Exceptional Initial Results on Sodium Ion Battery Materials Project

HIGHLIGHTS

- **Multiple trials have produced hard carbon anodes averaging ~45% higher reversible capacities as compared to commercial hard carbon anode materials**
- **New hard carbon processing technology is significantly faster and less energy intensive than conventional pyrolysis**
- **Rapidly building momentum in the sodium ion batteries industry with several global players commencing commercialisation activities in 2023**

Sparc Technologies Limited (ASX: SPN) (**Sparc** or the **Company**) is pleased to provide an update on its project with Queensland University of Technology (**QUT**) targeting development of sustainably sourced hard carbon anode material for sodium ion batteries (**SIBs**).

A high performing, low cost, sustainably sourced anode material for SIBs will meet a need for what is a growing alternative battery technology. Current hard carbon materials are typically sourced from carbonaceous precursors such as pitch (a by-product of the oil & gas industry) which undergo lengthy heating at high temperatures. This is a very energy consuming process, which combined with using a fossil fuel derived feedstock, has a significant environmental footprint. Furthermore, with China being the world's dominant supplier of hard carbon materials, the process under development with QUT aims to provide an alternative western supply of anode materials thereby reducing sovereign risk for SIB cell manufacturers.

Sparc Technologies Ltd. Executive Chairman, Stephen Hunt commented:

> *"Sparc is very encouraged by the positive results from its research program with QUT into the development of sustainable hard carbon anode materials for sodium ion batteries. The combination of green bio-waste feedstock and faster, less energy intensive processing with a very high capacity anode material offers attractive potential for further research and development.*
>
> *Equally as exciting is the continued progress of sodium ion batteries towards commercialisation as evidenced by recent activities of major global battery producers including CATL, BYD and Reliance Industries. Sparc is well positioned as one of the only ASX listed companies actively targeting sodium ion batteries."*

In line with the project schedule, QUT has delivered the first project milestone report which describes the results of SIB half-cell battery testing and material characterisation for a sustainably sourced anode material under a range of process conditions. Whilst further optimisation, testing and process development work is required, reversible capacities for a batch of materials under the same testing conditions exceeded 535mAh/g and averaged 477mAh/g across five separate trials. This was well beyond (~45% higher) the benchmark of 330mAh/g set at the beginning of the research program based on what is believed to represent commercial hard carbon anode materials (See Figure 1).

