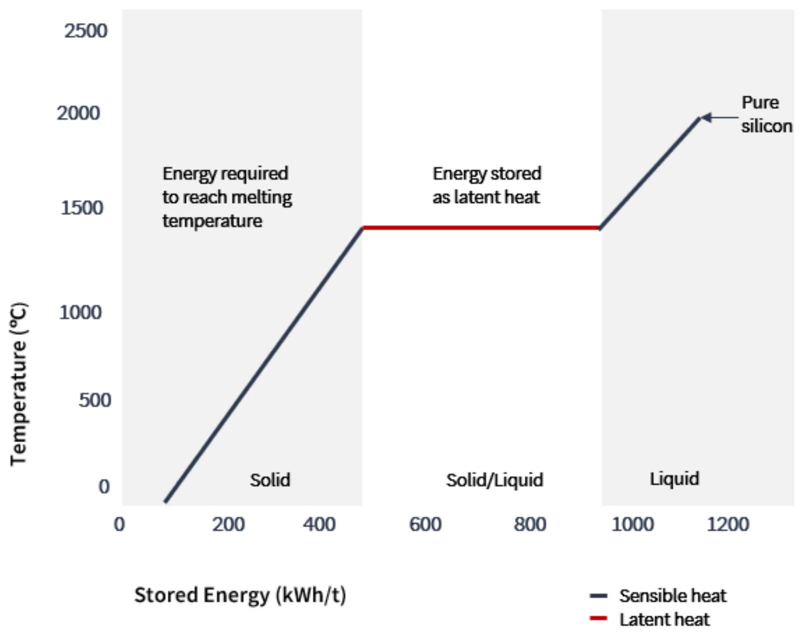
Phase-Change Materials

Phase-Change Materials ("PCM") are substances that absorb or release energy during the phase transition, in the form of latent heat, whilst maintaining a constant temperature. There are two types of latent heat- specific latent heat of fusion and specific latent heat of vaporisation.

Latent heat energy storage

Latent heat storage ("LHS") is based on the amount of energy absorbed or released during the phase change of a PCM - melting, solidification, gasification, and liquefaction. The high thermal energy storage density and almost constant working temperature, make LHS a viable solution to address the discrepancy between renewable energy supply and demand.

The process of latent heat storage



Source: Company reports

The process of latent heat storage involves heating the PCM, causing its temperature to increase, until the transition temperature is reached, and a phase change begins to occur. The latent heat of transition is the heat required to activate the phase change. During the phase change, the material absorbs heat energy at a constant temperature. When the solid entirely converts to liquid, the temperature will rise again. To retrieve the stored energy, the PCM can be reverted from the liquid to the solid phase by shutting off the heat generating component, releasing the energy stored as latent heat.

The Science of Silicon

Silicon is the second-most abundant element on the planet, after oxygen, denoted by the symbol Si and atomic number 14, a non-metallic chemical element in the carbon family. Silicon has a very high latent heat of fusion (1800 J/g), a melting point of 1,414°C and substantial thermal conductivity. Silicon has a diamond cubic crystal structure, which means a lot of energy is required to break the strong covalent bonds and thus, Silicon has a high melting point. Its high melting point allows for the storage and transfer of heat at elevated temperatures, making it suitable for applications requiring high-temperature heat.

The SiBrick consists of a silicon based PCM and ceramic containment - the means of containing the PCM. The brick harnesses the high latent heat of silicon, to convert renewable electricity to zero carbon heat, for high temperature industries. Comparatively, other energy storage systems relying on PCMs, such as Lithium Fluoride (molten salt) operate at lower temperatures, leading to substantially lower energy recovery efficiencies.

Silicon as a storage media

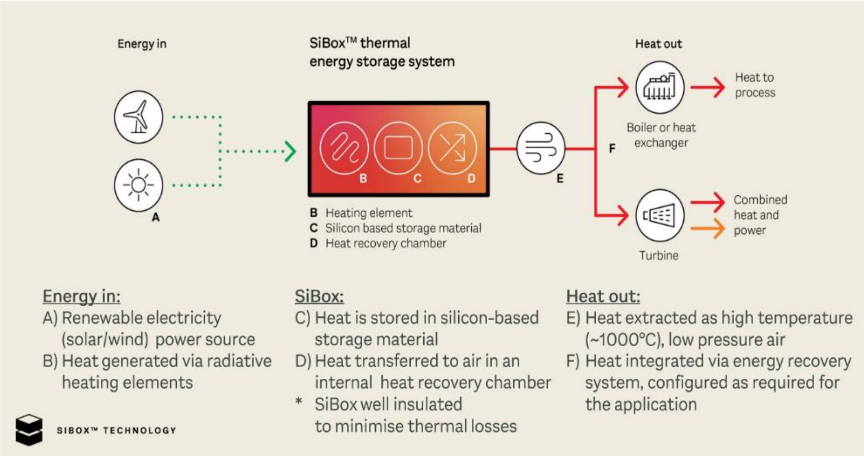
Silicon excels in several aspects, making it the preferred TES media for 14D.

