

ASX Announcement ([ASX: AXE](#))

27 July 2023

## Q4 FY23 Activities Report and Appendix 4C

For the quarter ended 30 June 2023.

---

### Overview

- Archer Materials achieves major coherence time milestone at room temperature for its <sup>12</sup>CQ chip qubit material, increasing the time-window for processing quantum information at room temperature beyond that for any known, similar qubit materials.
  - Archer engineers its qubit material giving rise to unprecedented quantum functionality at room temperature in air, which is a significant advantage over qubit proposals that are difficult to integrate onboard modern day devices.
  - Biochip first-generation graphene technology design transferred to a commercial fab to verify scalability, following completion of a proof of concept biosensing transistor.
  - Archer Materials becomes first Australian company to partner with the World Economic Forum's Centre for the Fourth Industrial Revolution, providing direct access for global collaborators to utilise Archer's semiconductor technology.
  - Strong cash position with \$23.3 million and no debt.
- 

Archer Materials Limited ("Archer", the "Company", "ASX: AXE"), a semiconductor company advancing the quantum computing and medical diagnostics industries, provides its Quarterly Activities Report and Appendix 4C for the quarter ended 30 June 2023 ("Quarter").

### Commenting on Q4 FY23 activities, Greg English, Executive Chairman of Archer, said

"During the Quarter, the Archer team showed that the electrons in the specially prepared qubit material can hold quantum information for over 230 nanoseconds (coherence time) at room temperature. Long quantum coherence times are crucial for qubit materials in quantum computing, giving the qubit more time to complete sophisticated calculations."

"The team used a combination of treatment techniques to create the qubit material with a long coherence time at room temperature. The team increased coherence time while maintaining the intrinsic metallic-like character of the qubit material, which was a great outcome."

"Biochip development continued during the Quarter with a biosensing graphene transistor design sent to a commercial foundry to make the devices on a multi-project wafer. The goal is to optimise the design and then select the design that works the best and can be easily scaled up for commercial production. By the end of 2023, the Company should receive the first batch of chips from the foundry."

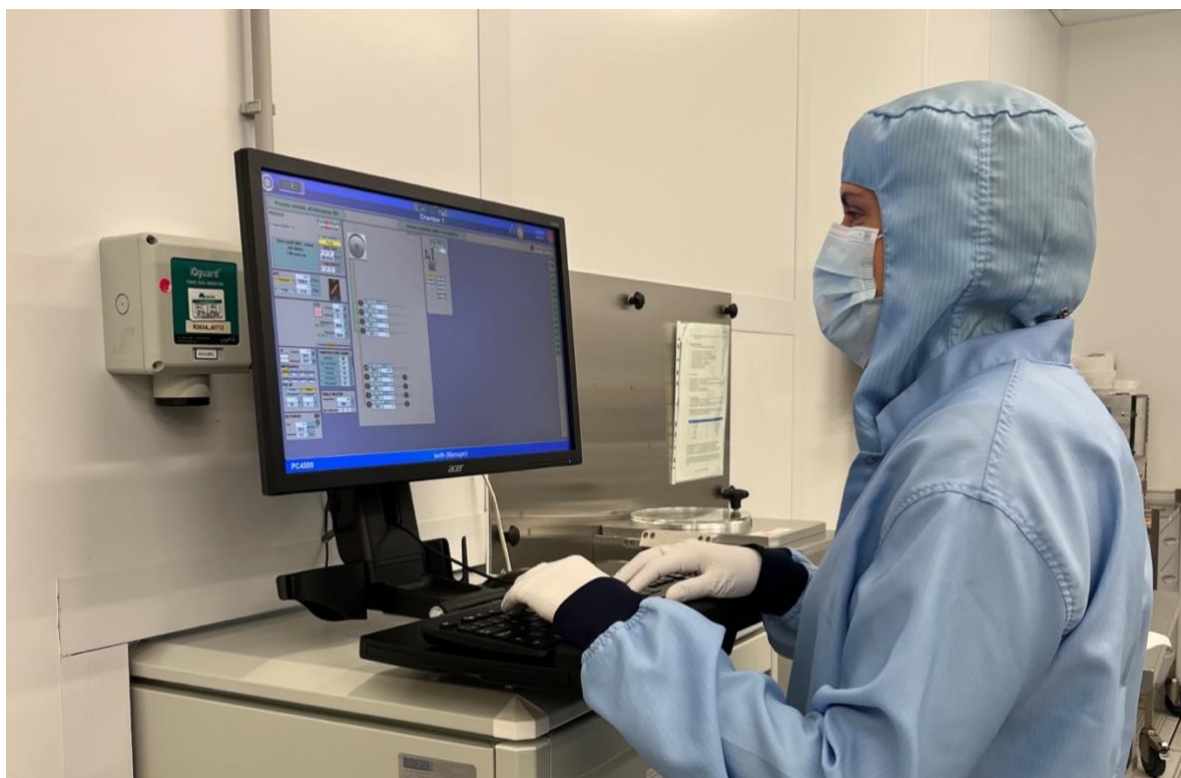
"Archer joined the World Economic Forum and became the first Australian company to partner with the World Economic Forum's Centre for the Fourth Industrial Revolution, opening several potential collaborative opportunities for Archer."