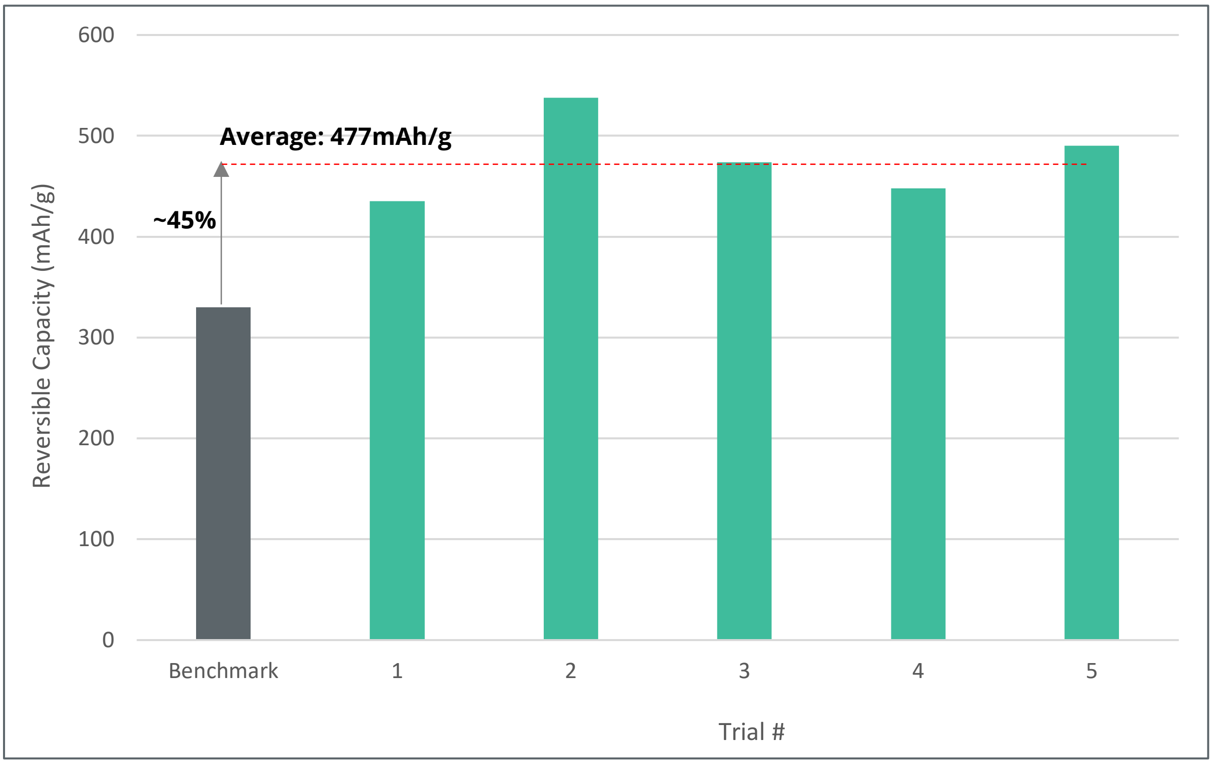

Figure 1 – Hard carbon anode discharge capacity from preliminary optimised process conditions (QUT research project)

Significant progress has been made since commencing the research project with QUT in September 2022. Preliminary optimisation of the process conditions under which the hard carbon is produced has been performed and the initial results demonstrate substantial improvement in reversible capacities of the anode materials in a SIB versus traditional pyrolysis methods.

Material characterisation of the hard carbon samples using various characterisation techniques (XRD, XPS, Raman, TEM, SEM, and BET) has been performed and will provide a basis for comparison in future test work, such as trialling alternative feedstock sources and process parameters.