- High energy storage density: Silicon's capacity to store large amounts of energy with a smaller footprint.
- High operating temperature: The high melting point (14D°C) of silicon enables the storage and transfer of heat at high temperatures.
- Consistent heat: PCM's latent heat storage enables the maintenance of temperatures within a narrow range, ensuring stable and consistent energy release or absorption.
- High Heat Conductivity: Ensures efficient transfer and distribution of heat throughout the storage system, minimising heat loss and optimising energy transfer.
- Environmental impact: Silicon is the second-most abundant element on the planet, after oxygen and TES silicon is able to undergo many cycles of heating and cooling without significant degradation. The process for producing silicon is carbon intensive- silica is blended with a carbon source and superheated in an arc furnace. However, the carbon intensity of SiBrick production is low in comparison to the amount of carbon saved over the lifetime of the SiBox.

Technology: The SiBox

The SiBox captures renewable energy from natural sources. The energy runs through the box, complete with a heating element, a silicon-based storage solution ("SiBrick") installed into the box's walls, and a heat recovery chamber. There are three operational phases in the 14D energy storage system - heating, storing, and energy recovery.

Energy storage technology: SiBox



Source: Company reports

1. Heating: Similar to the "charging" cycle in batteries, an electrical resistive heating element converts the renewable energy into heat, raising the temperature of the silicon to its melting point.

2. Storing: Once the transition temperature is reached, the silicon storage media will absorb heat at a constant temperature while it changes state. The silicon alloys melt as energy is absorbed while the outer containment material remains solid, keeping the particles in place. Although the system is able to hold heat for longer durations, commercial value is maximised by cycling on a daily basis, or even more frequently.

3. Energy recovery: During the discharge phase, the stored heat in the silicon is recovered to generate heat or power as required. Cold air is channelled through the system, reducing the silicon's temperature, causing the PCM to solidify. As this transition occurs, the silicon releases the stored latent heat, heating the passing air to a constant temperature. The discharge process yields high-temperature air output above 800°C, suitable for industrial use. The system operates without the need for a constant power input, ensuring a consistent and stable high-temperature heat supply, distinguishing it from sensible heat storage systems or simple heating elements.

Encasing silicon chips within a containment material enables phase transitions to occur (melting and re-solidifying), without the risk of leakage and reducing thermal expansion. As the SiBricks are heated and energy is absorbed, the chips melt while the containment material remains solid, holding the molten chips in place.

Temperature control system

To maintain a constant temperature and power flow rate, the temperature control system efficiently mixes the hot air with cooler air, providing precise and controlled energy output.

The TES landscape: Technology Comparison

Thermal Technology	Company	Process	Advantages
Latent Heat (Solid-Liquid)	1414 Degrees	Silicon storage – SiBrick TES system- SiBox 1. The SiBox captures renewable energy from natural sources 2. Electrical resistive heating element converts electricity into heat, raising the temperature of the silicon to its melting point 3. Once the transition temperature is reached, the silicon storage media will absorb heat at a constant temperature while it changes state 4. During the discharge phase, the stored heat in the silicon is recovered to generate heat or power as required.	- SiBrick is robust, and high energy density - SiBrick is highly conductive - Provides high-temperature air output, up to 1,000°C - Efficiency >90% - Lifespan of 20-25 years - Cost saving- Charging during periods of lower electricity prices - Modular & Scalable - Flexible energy output - Flexible location- plug &play - Can charge and discharge simultaneously
Latent Heat (Solid-Liquid)	MGA Thermal	Block- purpose invented material called Miscibility Gap Alloy (MGA) 1. The energy is stored in the solid-to-liquid phase change 2. Energy is released as the blocks cool and the particles become solid again.	- Sustainable - Recyclable - Long lifetime - 200-300% energy storage capacity - Modular - Safe
Latent Heat (Solid-Liquid)	TORC	1. Surplus electrical power is converted to thermal energy via a heat pump 2. Thermal energy stored in low temperature phase change material 3. Discharge through turbo generator- Thermal to power	- First low temperature long life storage solution - High energy density - Low temp phase change material- latent heat storage - High isothermal properties - Affordable - >20yr design life (>10,000 cycles) - Operating temperature- 70-130°C
Sensible Heat (Solids and Liquids)	Build to Zero	1. Store captured renewable energy in molten salt thermal storage media 2. Produce steam all day	- Continuous steam production - Latent heat energy storage - Behind-the-meter (BTM) industrial applications