## Technology development and commercialisation activities

### <sup>12</sup>CQ chip

During the Quarter, the Archer team reached significant milestones in the room temperature functionality of its cutting-edge qubit material. This included unprecedented electron spin coherence times exceeding 230 nanoseconds at room temperature<sup>1</sup> while maintaining the intrinsic metallic-like character of the qubit material. This was achieved by making the qubit material using a different precursor and applying post-synthesis treatments.

Archer believes that no other similar nanomaterial has been shown to achieve such long-lived electron spin coherence at room temperature<sup>2</sup>. The long room temperature quantum coherence times had previously<sup>3</sup> only been achieved for the qubit material at extremely low temperatures of approximately -173°C. In the context of qubit processor development, the increase in quantum coherence time at room temperature is significant.



**Image 1.** Archer staff in a research and prototyping semiconductor foundry in Sydney, Australia, operating some of the instruments used to encapsulate the qubit material.

Archer increased its qubit material room temperature capabilities by over 30%, meaning it can now routinely prepare qubit material maintaining quantum superposition states for over 30% longer than previously achieved at room temperature<sup>3</sup>. Extending quantum coherence times links to executing more sophisticated quantum algorithms and reliable quantum computations.

<sup>1</sup> At 21.85°C. The quantum coherence measurement was performed with the qubit material sample under vacuum.

<sup>2</sup> Origin of metallic-like behavior in disordered carbon nano-onions. Carbon, Vol 208, May 2023, Pages 303-310 (<https://www.sciencedirect.com/science/article/pii/S0008622323002166>)

<sup>3</sup> Room temperature manipulation of long lifetime spins in metallic-like carbon nanospheres. Nature Communications, Vol 7, July 2016, Article 12232 (<https://www.nature.com/articles/ncomms12232>)

Despite the long quantum coherence times reached, there was a need for a vacuum or inert atmosphere when operating the qubit material to preserve viable quantum coherence times. To advance the Company's <sup>12</sup>CQ chip development, there is a requirement for simple and practical solutions to address quantum decoherence caused by air on the qubit material.

During the Quarter, the Archer team for the first time also preserved the qubit materials' quantum coherence times and properties at room temperature in air while maintaining the intrinsic metallic-like character of the qubit material. Importantly, the quantum coherence times meet the lower-bound requirements to perform gate operations for quantum information processing. In the context of qubit processor development, applying foundry-compatible processes to readily handle and process a qubit material while preserving quantum coherence is significant.

The Archer team was able to achieve this pivotal development by applying methods of atomic layer deposition and also plasma enhanced chemical vapour deposition, to encapsulate the qubit material with atom-layer control over nanometre and micrometre thin films of metal oxides and other semiconductors.

The encapsulation processes are performed in a semiconductor foundry (Image 1). A typical example of encapsulation included approximately 20-25 atomistic layers on the nanometer sized qubit material that was processed in conformations relevant to planar device architectures. The Company filed a provisional patent related to qubit encapsulation and coherence.