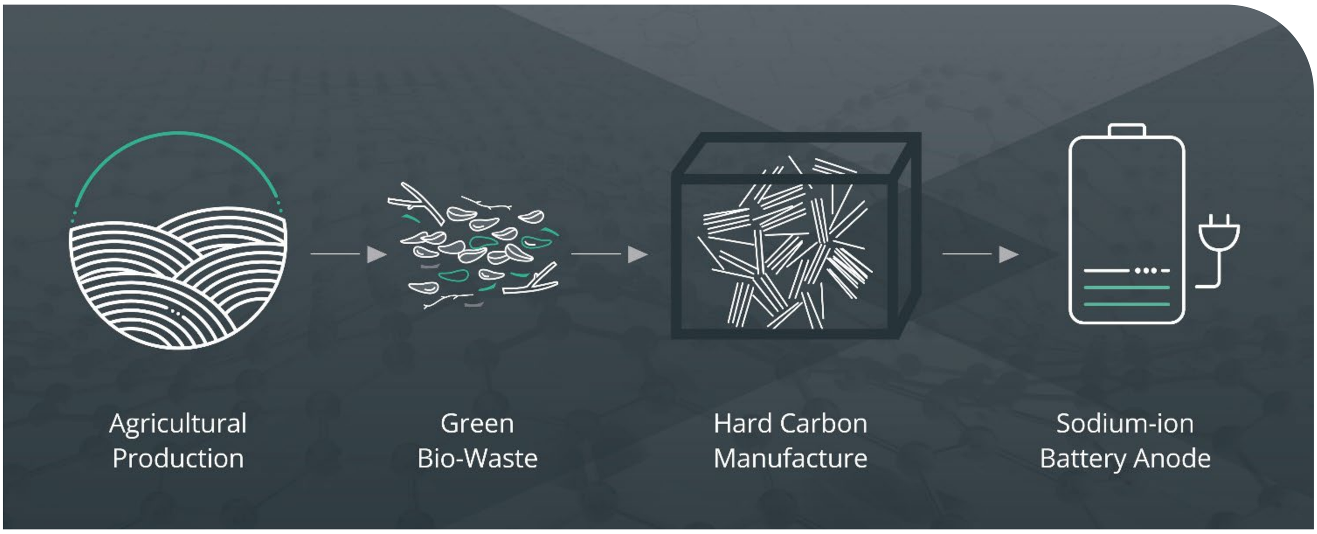

Figure 2 - Hard carbon production using low cost sustainably sourced green bio-waste process schematic

Sodium-ion battery performance of samples (in half-cell configuration) has been tested using electrochemical methods such as galvanostatic charge/discharge – capacity and cycling stability. Several coin cells (5 cells for each hard carbon sample) were made for each electrode to ensure the reproducibility of the measurements and commercial mass loadings and low C-rates (0.05) were used.

Future work will focus on testing cycling stabilities up to 500 cycles, trialling methods to improve initial coulombic efficiencies and fabrication and testing of full cells. Sparc has ~6 months to run on the research program with QUT and continues to engage with an experienced battery consultant on the project.

Sparc is planning to further explore the magnitude of energy and cost savings achievable through using the proposed processing route over existing hard carbon materials via life cycle analysis and economic modelling over the coming months.

SIBs are a very prospective alternative battery chemistry to lithium ion, particularly suited to energy storage markets. Well known and documented advantages of SIBs versus lithium ion batteries include:

- Lower cost and greater availability of raw materials.
- Safety and ease of transport.
- Greater operating temperature range.
- Similar manufacturing techniques to lithium ion batteries

Parameters	Lead Acid	Lithium ion	Sodium ion
Bill of Materials Cost	Low	High	Low ✓
Energy Density	Low	High	Moderate/High ~
Safety	Moderate	Low/Moderate	High ✓
Materials	Toxic	Scarce	Earth-abundant ✓
Stability	Moderate (high self-discharge)	High (negligible self-discharge)	High (negligible self-discharge) ✓
Efficiency	Low (< 75%)	High (> 90%)	High (> 90%) ✓
Temperature Range	-40 ^{0}C to 60 ^{0}C	-25 ^{0}C to 40 ^{0}C	-40 ^{0}C to 60 ^{0}C ✓
Remarks	Mature technology; fast charging not possible	Transportation restrictions; critical materials	Less mature but developing as an alternative to Li-ion

Figure 3 – Comparison and advantages of sodium ion batteries with existing battery technologies (adapted from evreporter.com)

These benefits, in particular around supply and cost of raw materials, have seen growing activity by energy developers, original equipment manufacturers (OEMs) and venture capital investors in SIBs. Commercialisation of SIBs for energy storage and mobility applications is targeted in 2023 by CATL, BYD, Reliance / Faradion and HiNa Battery. The requirement for the continued promotion and development of SIB technology has been noted by CATL.