Thermal Technology	Company	Process	Advantages
Sensible Heat (Solids and Liquids)	Kyoto	TES based on molten salt- Heatcube 1. Charge and discharge heat in the form of steam, using molten salt 2. Heatcube can produce saturated or superheated steam, according to customer requirements, and plug into existing pipes	- Plug and play - Stores energy from heat at up to 90% efficiency - Expected lifetime 20-30 years - Can charge and discharge simultaneously - Modular - Molten salt- commercially proven - Temperature range of heat- 170-400°C
Sensible Heat (Solids and Liquids)	Malta	1. Energy is gathered from wind, solar, or fossil generators on the grid 2. Electricity drives a heat pump, which converts electrical energy into thermal energy 3. The heat is stored in molten salt, while the cold is stored in a chilled liquid 4. Thermal energy converted back to electrical energy by heat engine 5. Electricity is sent back to the grid when it is needed.	- Flexible - Cost-Effective - Zero Waste, Circular Solution - Lifespan >30 years - Reliable Supply Chains - Abundant raw materials - Recyclable
Sensible Heat (Solids)	Antora	1. Uses excess solar and wind electricity to heat blocks of carbon to glowing-hot temperatures 2. Discharges electricity or process heat up to 1500°C, on demand	- Zero carbon heat - Affordable - Reliable - Compact & Siteable - Rapid charging - Modular - Safe - Flexible - Electricity or industrial process heat delivered at up to 1500°C

Thermal Technology	Company	Process	Advantages
Sensible Heat (Solids)	Brenmiller	Crushed Rocks fill bCells which are stacked into 40ft modules Elctrical Charging 1. The bGen unit is charged from renewable sources 2. Energy is piped through electric heaters embedded inside the TES system that convert the electricity into heat Thermal charging 3. Thermal sources could be used to charge the bGen 4. Heat is transferred into the storage media. When the module is discharging, the accumulated thermal energy is released, heats pressurized water, and generates steam	- Crushed rocks- can be sourced cleanly and ethically and are abundant and safe - Generate clean and steady heat - Utilise waste heat - Utilise low- tariff energy prices - Bgen can reach up to 750°C and discharge steam, hot water, or hot air at temperatures of ~500°C
Sensible Heat (Solids)	Echogen	1. Turns thermal energy into electricity, using sand as the storage medium 2. The process involves using a carbon dioxide heat pump cycle to convert electricity into thermal energy by heating the sand-based reservoir 3. Converted back into electricity on demand.	- Low capital cost - Full operational flexibility with no limit to cycling duty - Safe, environmentally benign materials - Zero augmentation costs - Higher projected reliability - Low environmental impact - LTR: -10 to -2°C– no cryogenic materials - HTR: 300-350°C
Sensible Heat (Solids)	Electrified Thermal Solutions	1. Joule Hive- a stack of electrically conductive firebricks in an insulated container 2. Charge- run electricity directly through the bricks to joule-heat them 3. The same bricks store thermal energy 4. Discharge- run air or another gas through the brick channels to provide constant, high temperature heat	- 3x cheaper than green hydrogen - Retrofitting available - Stores and delivers up to 1,800°C - Affordable- materials are abundant, stable and energy dense - Scalable - Provides decarbonised heat - up to 1,800°C

Source: Company websites

Long-duration energy storage

LDES technologies are designed to store energy in various forms for extended periods and when required provide a reliable and continuous power supply over prolonged timeframes - spanning hours, days, or seasons. Although there is no standardised definition of LDES, the U.S. Department of Energy's ("DOE") definition of 'long duration' is >10 hours discharge duration.