The milestones reached during the Quarter link to the future operation of Archer's <sup>12</sup>CQ chip, as the number of quantum control pulses performed in a quantum algorithm is directly related to the quantum coherence time. The development potentially broadens the application space for Archer's qubit material that would be suited to more normal operating environments.

### **Archer's Biochip**

Archer's biochip innovation aims to integrate graphene field effect transistors ("gFETs") into advanced fluidic systems to create miniaturised lab-on-a-chip device platforms for medical diagnostics. This could potentially enable the ability to parallelise the detection of multiple biologically relevant targets, on a chip.

During the Quarter, the Company completed a proof of concept biosensing graphene transistor for use in its biochip, and submitted the technology design to a commercial foundry to verify scalability. The gFET design transfer to a foundry partner follows the completion of Archer's optical lithography-compatible chip layout, which is designed to scale more easily to produce complete wafers in collaboration with commercial foundries.

The Archer-designed gFET sensing chips will be produced by a commercial foundry, with the aim of Archer validating its design to ensure appropriate scalability for the manufacturing process. Archer expects completed runs to arrive at the end of 2023. The runs will be evaluated to test which foundry and process are best suited to Archer's technology. Archer's design and process can then be scaled to manufacture complete wafers containing the graphene-based sensors for biochip integration in collaboration with a range of different commercial foundries.

Archer has, in parallel, started discussions with potential global foundry partners for initial small production runs of its graphene chip designs to evaluate the reliability of the product.

## **World Economic Forum C4IR Partnership**

During the Quarter, Archer become the first Australian company to partner with the World Economic Forum's Centre for the Fourth Industrial Revolution ("C4IR"). Archer will join as an Australian industry representative at C4IR alongside other advanced technology centres.

Archer will contribute across several channels through the C4IR partnership, including working with organisations looking to utilise the Company's semiconductor technology, public and private sector collaborators, strategic partnerships for product development, and paths to capital streams.

The C4IR partnership complements Archer's work at a macro level through its other strategic cooperation with GlobalFoundries, Taiwan Semiconductor Manufacturing Company Limited, the Australian Institute for Machine Learning, and École Polytechnique Fédérale de Lausanne, to secure future semiconductor product manufacturing capability and to support technology development.

## **Financial and corporate update**

The Company's cash balance at the end of the Quarter was \$23,317,462.

The Company holds 1,633,944 shares in Canadian Stock Exchange listed Volatus Capital Corp (CSE:VC) and 11,571,119 shares and 2,892,780 quoted options in ASX listed ChemX Materials Ltd (ASX:CMX).

Archer's accompanying Appendix 4C cashflow report for the Quarter includes an amount of \$128,000 at item 6.1, relating to executive and non-executive director fees paid as salaries and wages.

## **Events and outreach**

Archer distributed several newsletters, research, and explainers during the quarter including:

- Explainer Article: [Storing quantum states](#)
- June Newsletter: [Record-setting qubit material for practical use](#)
- Explainer Article: [Streamlining Archer's quantum measurements, instrument control and data analysis](#)
- May Newsletter: [Archer partners with the World Economic Forum](#)
- Research Article: [Archer-EPFL study explores origins of metallic states in carbon onions](#)
- April Newsletter: [The first supercomputer generated models of Archer's qubit material](#)

The Board of Archer authorised this announcement to be given to ASX.

### **Investor enquiries**

Eric Kuret  
+61 417 311 335  
[eric.kuret@automicgroup.com.au](mailto:eric.kuret@automicgroup.com.au)

### **Media enquiries**

Tristan Everett  
+61 403 789 096  
[tristan.everett@automicgroup.com.au](mailto:tristan.everett@automicgroup.com.au)

## About Archer

Archer is a technology company that operates within the semiconductor industry. The Company is developing advanced semiconductor devices, including chips relevant to quantum computing and medical diagnostics. [www.archerx.com.au](http://www.archerx.com.au)