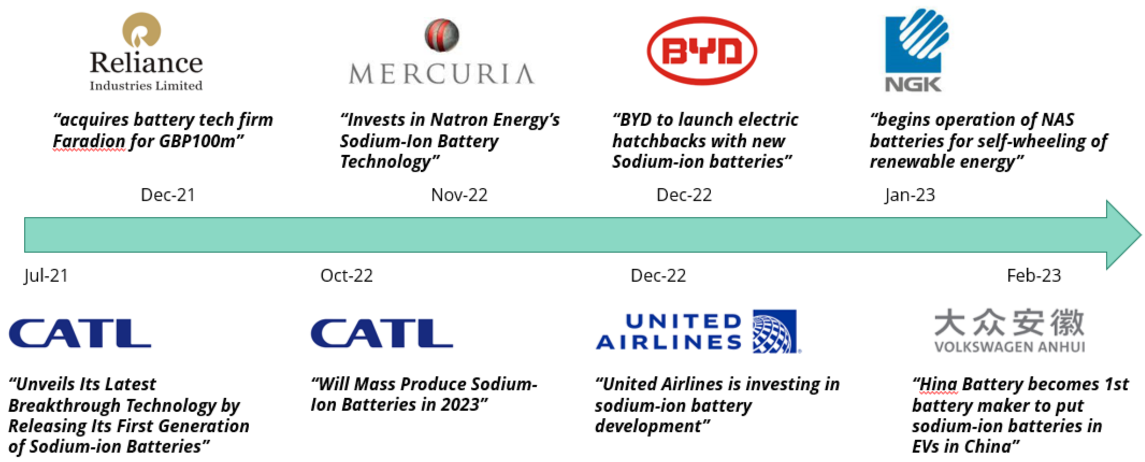

Figure 4 - Recent news flow in relation to sodium ion battery investment and commercialisation

Glossary of terms

Sodium ion batteries: Type of rechargeable battery that uses sodium ions (Na+) as the charge carrier instead of lithium ions (Li+), which are used in conventional lithium-ion batteries. Sodium ion batteries are similar in structure and operation to lithium ion batteries.

Anode: In a sodium ion battery, sodium ions and electrons are stored in the anode as the device is charged, and released as it is discharged.

Hard carbon anode: Carbon-based material with a largely disordered structure, commonly used as the anode in sodium ion batteries.

Pyrolysis: Chemical process that involves the thermal decomposition of organic materials in the absence of oxygen.

Reversible (specific) capacity: Scientific term used to establish the energy storage capacity of the active material in a battery. Units are typically milliamp hours per gram (mAh/g). It allows researchers to describe direct measurement of active material performance without taking into account the weight of other battery components such as packaging, separators and current collectors. Reversible capacity typically refers to the capacity that remains after several cycles.

C-rate: A measure of how fast a cell delivers or receives energy. In simple terms a 1C rate is a current draw sufficient to fully charge or discharge a cell in 1 hour. A 4C rate would be the full charge or discharge in 15 minutes. The C rate is useful as it can be applied irrespective of the size of cell.

Initial coulombic efficiency: Coulombic efficiency, also called faradaic efficiency or current efficiency, is the percentage of electrons that can be removed from the battery after charging. Initial coulombic or first cycle efficiency is the percentage of charge that is removed after the first cycle. First cycle charging is commonly inefficient relative to subsequent cycles, and first cycle capacity is commonly excluded from calculations of reversible capacity.

Mass loading: The weight of the dried electrode slurry on the current collector over a unit area, typically in units of mg/cm^2.

Cycling stability: The cycling stability or cycle life of a battery is the number of charging / discharging cycles the battery can complete before its capacity is reduced to a predetermined amount of its reversible capacity, for example to 80%.

-ENDS-

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About Sparc Technologies

Sparc Technologies Limited (ASX: SPN) is an Australian company pioneering new technologies to disrupt and transform industry while seeking to deliver a more sustainable world. Sparc Technologies has established offices in Europe and North America.

Graphene, a major focus for Sparc Technologies, is a 2-dimensional material made of carbon atoms arranged in a hexagonal lattice which creates unique and powerful properties that can be imparted on products to improve performance. Sparc Technologies is commercialising graphene in a number of applications including Graphene Based Additives for the Protective and Marine Coatings market along with applications in the renewable energy and construction materials sectors.

Sparc Technologies, via its majority interest in Sparc Hydrogen, is also focussed on developing photocatalytic green hydrogen technology that does not require solar and/or wind farms, nor electrolysers as with conventional green hydrogen processes.