As the world transitions from fossil fuel-based energy systems to low-carbon alternatives, the adoption of LDES technologies is expected to play a pivotal role in addressing the variability of renewable energy generation, enhancing grid reliability, whilst supporting the decarbonisation of the energy system. It is estimated by the LDES Council that by 2040, LDES deployment could result in the avoidance of 1.5-2.3 Gt CO2 eq per year.

LDES Market

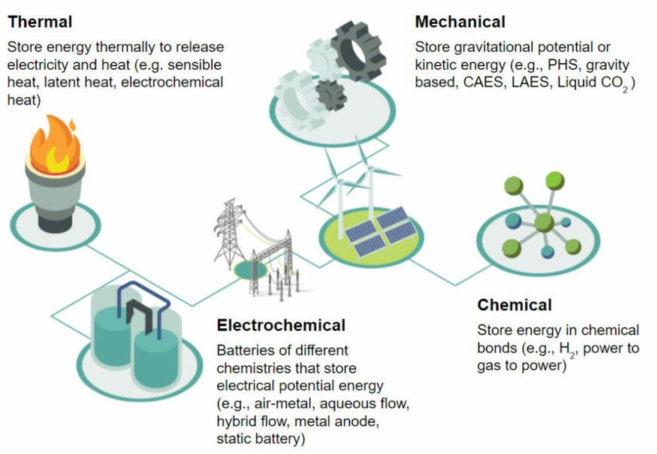
The transition to a sustainable and low-carbon energy future relies heavily on the development and integration of technologies such as LDES. As governments and companies recognise the critical role of LDES in future energy systems, investment in these technologies is steadily increasing, with a promising outlook for higher deployment rates in the coming years.

Recent progress in the LDES market is evident from the substantial commitments made by governments and companies, amounting to over US$58 billion since 2019. However, this represents only a fraction of the market's true potential. Research conducted by the LDES Council indicates the market could scale up exponentially, reaching a potential US$4 trillion by 2040, with the deployment of 8TW of LDES.

Types of LDES

LDES technology is broadly categorised into four types: electrochemical, chemical, thermal, and mechanical, each at varying levels of technological readiness. However, these solutions share the core function of effectively storing and discharging energy for extended periods, providing certainty in scaling up the utilisation of clean energy sources, which are inherently intermittent.

Four broad categories of LDES



Source: LDES Council

Thermal Energy Storage

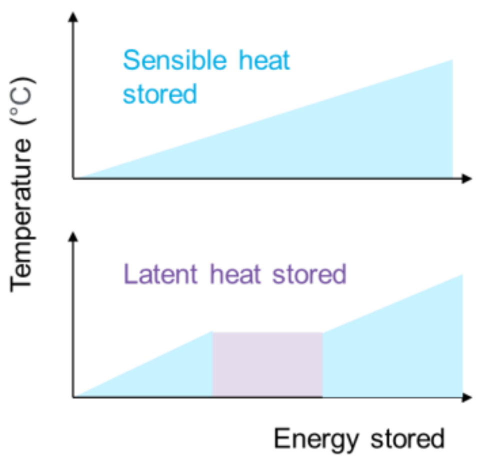
Thermal Energy Storage ("TES") addresses both power and heat decarbonisation. Notably, TES systems can deliver electricity or heat at its rated capacity for extended durations. Utilising renewable energy sources to heat or cool a storage medium, TES stores thermal energy to be used at a later time for heating or cooling applications and power generation. TES applications enable the storage of heat over different time scales, ranging from intra-day, daily, weekly, to even inter-seasonal storage.

Classification: Three types of TES:

1. Sensible heat storage: Sensible heat storage occurs when the temperature of a material is altered, without changing its phase or undergoing any chemical reactions. Common materials used for sensible heat storage include water, rocks, and concrete. Sensible heat storage stores thermal energy by increasing the temperature of a solid or liquid and then decreasing the temperature to discharge it. Sensible heat storage is the most commercially advanced type of thermal energy storage, with the primary type being hot water tanks.

2. Latent heat storage*:* Centres on the use of Phase-Change Materials ("PCM"). PCMs store and release energy during the phase transition, providing higher energy storage density compared to sensible heat storage. These materials undergo solid-to-liquid or liquid-to-solid phase changes (less common is the change of phase from liquid to gas), enabling them to store and release energy at a constant temperature within a narrow temperature range. A wide range of materials can be employed as storage medium including silicon, paraffin wax, and salts.