## Appendix 4C

### Quarterly cash flow report for entities subject to Listing Rule 4.7B

**Name of entity**

Archer Materials Limited
--------------------------

**ABN**

64 123 993 233
----------------

**Quarter ended ("current quarter")**

30 June 2023
--------------

<b>Consolidated statement of cash flows</b>	<b>Current quarter \$A'000</b>	<b>Year to date (12 months) \$A'000</b>
<b>1. Cash flows from operating activities</b>		
1.1 Receipts from customers	-	-
1.2 Payments for		
(a) research and development (exclusive of wages allocated to R&D)	(201)	(507)
(b) product manufacturing and operating costs	-	-
(c) advertising and marketing	-	-
(d) leased assets	(6)	(11)
(e) staff costs	(693)	(2,855)
(f) administration and corporate costs	(230)	(938)
1.3 Dividends received (see note 3)	-	-
1.4 Interest received	44	228
1.5 Interest and other costs of finance paid	-	-
1.6 Income taxes paid	-	-
1.7 Government grants and tax incentives	-	1,046
1.8 Other (provide details if material)		
<b>1.9 Net cash from / (used in) operating activities</b>	<b>(1,086)</b>	<b>(3,037)</b>

<b>2. Cash flows from investing activities</b>		
2.1 Payments to acquire or for:		
(a) entities	-	-
(b) businesses	-	-
(c) property, plant and equipment	-	(61)
(d) investments		
(e) intellectual property	(59)	(125)

Consolidated statement of cash flows	Current quarter \$A'000	Year to date (12 months) \$A'000
(f) other non-current assets	-	-
2.2 Proceeds from disposal of:		
(a) entities	-	-
(b) businesses	-	-
(c) property, plant and equipment	-	-
(d) investments	-	-
(e) intellectual property	-	-
(f) other non-current assets	-	-
2.3 Cash flows from loans to other entities	-	-
2.4 Dividends received (see note 3)	-	-
2.5 Other (provide details if material)	-	-
<b>2.6 Net cash from / (used in) investing activities</b>	<b>(59)</b>	<b>(186)</b>

<b>3. Cash flows from financing activities</b>		
3.1 Proceeds from issues of equity securities (excluding convertible debt securities)	-	-
3.2 Proceeds from issue of convertible debt securities	-	-
3.3 Proceeds from exercise of options	-	76
3.4 Transaction costs related to issues of equity securities or convertible debt securities	-	-
3.5 Proceeds from borrowings	-	-
3.6 Repayment of borrowings	-	-
3.7 Transaction costs related to loans and borrowings	-	-
3.8 Dividends paid	-	-
3.9 Other (provide details if material)	-	-
<b>3.10 Net cash from / (used in) financing activities</b>	<b>-</b>	<b>76</b>

<b>4. Net increase / (decrease) in cash and cash equivalents for the period</b>		
4.1 Cash and cash equivalents at beginning of period	24,462	26,464
4.2 Net cash from / (used in) operating activities (item 1.9 above)	(1,086)	(3,037)
4.3 Net cash from / (used in) investing activities (item 2.6 above)	(59)	(186)

<b>Consolidated statement of cash flows</b>		<b>Current quarter \$A'000</b>	<b>Year to date (12 months) \$A'000</b>
4.4	Net cash from / (used in) financing activities (item 3.10 above)	-	76
4.5	Effect of movement in exchange rates on cash held	-	-
<b>4.6</b>	<b>Cash and cash equivalents at end of period</b>	<b>23,317</b>	<b>23,317</b>

<b>5.</b>	<b>Reconciliation of cash and cash equivalents</b> at the end of the quarter (as shown in the consolidated statement of cash flows) to the related items in the accounts	<b>Current quarter \$A'000</b>	<b>Previous quarter \$A'000</b>
5.1	Bank balances	772	3,417
5.2	Call deposits	22,545	21,045
5.3	Bank overdrafts	-	-
5.4	Other (provide details)	-	-
<b>5.5</b>	<b>Cash and cash equivalents at end of quarter (should equal item 4.6 above)</b>	<b>23,317</b>	<b>24,462</b>

<b>6.</b>	<b>Payments to related parties of the entity and their associates</b>	<b>Current quarter \$A'000</b>
6.1	Aggregate amount of payments to related parties and their associates included in item 1 * The above payments relate to fees and salaries paid to Directors during the quarter.	128
6.2	Aggregate amount of payments to related parties and their associates included in item 2	-
<i>Note: if any amounts are shown in items 6.1 or 6.2, your quarterly activity report must include a description of, and an explanation for, such payments.</i>		