Sensible vs Latent heat Storage



Source: BloombergNEF

3. Thermochemical heat storage*:* Thermochemical heat storage harnesses reversible chemical reactions to store and release large quantities of energy. Through the combination or separation of two substances, heat is absorbed or released. Although, the system has the potential for high energy storage density, it is still in the early stages of implementation.

TES can support broad temperature ranges and energy storage durations

	Sensible heat	Latent heat	Thermochemical heat
Temperature	**<0–2,400°C** Most technologies able to span a large range of temperatures	**<0–1,600°C** Specific temperature ranges served by specific technologies	**0–900°C** Spans a smaller range of temperatures due to less variety in available technologies
Duration use case	**Minutes to months** Most technologies are able to serve intraday to multiday durations, with several being able to serve monthly durations	**Hours to days** Most technologies serve intraday to multiday durations	**Hours to months** Potential to serve intraday to monthly durations
Technical maturity	**Most commercially available** Most technologies are already commercially available with track records of pilots and use cases	**Some commercially available** Large range of technical maturity, with some already commercially available and others in the R&D phase	**Pilots and R&D stage** Relatively nascent with most technologies in the R&D or pilot phases

Source: LDES Council

Other types of LDES: Mechanical, Chemical & Electrochemical

Thermal Energy Storage is part of the wider, rapidly evolving LDES landscape. We provide a brief overview below of the other broad categories of storage systems: mechanical, chemical, and electrochemical. At present, we do not view other LDES forms are relevant substitutes for TES in industrial heating as they deliver energy as electricity. This would then need to be converted to heat, incurring additional efficiency losses. However, to the extent that widespread adoption of LDES could flatten the duck curve in the very long term, there could be some knock-on impact on the use case for TES systems.

Mechanical Energy Storage

Mechanical energy storage is based on storing energy in kinetic or potential form. The most prominent mechanical energy storage technologies include pumped hydro-storage ("PHS"), flywheels, gravity-based, compressed air energy storage ("CAES"), and liquid air energy storage ("LAES"). Mechanical systems have low energy density and thus a large physical footprint. Where feasible to construct, mechanical storage systems such as PHS are useful for balancing supply and demand at the grid scale. PHS is the most widely deployed and mature form of mechanical energy storage but is limited by location.

Chemical Energy Storage

The two most popular emerging technologies are based on power-to-gas concepts: power-to-hydrogen-to-power, and power-to-syngas (synthetic gas)-to-power. Power-to-gas conversion involves converting excess electricity from renewable sources into chemical energy through the production of gases such as hydrogen or methane. These gases can be injected into natural gas pipelines or stored in underground caverns for later use in power generation, heating, or transportation. Benefits of chemical energy storage include high energy density and long discharge durations.

Electrochemical Energy Storage

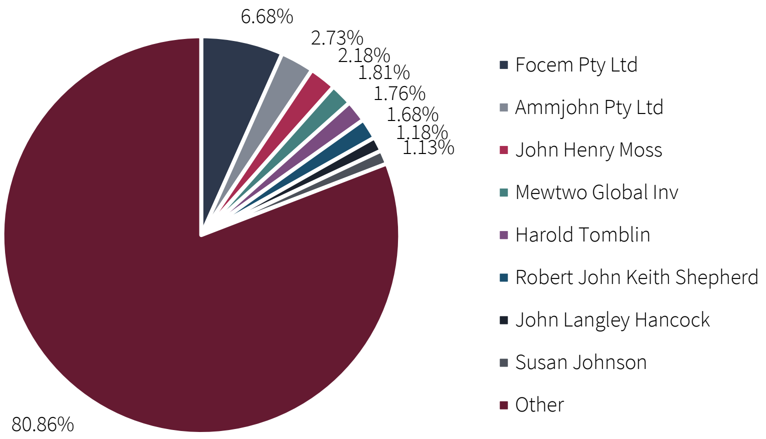
Electrochemical energy storage devices store energy in the form of chemical energy. A battery stores chemical energy and converts it to electrical energy. The conversion between chemical energy and electrical energy occurs through a process known as reduction and oxidation reactions. Electrochemical energy storage systems include batteries of varying chemistries, such as flow batteries, that utilise liquid electrolyte as the energy storage medium or a metal air battery, with a metal anode, which is oxidised while discharging to generate an electric current.