## Quarterly cash flow report for entities subject to Listing Rule 4.7B

<b>7. Financing facilities</b>	<b>Total facility amount at quarter end \$A'000</b>	<b>Amount drawn at quarter end \$A'000</b>
<i>Note: the term "facility" includes all forms of financing arrangements available to the entity.</i>		
<i>Add notes as necessary for an understanding of the sources of finance available to the entity.</i>		
7.1 Loan facilities	-	-
7.2 Credit standby arrangements	-	-
7.3 Other (please specify)	-	-
7.4 <b>Total financing facilities</b>	-	-
7.5 <b>Unused financing facilities available at quarter end</b>		n/a
7.6 Include in the box below a description of each facility above, including the lender, interest rate, maturity date and whether it is secured or unsecured. If any additional financing facilities have been entered into or are proposed to be entered into after quarter end, include a note providing details of those facilities as well.	n/a	

<b>8. Estimated cash available for future operating activities</b>	<b>\$A'000</b>
8.1 Net cash from / (used in) operating activities (item 1.9)	(1,086)
8.2 Cash and cash equivalents at quarter end (item 4.6)	23,317
8.3 Unused finance facilities available at quarter end (item 7.5)	-
8.4 Total available funding (item 8.2 + item 8.3)	23,317
8.5 <b>Estimated quarters of funding available (item 8.4 divided by item 8.1)</b>	21 quarters
<i>Note: if the entity has reported positive net operating cash flows in item 1.9, answer item 8.5 as "N/A". Otherwise, a figure for the estimated quarters of funding available must be included in item 8.5.</i>	
8.6 If item 8.5 is less than 2 quarters, please provide answers to the following questions:	
8.6.1 Does the entity expect that it will continue to have the current level of net operating cash flows for the time being and, if not, why not?	
Answer: n/a	
8.6.2 Has the entity taken any steps, or does it propose to take any steps, to raise further cash to fund its operations and, if so, what are those steps and how likely does it believe that they will be successful?	
Answer: n/a	
8.6.3 Does the entity expect to be able to continue its operations and to meet its business objectives and, if so, on what basis?	
Answer: n/a	
<i>Note: where item 8.5 is less than 2 quarters, all of questions 8.6.1, 8.6.2 and 8.6.3 above must be answered.</i>	

## Compliance statement

- 1 This statement has been prepared in accordance with accounting standards and policies which comply with Listing Rule 19.11A.
- 2 This statement gives a true and fair view of the matters disclosed.

Date: ..... 27 July 2023.....

Authorised by: ..... By the Board.....  
(Name of body or officer authorising release – see note 4)

## Notes

1. This quarterly cash flow report and the accompanying activity report provide a basis for informing the market about the entity's activities for the past quarter, how they have been financed and the effect this has had on its cash position. An entity that wishes to disclose additional information over and above the minimum required under the Listing Rules is encouraged to do so.
2. If this quarterly cash flow report has been prepared in accordance with Australian Accounting Standards, the definitions in, and provisions of, *AASB 107: Statement of Cash Flows* apply to this report. If this quarterly cash flow report has been prepared in accordance with other accounting standards agreed by ASX pursuant to Listing Rule 19.11A, the corresponding equivalent standard applies to this report.
3. Dividends received may be classified either as cash flows from operating activities or cash flows from investing activities, depending on the accounting policy of the entity.
4. If this report has been authorised for release to the market by your board of directors, you can insert here: "By the board". If it has been authorised for release to the market by a committee of your board of directors, you can insert here: "By the [name of board committee – eg Audit and Risk Committee]". If it has been authorised for release to the market by a disclosure committee, you can insert here: "By the Disclosure Committee".
5. If this report has been authorised for release to the market by your board of directors and you wish to hold yourself out as complying with recommendation 4.2 of the ASX Corporate Governance Council's *Corporate Governance Principles and Recommendations*, the board should have received a declaration from its CEO and CFO that, in their opinion, the financial records of the entity have been properly maintained, that this report complies with the appropriate accounting standards and gives a true and fair view of the cash flows of the entity, and that their opinion has been formed on the basis of a sound system of risk management and internal control which is operating effectively.