Lithium-ion batteries are widely implemented and hold a high market share within the energy storage market; however, the technology is not optimised for application beyond ~4 hours. As such, the focus of this section is on non-lithium options at 10+ hours of discharge. Other forms of non-metal battery chemical storage systems are also being researched.

Appendices

Corporate Overview

1414 Degrees – Major Shareholders



Source: Bloomberg

Shareholders	Number of Shares (Million)	% of Total Shares
Focem Pty Ltd	15.9	6.68%
Ammjohn Pty Ltd	6.5	2.73%
John Henry Moss	5.2	2.18%
Mewtwo Global Inv	4.3	1.81%
Harold Tomblin	4.2	1.76%
Robert John Keith Shepherd	4.0	1.68%
John Langley Hancock	2.8	1.18%
Susan Johnson	2.7	1.13%
Other	192.6	80.86%
Total	**238.2**	**100.0%**

Source: Bloomberg (29/09/2023)

Board of Directors & Key Management

Name	Title	Tenure	Profile
Dr Kevin Moriarty	Executive Chairman	7 years	• Dr Moriarty has over 40 years of mining and oil exploration and development experience and over 30 years of corporate experience in roles including Chairman and Managing Director of listed companies • He founded and led several companies to develop mines in Australia and Africa • Served as Executive Chairman of 1414 Degrees for 5 years until retiring in 2021, and was re-elected in 2022 • Obtained a BSc Hons degree in Physics and Geology from University of Adelaide and completed his PhD in Geological and Earth Sciences / Geosciences from Flinders University. He is a member of MAusIMM
Dr Mahesh Venkataraman	Chief Technology Officer	4 years	• Dr Venkataraman has over 10 years' experience in technological research in high temperature materials, thermal storage, solar thermochemistry, and renewable energy integration • He leads the engineering and R&D teams at 1414 Degrees • Previously worked at renowned academic institutions including the Australian National University, University of Connecticut and Monash University • Has active collaborations with several universities and national labs in Australia and overseas • Completed his BTech (Metallurgical & Materials Engineering) from IIT, Kanpur (India) and PhD in Mechanical and Aerospace Engineering from Monash University (Australia)
Josh Zowtyj	SiBox Development Manager	6 years	• Mr Zowtyj is a qualified mechanical engineer, with over 9 years' experience. He has worked on a wide range of projects across industries including cement, food processing, mining, and energy • His previous experience includes working at Ammjohn and GHR Logistics as a Mechanical Engineer • He holds a bachelor's degree in mechanical engineering, from the University of Adelaide

Name	Title	Tenure	Profile
Katelyn Adams	Company Secretary		• Katelyn has more than 15 years' accounting and company secretarial experience, servicing mainly ASX listed companies • She holds a Bachelor in Commerce
Maretta Layton	Communications and Engagement Lead	1 year	• Ms Layton has been in her role as Communications and Engagement Lead for 9 months, however, she previously worked at 1414 Degrees for 5 years 6 months as a Business Development & Marketing Manager • She has extensive experience in Marketing, working in the hospitality industry, before moving to 1414 Degrees
Graham J. Dooley	Non-Executive Director	1 year	• Mr Dooley is an accomplished Non-Executive Director, Managing Director and Chairman with extensive infrastructure and investment experience • Currently holds several roles, including Non-Executive Director of IWS Group, Director of Water Authority of Fiji, Senior Advisor with First Sentier Investors and to Local Government in South Australia, among others • Previously established and served as Managing Director of United Utilities Australia (now Trility) from 1991-2007 • He also held non-executive roles with the Blue Sky Group, including chair of Water Utilities Australia Group • Holds BE degree in Civil Engineering from University of Sydney and Masters of Public Administration degree in Finance and Economics from American University
Randolph Bowen	Non-Executive Director	1 year	• Mr Bowen is a strategic management executive with many years of experience • He is the Director and Proprietor of Seppeltsfield Wines and holds directorships with Balthazar Barossa, Bunyip Water, Duxton Vineyards and Pure Wine Distributors • Previously, he served as the Senior Vice President, Global Supply Chain at the Fosters Group • Holds Bachelor in Applied Science degree in Winemaking and is a Graduate from the Australian Institute of Company Directors

Source: Company Website, LinkedIn

Company History

- **11th August 2009**: Incorporated as Gnomon Technologies Pty Ltd
- **2nd June 2014**: Changed its name to Latent Heat Storage Pty Ltd
- **September 2016**: Successfully commissioned a prototype of its large-scale Thermal Energy Storage System (TESS)
- **8th December 2016**: Converted to public Company and changed its name to 14D Degrees Limited
- **5th December 2017**: Received a grant of $1.6m from the South Australian Government's Renewable Technology Fund
- In 2017, 14D also raised $7.5m from private investors
- **12th September 2018**: Raised $16.3m in an IPO and began trading on ASX under the ticker 14D
- **17th October 2018:** Signed a project development agreement with SA Water for construction of the Company's GAS-TESS device at SA Water's Glenelg wastewater treatment plant
    - It was the world's first, biogas powered, thermal energy storage system
- **15th January 2019**: Commissioning of the first TESS-IND verified by Bureau Veritas Asset Integrity and Reliability Services Pty Ltd
- **15th April 2019**: Commenced the commissioning of GAS-TESS at Glenelg wastewater treatment plant; it was completed in May end.
- **11th July 2019**: GAS-TESS recognised as an embedded generator on the National Electricity Market ("NEM")
- **1st August 2019**: Signed MoU with Nectar Farms Management Limited, Ampcontrol SWG Pty Ltd, and BE Power Solutions Pty Ltd to identify and develop SmartFarm projects using TESS
- **12th December 2019**: Acquired 100% of the issued shares in SolarReserve II Pty Ltd (renamed to SiliconAurora Pty Ltd)
    - Silicon Aurora owns the Aurora Energy Project near Port Augusta in South Australia and includes development approval from the South Australian government for a Battery Energy Storage System (BESS) up to 140 MW / 280 MWh, 70 MW solar PV and 150 MW CSP as well as connection to the adjacent 275 kV transmission line
- **9th September 2020**: Signed MoU with Vast Solar to investigate the commercial feasibility of incorporating Vast Solar's modular CSP technology in a dispatchable renewable energy park

- 16th October 2020: GAS-TESS recommissioned in preparation for power export to the grid
- 2nd February 2021: Aurora project received Crown Sponsorship from the South Australian Government to support construction of a battery and the Company's TESS-GRID
    - The sponsorship was extended in May 2021 to support an increase of the battery storage component
- 13th October 2021: Entered into a partnership with Woodside Energy Technologies Pty Ltd ("Woodside") for up to $2m to support further development of the Company's SiBo technology. Included provision for Woodside to earn up to 49% of SiBox IP by funding further development
- 18th November 2021: Awarded a $2.2m Modern Manufacturing Initiative grant from the Australian Government to accelerate the commercialisation of its SiBox thermal energy storage technology
- 20th December 2021: Entered into an exclusivity MoU with Ovida Infrastructure Pty Ltd to develop the Aurora Energy Project; however, the partnership was terminated in April 2022 due to a change in Ovida's strategic priorities
- 15th June 2022: Sold 50% shares in Silicon Aurora to Vast Solar Pty Ltd and formed a 50:50 JV to govern the ongoing operation of Silicon Aurora and the development of the Aurora Energy Project
- 1st December 2022: Higher revenue outlook for a battery on Aurora Project based on various scenarios for a 140MW BESS connected to the NEM through the 275kV transmission line at the site
- 27th February 2023: The silicon storage media was heated to 1414°C in the SDM in preparation for commissioning and cycling
- 17th March 2023: Receipt of $847,000 grant funding tranche from the Australian Federal Government's Modern Manufacturing Initiative ("MMI")
- 9th May 2023: The SDM's first full cycle of commissioning tests demonstrated the SiBox was performing to expectations for supply of high temperature industrial heat
- 30th May 2023: Aurora Energy Project update- the joint venture is progressing well. Due to ownership changes and ongoing discussions with BHP regarding sharing the transmission line, site works are now scheduled to commence in early 2024
- 31st May 2023: The 14D Brick renamed as SiBrick and trade mark applied for
- 6th July 2023: Strategic partnership agreement signed with Refratechnik-Steel GmbH, to trial manufacture 600 SiBricks
- 20th July 2023: Shareholders advised of Non-Renounceable Pro-Rata Entitlement Offer

- 11th August 2023: Key funding milestone achieved in Woodside agreement with successful commissioning of the SDM

- 18th August 2023: Entitlement Offer strongly supported by shareholders. The Company received total applications from Eligible Shareholders of ~A$1.471m

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